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# TOTALITY!

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THE JOURNAL FOR ECLIPSE CHASERS

eclipse travel adventures

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[http://xjubier.free.fr/en/site\\_pages/Solar\\_Eclipses.html](http://xjubier.free.fr/en/site_pages/Solar_Eclipses.html)  
and

<http://www.eclipse-chasers.com/totality.html>



Shadow Bands Imaged on Tatakoto, © Joe Cali  
*William Optic 70mm f6.3, Pentax K10D, 1/125s*

## *IN THIS ISSUE:*

- Eclipse in the South Pacific
- An Unprecedented 9m 23s of Totality
- Shadow Bands in the Sky!

# ECLIPSE IN THE SOUTH PACIFIC

**MANGAIA - AREMITI FERRY & TAHITI - PAUL GAUGUIN & ARANUI 3  
ANNA - HIKUERU - HAO - TATAHOTO - EFLIGHT2010 - RAPA NUI  
AND EL CALAFATE, ARGENTINA**

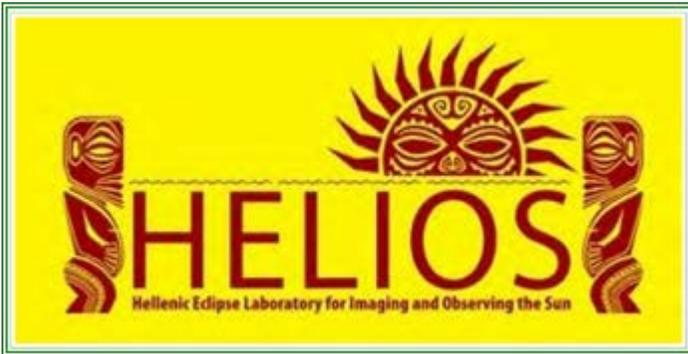
TSE2010 was an eclipse with a near absence of land mass in the path of totality. As all eclipse chasers know that only a very tiny amount of the entire Earth's surface experiences totality for a single eclipse, and because of these circumstances, a much smaller fraction occurred on dry land for this eclipse as only a handful of tiny islands and atolls interrupted the ocean with their protrusions across the South Pacific. And eclipse chasers spread out among these archipelagos.

The weather predictions across the entire region was, at best, only a bit better than 50-50, and odds dropped notably more as the path dropped further to the south. Reports from the start to the end of the path were overwhelmingly positive. All locations were partly cloudy with the exception of El Calafate, Argentina, where conditions were contrary to predictions, and were absolutely clear. A great contrast to TSE2009 where being in a clear location was a rare accomplishment. No location outside of El Calafate was cloud free, which meant that when observers spread across the islands, some were under clouds during totality, and others were not, but the largest fraction of those managed to be in the right place and, of course, at the right time.

Many locations had to put up with a bit of clouds that unfortunately eclipsed the eclipse itself during totality; this happened on Mangaia and Hao, and clouds passed in front of the eclipsed Sun for several seconds at other Polynesian locations. Without question the cooling of the atmosphere helped the clouds to dissipate during totality, increasing the chances of observing totality.

On many of the small atolls, the only places to board were with locals or in houses vacated by the local population to allow the visitors a place to stay, unless, of course, you brought your own tents. In French Polynesia it was estimated that 4500 eclipse chasers came to view the eclipse among the various atolls. 15 planes, at least two cruise ships, one ferry, and an unknown number of catamarans and other private craft, both seagoing and air, were specially chartered or tasked to help with this brief migration.

**Mangaia**, in the Cook Islands, subtends 9 kilometers diagonally, and was the first land in the path of totality shortly after sunrise. A number of observers were faced with cloudy skies on this small island, but a few luckily placed individuals and groups happened to be in just the right location, and managed to see much or even all of totality. Even though most did not get to see totality, eclipse chasers had only good words about their hosts and their choice of location.



However one success story comes from a group that traveled half way around the globe from Greece, taking 2½ days to arrive on Mangaia, with stops in Dubai, Sydney, Auckland and Rarotonga. They call their group HELIOS, the *Hellenic Eclipse Laboratory for Imaging and Observing the Sun*. They stayed at the Ara Moana bungalows, and from a location on the beachfront would be positioned where they would have a potential to see 3m 13.4s of totality. In their group were

Orsoula Avgouli, and George Xystouris, both of the Physics Department of the National and Kapodistrian University of Athens, and Constantinos Emmanouilidis, an amateur astronomer from Thessaloniki, Greece. This is their account of the trip:

Orsoula Avgouli  
Department of Physics  
National and Kapodistrian, University of Athens, GR

After a long search of possible sites, we selected Mangaia in the Cook Islands, which offered many advantages for our observing goals. Besides the fact

that July is the driest month for this island, it would be the first piece of land from where the eclipse would be visible. Since we were going to travel a lot in order to be on land anywhere across the shadow, transportation expenses for the equipment and ourselves were a very important parameter. Mangaia offered the lowest prices for getting and staying there in comparison with all other land-sites available on the path of the shadow. The trip was a challenge itself and we couldn't resist booking tickets and accommodation at the soonest possible date, which was some ten months before E-day.

Observing a TSE is a great challenge by itself. But doing some real science is a different story, you need good preparation of the experiments you are going to perform for months (sometimes years) before totality, then you need a clear sky during totality, and after that you have a lot of work to process your data and extract as much information as possible. Our team is performing some experiments for the study of solar corona and its energy state. Mostly we give basis to imaging the solar corona in high resolution with modern mathematic image processing techniques and also doing low resolution spectroscopy of the chromosphere and transition region, combined with high resolution spectroscopy of the corona during totality. These data give us useful information about the temperature of the corona in the equator and the poles of the Sun. Being able to do some real science during totality makes our adventure more exciting.





Three days before our trip and after months of preparations, we all met in Athens packing our equipment for a long and tough journey to the other side of our planet. Many questions and thoughts were on our minds; Will it be clear? Will our equipment fit into that small airplane? What about jet lag? We felt ready only after everything was carefully packed and from that moment the journey began. A journey that will never be forgotten....

L-R; George Xystouris (Low Resolution Spectra), Constantinos Emmanouilidis (High Resolution white Light Imaging), Orsoula Avgouli (High Resolution Spectra) arrive on Mangaia after 2½ days of travel.

We were one of the first groups to arrive in Mangaia, 5 days before the eclipse. Amazed from the first moments we stepped on the island, local ladies offered us the traditional flower necklace, while our hosts Jan and Tu were waiting for us at the airport. The chief of a local tribe surprisingly informed us that we were the first Greek explorers on the Island.



Although it was our very first day there, we had already picked our observing point, a small plateau close to Ara Moana bungalows. It took us 2 days to find pieces of cables and join them in order to bring power for the first time to our spot through the jungle. We were now ready to set up.

ABOVE: Constantinos; apply every 3 hours to survive the indigenous mosquito wildlife

It was our first time in the southern hemisphere, at a place without cities and light pollution where the night sky was incredibly amazing! One can say a lot for the breathtaking night sky; constellations that we had never seen before, the stars looked like diamonds and the Milky Way lighting up small clouds traveling above us. We spent our nights observing and setting up equipment, learning the southern hemisphere sky, taking pictures and dreaming of a magnificent solar corona we would soon see.



LEFT: Constantinos & Orsola; Uranography, learning the Southern hemisphere night sky, Photo © David Andrew Chamberlain



RIGHT: Part of Milky Way with Alpha and Beta Centauri, Crux, the southern cross and Eta Carinae are easily visible in this image

In these first days the weather was good and that helped us with the accurate polar alignment of our equipment. The day of the eclipse started with thick dark clouds all over the sky and we knew they would be difficult to scatter. Totality began and we couldn't even see where the Sun was. A minute later the clouds moved and we managed to observe the last 2 minutes of the totality through a small hole! The Sun again was hidden and it started to rain... we were very lucky! What an amazing experience! People yelling, clapping, singing! Nature was playing its games and we were happy. Only a few minutes later our data was downloaded to our PCs and we were informing friends and families back home of our success.

It was now time to relax and enjoy the Island. We rented bikes and did the round of the Island, driving on Makatea (coral surroundings) but also on the volcanic inland. Nature on Mangaia goes wild, with big trees, colorful flowers and birds. Swimming in the Pacific for the first time, we spent hours at the scenic beaches. The locals were very friendly and they made us feel welcomed. They even organized an island celebration, the night after the eclipse, with good food, drinks and local dance. We made a lot of friends from around the world... people that went to Mangaia for the same reason as we did. Friends that we hope to see again, why not, at the following eclipses.

After staying 10 days in Mangaia, it was time for our return. We didn't say goodbye, we just made our plans for the next total solar eclipse at Australia! Packed with extraordinary experiences we finally get back home, planning our next adventures...

A Special thanks to Iakovos Strikis and Thanassis Kouloumvakos, our collaborators who did not travel with us in Mangaia and Xenophon Moussas and Panagiota Preka, teachers in University of Athens, for their support and scientific contribution.



ABOVE: Instruments, spectroscopes — telescopes and narrowband filters with CCDs and many laptops, are set and ready for totality one morning before the eclipse.

BELOW: Constantinos Emmanouilidis gives a thumbs up, after successfully cleaning the sensors of his EOS cameras



ABOVE: George Xystouris relaxes after setting up one of the mounts and a scope facing the sun.



BELOW: The instant of second contact is captured here, and shows detail in the lower chromosphere and prominences reaching spaceward. First image of the eclipse published online @ [www.spaceweather.com](http://www.spaceweather.com) - © Constantinos Emmanouilidis,



BELOW: Thin clouds mute the corona in this image.





< Only moments after totality, the lucky team © David Andrew Chamberlain



RIGHT: Success is celebrated with Mojitos & local beer

RIGHT: Finally taking a nap at the observing site, © David Andrew Chamberlain



Additional photos of this trip can be seen at;  
<http://tse2010.weebly.com/2010-eclipse.html>  
<http://tse2010.weebly.com/funny-pictures.html>  
Web Site: [www.tse2010.weebly.com](http://www.tse2010.weebly.com)  
[www.solar-eclipse.weebly.com](http://www.solar-eclipse.weebly.com)

< Celebration dance the night after the eclipse



Eclipse on the beach >



# TAHITI

Eclipse chaser, Thomas Goodey, chose to view the eclipse from the extreme southeast corner of **Tahiti**, at Presque-Ile and viewed a 99.5% partial eclipse. The Sun however was still too bright to allow the solar corona to be visible, and also too bright to view directly, he reports . . .

*We couldn't see any corona. The usual partial phase phenomena were evident - the thin crescents were superb when seen under the palm trees. But what was really outstanding were the shadow bands. For a couple of minutes around greatest obscuration, bands chased one another across the beach, generally extending E-W and moving N-S. That was very impressive; I have not seen that before."*



## AREMITI FERRY

Near Mehetia, 33 kilometers southeast of Tahiti, and 110 kilometers east of Tairapu, the Aremiti Ferry took 500 passengers to get a few brief seconds of totality. Designed as a quick and less expensive way for locals to see totality, the cost was still a rather steep \$800.USD.



## PAUL GAUGUIN

The cruise ship **Paul Gauguin** has been an eclipse chasers' fixture in this region as it has been chartered for 3 eclipse cruises in the past 5 years, for TSE2005, TSE2009 and now TSE2010. For this eclipse it was positioned not far from its base port of Tahiti, and served well as a mobile platform for about 330 eclipse chasers and 200 crew members.

At second contact, the Sun went behind a cloud for the first 28 seconds, but the captain quickly maneuvered to distance the ship from the cloud that covered the Sun, and only a few smaller and brief clouds interrupted the view, and a couple of seconds shy of a 4 minute totality was visible



## ARANUI 3

The **Aranui 3** is a part time freighter, part time cruise ship that delivers cargo to the Marquesan Archipelago, while passengers tag along for the two week cruise to experience the out of the ordinary locals that it makes land on. Some 180 passengers and 60 crewmembers were aboard to see the solar eclipse. On the morning of the eclipse the ship was scheduled Hikuera, where the passengers

would be able to view totality, but the morning before when landing on Makemo atoll, they saw a cloudy morning, and it was decided then that the eclipse would be viewed aboard ship, where they could try to maneuver between clouds. They ended up near the centerline about 38 miles south of Hikuera at 17° 54' south, 142° 23' west. About 5 seconds before totality, the Sun emerged from behind a cloud, and remained visible throughout the 4m 04s of totality.

# ANAA



## TOTAL SOLAR ECLIPSE, 11 JULY 2010 FROM ANAA, FRENCH POLYNESIA TERRY CUTTLE, AU



© Terry Cuttle 2010

Totality from Anaa, used by permission and © Terry Cuttle

an extensive lagoon. It is a gorgeous location, with crystal clear waters, extensive coconut plantations and about 450 very friendly inhabitants.

Anaa is a small atoll in the Tuamotu Archipelago of French Polynesia. It was the closest atoll with an aerodrome to Tahiti in the shadow path for the 11 July 2010 eclipse. Anaa is about 30 km long by about 6 km wide and is made up of a series of low islands surrounding

Astro Expeditions of the UK had organized tours including a charter flight to Anaa from Tahiti. There were about 60 in the group arriving the day before the eclipse to be met by a warm welcome of traditional singing and dancing by locals. Other observers were also on the atoll for the eclipse. Accommodation was for two nights staying with families on the atoll. This made for a wonderful cultural experience living with the locals, made more interesting by many of the population only speaking French or Polynesian. Food was typically a mix of French and Polynesian styles with fish being a major ingredient.

On eclipse morning about 40 people including locals and visitors left the village pre dawn for a 45 minute, 18 km ride in open fishing boats to cross the lagoon to an observing site towards the south end of the atoll. The boat trip was expected to add about 40 seconds



Eclipse Chasers arrive at the south end of Anaa, ©Terry Cuttle

to the duration of totality. The rest of the group stayed in the northern part to observe from near the village or the aerodrome. They were joined by others who flew in early morning for the day.



Setting up at the south beach on Anna, © Terry Cuttle

At the southern end, the observing site (Lat 17° 28' 45"S, Long 145° 27' 21"W) was on a beautiful sandy beach on a tiny island with shade and wind shelter from coconut palms and a gorgeous view across the lagoon towards the rising sun. Thin scattered clouds interrupted the initial partial phases briefly. Thicker clouds were building round the atoll, but fortunately stayed clear of the sun as viewed from the southern end.

There was a very thin cloud layer at second contact and in images, there is only the slightest hint of shadow bands projected onto the cloud layer as reported extensively by others. However a most striking aspect

of the eclipse was the very strongly defined shadow bands clearly visible running along the white sandy beach during the approximately two minutes both before and after totality. By far the most strongly defined that I have seen at any eclipse. Their visibility appeared to be enhanced because we could see them over a wide area of beach in front of us and because of the brilliant white of the sand.

There was a beautiful diamond ring at second contact and an especially long and stunning one at third contact. The sky generally stayed clear during the 2 minutes and 59 seconds of totality (the north beach received 2m 24s) although thin high cloud drifted through at one point. There was a beautiful corona with pronounced polar brushes in the clear sky and a large and bright prominence made an appearance before third contact.



Celebrating a great eclipse with coconut drinks, © Terry Cuttle

Throughout the partial phases there were thousands on crescents on the ground under the coconut palms. The closing partial phases were interrupted by passing clouds. Those who observed from the village or the aerodrome experienced more cloud, but I understand that they were generally still able to see totality through breaks in the cloud or through thin cloud layers.

The clear cool waters of the lagoon were a popular place to relax after the eclipse was over. On the night of the eclipse all visitors were invited to witness an enthusiastic and energetic traditional song and dance competition. All together it was a wonderful eclipse experience in a beautiful tropical island paradise.

# HIKUERU



ABOVE: Group picture of Ring of Fire Expeditions at Hikueru Airport, and their signature Texas flag. Photo © Alan Dryer

As in just about every location among French Polynesia, every atoll had to face clouds at some point, where either all of totality was visible, or all of totality was not visible, or of course where clouds interfered with totality for varying durations. Such was the case on Hikueru, where some observers were in the right location, and others were not. The *Ring of Fire* group observing from the airport and were clouded out, but observers in the village of Tupapati were able to see totality. The difference was only a few kilometers between success or failure, and this is what eclipse chasers encounter when selecting a site when clouds move too rapidly to readily relocate with minutes or even seconds before totality.

*“A distance of only 3 kilometers was enough to keep the site under clouds during all totality . . . just as 2nd contact began heavy cloud obscured the Sun . . . . Only well after totality was over did the dark cloud clear and the remaining partial phases were seen without further issue. The people just to our southwest in the village . . . . would get a good view.”*

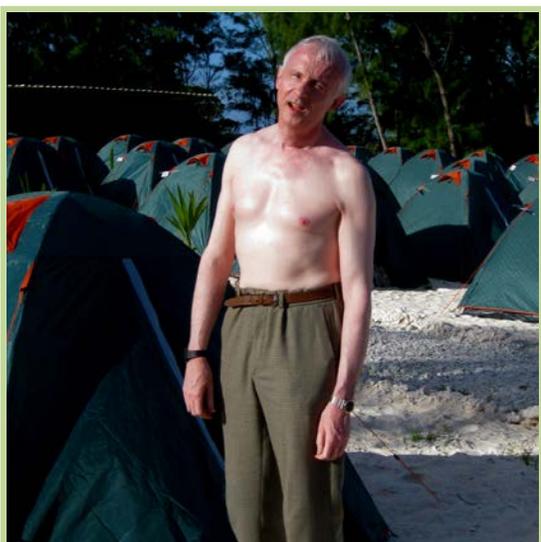
- Paul Maley  
Ring of Fire Expeditions

*“Great success in Hikueru village [Tupapati] with 4m 17s of totality. I have heard that those on the runway [at the airport] were less successful even though it was only 2 miles from the village.”*

- Sheridan Williams



There are 425 atolls catalogued in the world, and 85 reside within the boundaries of French Polynesia; 75 of these are part of the Tuamotu archipelago <sup>[1]</sup>. Definitely not the largest atoll in the world, but still quite impressive, is Hao, which is 55 kilometres long, amazing! Because of the large extent of Hao, there were several locations where observers could locate. Two of the primary locations were for day trippers at the Hao airport, and for those staying longer, in the main town of Otepa, about 3 kilometers southeast of the Airport. Since Hao was about halfway from the centerline to the edge of the path of totality, Baily's beads were more pronounced here than any other location on land.



Martin Mobberley next to his tent at the tent village on Hao, © Nigel Evans

## ECLIPSE ON HAO

by Martin Mobberley, UK

<http://martinmobberley.co.uk/>

Originally published in its entirety as a 4 part series in *The Astronomer* for 2010, Aug/Sep/Oct/Nov; <http://www.theastronomer.org/>, and can also be found at Martin Mobberley's web site. The article here is an abridged version, highlighting details from parts 1 and 2 of the original articles.

Despite the gruelling nature of all the 2010 July 11<sup>th</sup> Total Solar Eclipse expeditions I signed up for the *Explorers* trip to Hao as soon as it came out on the company's website, and threw in the post-eclipse trip to Easter Island as well. I'm a very reluctant traveller, but you only live once and, if I can't download my neural net to a Petabyte memory stick before I'm 100 (2058) I may only have 48 years of life left. In a 13.7 billion year old Universe humans are a long time dead. So, a bit of travel hassle and airport misery has to be endured. However, this would be by far the longest and most

expensive trip I had ever been on and would involve the most number of flights too: a total of eight. In addition, the nightmare scenario of another Icelandic volcanic eruption occurring could not be ruled out and, just as disturbing, a whole series of strikes by Air Tahiti workers in the weeks leading up to the eclipse made everyone a bit nervous. As it turned out, Iceland's volcanoes were quiet and Air Tahiti workers went back to work.

[Four days of travelling to Tahiti, then relocating to a different hotel for logistical reasons and] transferring my eclipse photography gear, sleeping bag and pillow to the ten and five kilogram cases I would be lugging to Hao and triple-checking that everything would work at the critical time, I was ready the next morning [and] it was off to the island of Hao, 920 km east of Tahiti, the northern tip of which protruded far enough into the eclipse track that we would be under the umbral shadow for at least three and a half minutes on the morning of July 11<sup>th</sup>.

We set off to Tahiti airport in two groups as there were two planes, each one seating up to 66 people, bound for the long runway on the coral atoll that was Hao. We bumped into the founder of *Explorers*, Brian McGee at the airport, along with Hazel McGee. Brian now fronts the *Astro-Expeditions* tours after selling the *Explorers* business. It was a bit of a strange feeling seeing Brian and Hazel not with *Explorers* and not with John Mason, and separate from the main BAA contingent I was with, but on the same sort of eclipse expedition. The *Astro-Expeditions* travellers were headed to two different islands, Anaa and Hikueru.

Well, after a two hour flight we landed on the Hao runway, supposedly the longest runway in that part of the South Pacific, and a designated emergency Space Shuttle landing strip too. We were greeted by dancing girls and the local men in native costumes at the airport and then bussed to our camp site. We were not sure if this was a tribal greeting or if they were planning on having us for lunch. The second plane with the other 65 or so *Explorers* travellers landed shortly after us. Strangely they had enjoyed far better meals on their flight, notably with a splendid Lemon Meringue pie, which was strangely absent on our plane. This was particularly sad as for the next two days we would be eating meat as tough as shoe leather with absurdly thin plastic knives along with wallpaper paste masquerading as mashed potato. Small packets of crisps were available to purchase from *Explorers*, who had brought a shed load of them to Hao, but at six quid per packet we stubbornly refused to buy any, hoping they would lower the price: they refused!!



Martin Mobberley sets up his photo gear between the tents of tent city in order to help block the wind, © David Phillips

## The Hao campsite

*Explorers* had used the local people to create an impressive tented village for the eclipse chasers. Every single traveller or couple had their own tent and this was where I was so pleased I had paid my single supplement, as I got a whole tent to myself, and I was far better off than the married couples on the trip as these tents were only really designed for one adult. There were 80 tents on the site and *Explorers*, educated by John Mason, had ensured that all the usual BAA trouble makers were lumped in one corner. These were the tents of John and Jane Mason, Roger and Gillian Perry, Nigel and Alex Evans, myself, Jean and Brian Felles and Nick James.

Shortly after our arrival, a strange local woman dressed to resemble a cross between Margaret Beckett, Davros and the Statue of Liberty, drifted amongst us giving us a couple of black pearls each. Actually, mine looked like the ball bearings from a Morris Marina drive shaft, but I wasn't complaining.

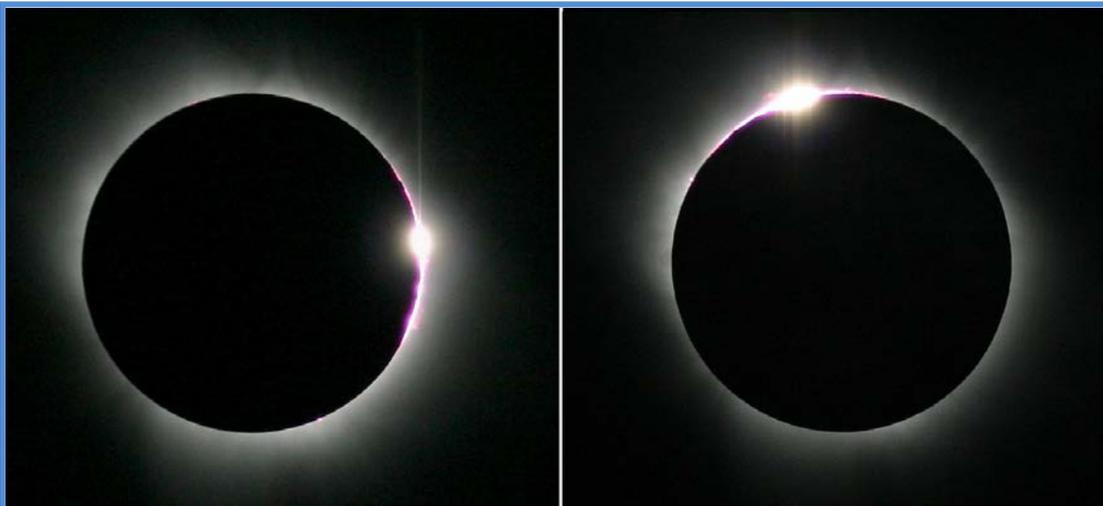
The facilities at our campsite were quickly explained, namely the dining/kitchen shed and the shower/toilet block. We knew these would be basic and we were not disappointed. It was, as Alex Evans commented "like a scene from Tenko". The type of toilet used was initially described in management-speak terms as a 'natural' toilet.....Hmmm, doesn't sound too bad does it? But then another term was added, namely 'of the long drop design'. Ooooooh dear! Essentially a set of toilet seats mounted above a deep pit. No flush, no toilet paper (you bring your own) and you hold your nose..... However, as we were all wearing sunhats and sunglasses and shirts with handy top pockets the most scary prospect was bending over the long drop and seeing some vital piece of kit fall down the hole..... I quickly ensured that my Passport was no longer in my top pocket. The thought of it dropping into the open sewer pit below was horrendous as it would \*have\* to be recovered! Hao, like Tahiti, was a place where insects bite you on a regular basis, whether you were using insect repellent or not. I am not usually bitten by insects but, like almost everyone else I knew, this doesn't seem to count on Hao or Tahiti. We were told Malaria was not a problem and we only had to watch out for those insects carrying Dengue fever....well, thanks for that useful tip! I also found out that paddling in the water is dangerous too. The merest scratch from a piece of coral in the waters of the atoll left me with an angry red rash and a swollen calf that took days to disappear.

On the evening before the eclipse we were taken into the centre of the community on Hao to witness the island's equivalent of The X Factor, where numerous grass skirted French Polynesian women gyrated in front of the islanders to much amusement. We were soon back on the primitive bus though, ready for some viewing of the southern skies and preparing for the eclipse the next morning.

I've never been camping before in my life and I never plan to again, post Hao. The green foam mats we were supplied with were more uncomfortable than a Shanghai bed and I was amazed I got any sleep at all. Various people claimed a wild boar was loose in the camp site that night, but others claimed it was simply the sound of snoring (or snoring and breaking wind simultaneously). I woke very early and, in the darkness, sussed out that Nick James was looking at the southern sky. Before dawn we took a careful stroll to the coral atoll lakeside where there was a good view of the Large and Small Magellanic clouds and Jupiter was almost at the zenith.

## Totality

Soon though it was dawn on July 11th, and after an early primitive breakfast, eaten with the utterly hopeless plastic cutlery, we all started assembling our eclipse gear and deciding where to view totality. My equipment was very simple, namely, a 355mm focal length 60mm aperture f/5.9 Takahashi FS60c refractor used with a Canon 300D camera, on a lightweight tripod, along with an old JVC camcorder set to 15x zoom, as well as a Canon Powershot A560 digicam taking a wide angle video recording of the sky. I decided to stay at the camp site as my tent would act as a good windbreak and it was quite windy. The Takahashi had served me well at Novosibirsk and even through cloud at Shanghai, so I was sticking with modest gear that had a reliable track record but also could be lost or damaged without too much pain should the worst happen.



2<sup>nd</sup> (left) and 3<sup>rd</sup> contact (right) imaged with a Takahashi FS60c (355mm) f/5.9 and Canon 300D, each were 1/2000 sec. exposures, © Martin P. Mobberley

Nick James and Sue Brown moved away from the campsite to sit behind a big clump of vegetation which also acted as a windbreak. Nick's main equipment was a William Optics Megrez 72 refractor attached to a Canon 550D Digital SLR which could record HD video and stills at the same time. He also used an older camcorder as a back up, although mysteriously that

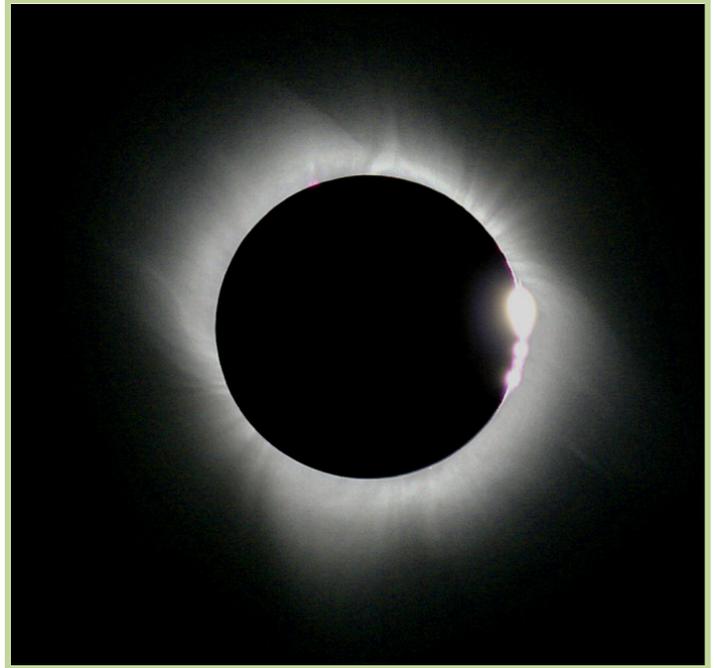
backup system was found to have recorded nothing after the eclipse ended! Nigel Evans decided to move to the sea coast side of the atoll, hundreds of metres further away, to site his usual barrage of equipment, somewhat reduced in size this time due to the 30 kg restriction (for him plus Alex) on the flight to Hao.

The timings of the eclipse for our position on Hao on July 11 were predicted to be as follows: First contact 17:24:42.0 UT; Second contact 18:41:29.0 UT; Third contact 18:45:02.6 UT; Fourth contact 20:13:02.6 UT.

This gave a duration for totality of 3 minutes 33.6 seconds and meant totality would start eleven minutes after the world cup final started between Spain and the Netherlands. The local Polynesia time was ten hours behind UT, making this a breakfast time event.

Well, as always at these total solar eclipses, time seems to creep forward ever rapidly as second contact approaches, but unlike virtually everything else in life, they always proceed dead on time and it always strikes me as very impressive just how accurately we can now predict these events. I settled in position behind my tent while leaning with my elbow on my airline carry on bag, which seemed remarkably comfortable, almost as if it had been designed specifically for the purpose! I would have to investigate the bag's spongy nature after the eclipse.

As the shadow started to swallow up more and more of the Sun some rather disturbingly large chunks of cloud started to appear, seemingly triggered by the solar heating, but we hoped these might fade away as the temperature dropped?? It was going to be a close call..... With 60 seconds to go my camcorder and digicam were switched on and pointed at the Sun and the solar filter was whipped off the Takahashi refractor. The light levels were dropping rapidly now and it was clear that some thin cloud was licking at the rapidly dimming Sun. With the Sun and Moon some thirty five degrees above the horizon the last beads of sunlight faded out on the right hand side of the Sun with a main bright bead and three smaller ones fading out almost simultaneously. Remarkably, on a Sun with so little activity recently, there were some fine pink prominences visible on the limb after the second contact beads had faded. The shape of the corona was, arguably, quite similar to that of the 1994 November 3<sup>rd</sup> Chile totality, being neither a solar minimum or maximum corona but showing some fine polar brushes and three distinctive streamers (horn like wing features) projecting from the disk of the eclipsed Sun: two stubby ones above the Sun and a long streamer below it.



Takahashi FS60c (355mm f5.9) Canon 300D @ ISO 400, Composite of multiple images of the corona from 1/400 to 1/60 second during totality and a 1/2000 second exposure just before 2<sup>nd</sup> contact

With the light levels much reduced during totality the thin cloud in the vicinity was much harder to spot but there was enough of it about to mean that the remote shutter release could not simply be hit every few seconds as many exposures would end up with some cloud being present. My intended strategy had been to take lots of frames of different exposures up to quite lengthy durations during the totality period. However, with the cloud I had to be far more selective and ended up simply taking a range of inner to medium corona exposures from 1/400<sup>th</sup> to 1/40<sup>th</sup> at ISO 400. There simply were not enough totally clear gaps to do a wider range and watch the event too. For second and third contact I simply fired a barrage of 1/2000<sup>th</sup> second shots so that the beads of light were captured as they shrank and emerged at the critical time.

As I was sitting on white sand I made sure to look for shadow bands at second and third contact, but I saw nothing, unlike the magnificent slithering snake features we all saw in Libya in 2006. John Mason saw nothing at second contact but thought there was a hint of something at third contact. Interestingly Nick James HD video captured dark bands on the thin cloud near the eclipsed Sun at second and third contact and these appeared on my still frames taken at the third contact time. As these bands were parallel to the thin slit of light it is tempting to think they must indeed have been caused by such a brightly illuminated beam being deviated by moving layers of the atmosphere, i.e. shadow bands projected onto the clouds.

Well, as with all these eclipses, it was over far too quickly and so it was soon time to trudge around to the other observers, at the camp site and on the lake side of the atoll, to see how they had fared. On the other side of the

world, some forty minutes after fourth contact Spain were declared the winners of the World Cup in the final against the Netherlands, just as predicted by Paul the psychic Octopus.

As always at these events the results in those panic-stricken minutes were mixed. Nigel Evans reported a particularly frustrating bug in his automated system. He had been fine tuning the precise GPS time on his netbook so that all his cameras would take the right pictures at the right time using Fred Bruenjes's *Eclipse Orchestrator* software, but did not know that when incrementing the time past the 59 second point, to 00, the clock did not increment to the next minute. Thus, the system was running precisely one minute behind the real time. Aarghhhhh! Nigel's main camera had also ended up with a tiny grain of sand on the CCD sensor, leaving a dust doughnut on the images. Other observers, such as Gillian Perry, reported cameras that had mysteriously slipped out of precise focus as the daytime heating had dropped, approaching totality. However, John Mason, normally a purely visual observer, secured some very fine shots of the eclipse on his first attempt with decent photographic gear in a mainly clear sky. During the eclipse John had been wearing a very fetching red version of the Hogwarts sorting hat, which had to be seen to be believed!

A few hours after the eclipse I found out why my airline bag had been such a comfortable arm rest for me during totality. The whole of my forearm had been cushioned by my giant squeezey bottle of suncream and anti-insect bite lotion. For totality it had acted like a hydraulic cushion, but then had exploded, shooting its load of sticky white gunk inside the front pocket of my airline bag. Fortunately there had been no camera gear in that pocket, just the suncream...but it took a while to clean it out.

For our second night on Hao, post eclipse, we were treated to a John Mason special. His 'Living Planetarium' talk (which somehow became corrupted into a 'Living Sanatorium' talk) was, for me, the highlight of the entire trip. We had small aperture telescopes with us and, in the end, Nick James's William Optics Megrez 72 refractor proved to perform well in the dark Hao skies.

## Spectacular skies

John's "Living Planetarium" talk was excellent. For most of us the southern skies were a bewildering place with even northern constellations looking unfamiliar due to them being seen upside down. But John knows his way around and on the evening of the 11<sup>th</sup>, which, of course, was New Moon, John led a long crocodile of people to the old runway on Hao, a few hundred yards from our campsite, so the few bulbs at the site would not be visible. The view of the southern Milky Way from the runway was truly staggering. Indeed, it was just a bit scary. One spooky feature was that the sky was so black that any clouds drifting past were invisible; as they covered constellations the stars just fell into a black hole. The clouds themselves could not be seen! The dust lane structure visible within the Milky way to the naked eye was amazing and, with a night time temperature in the mid 20s Centigrade, the observing conditions, with no dew, were about as pleasant as they could possibly be. It was like being on a different planet in a different solar system where light pollution was totally absent. At home I can only get down to a naked eye magnitude of 5.5 at the zenith from deepest Suffolk, but I was seeing down to about 7.0 from Hao, without really trying! Apart from those horrible biting insects trying to fly into our ears, nostrils and eyes, it was Deep Sky paradise. The black silhouette of the Coal Sack dark nebula was especially eerie to me. We aimed Nick's Megrez 72 at Eta Carinae, Omega Centauri, Centaurus A, the Jewel Box (NGC 4755), the false comet cluster (NGC 6231, 6242 and Collinder 316) in Scorpius, M16, M8 and M20. All the objects were seen against a black sky and even the low altitude northern hemisphere objects were as good as you would see them in an instrument of twice the aperture back home. A number of observers looked at M13 in Hercules on one side of the sky and then swung their telescopes onto Omega Centauri in the opposite direction. Compared to Omega Centauri, M13 looked a very sad globular cluster indeed. Yes, the eclipse had been spectacular, but it was brief and I had been to nine other totalities before, with only two being completely clouded out. However, seeing the southern sky as it looked on Hao was a new experience and had to rank as the best memory of the entire trip, and almost any trip, except the sight of [Comet] Hyakutake at altitude from Tenerife in 1996. The only light pollution we saw that night was from John's thermonuclear green laser pointer and from the lights on a distant cruise ship, which some said belonged to Bill Gates. I bet Microsoft Windows wasn't controlling his tub's engine room!

Next day we left Hao with memories of a good eclipse and a spectacular night with John Mason under southern skies. We were confident that no other group of eclipse travellers (and there were plenty of other groups, even on Hao) had a tour guide in the same league as John. From reports that filtered back from other groups, even ones with NASA tour guides, there were some very poor public communicators around, in a post that demands communication skills, knowledge of astronomy, knowledge of eclipses and a helpful manner. It would appear that even huge US based travel companies have not got the slightest concept of how important having a charismatic tour expert is to retain the diehard eclipse chasers. Strange!

By the time we arrived back in Tahiti a number of us had some battle scars to show we had survived Hao. Despite insect repellent most people's ankles and wrists were dotted with insect bites and I had that nasty coral scratch on my ankle too, after a brief paddle in the Hao waters.

<sup>1</sup> Philippe Dufour, IRD (Institute for Research and Development), *The Diversity of the French Polynesia atolls*, <http://www.com.univ-mrs.fr/IRD/atollpol/irdpoly/ukdivato.htm>

## RING OF FIRE EXPEDITIONS ON HAO . . .



Photo © J. Guertin

See the complete Ring of Fire Expeditions report on the web at;  
<http://www.eclipsetours.com/t10results.html>

# TATAKOTO



The population of the 10 kilometer by 4 kilometer French Polynesian atoll of Tatakoto more than doubled during the total solar eclipse on July 11, 2010. Some 200+ local people heartily welcomed in excess of 200 more to their somewhat



Above: Exclusive edition T-shirt designed by Joe Cali for our eclipse group.

secluded world for a brief time. One of the smaller groups was the one I was a member of, which we dubbed, "The Beattie Bunch."

Master eclipse chaser John Beattie signed up some of his past eclipse chaser acquaintances, and organized an economically priced trip to view TSE2010 in the South Pacific. John managed to find a contact in this remote outpost near the eastern edge of the archipelago, and conversed by both e-mail and by telephone to determine what the living circumstances were like and what arrangements might be made for visitors to visit the far-off atoll of Tatakoto.



Back row; Bill Speare-USA [27], Michelle Bales-USA [4], our host Madeleine Vorin, Emily Love-AUS [1], Bob Pine-USA [10], Front row; Larry Stevens-USA [10], Geoff Sims-AUS [5], Matthew Poulton-UK [9], Joe Cali-AUS [8], Ground Level; Bengt Alfredsson-SWE [12]

Tatakoto is a small atoll about 1200 kilometers due east of Tahiti, and is part of French Polynesia. Its location for the eclipse made it a prime spot since it was in the region where the weather was predicted to be the best of all other locations, and held the distinction of having the longest duration of totality in French Polynesia. The duration of totality would only be exceeded by someone on a ship east of Tatakoto, where up to over 1700 kilometers away a maximum duration of 5m 20s would be possible or on Rapa Nui (Easter Island) where 4m 47s would be attainable, although I have heard of no reports of observations being made between Tatakoto and Rapa Nui.

What made the trip so affordable was instead of using the usual eclipse trip tour groups, we would use regular scheduled flights, but instead we used the same travel company to book the flights and hotels individually (or together) we selected for our stays on Tahiti and Moorea. Thanks to Bengt Alfredsson, who kept scanning the flights and found a new flight that would bring us to the island several days before and several days after eclipse day, and allow us only a 7 day stay, as opposed to a 10 day stay, this came up just 3 months before the eclipse. John departed on the same plane we landed on, on to Hao where he would scout out viewing locations for additional eclipse chasers scheduled to come in for a short stay.

Since there are no hotels of any kind on Tatakoto, as is the case on any of these remote atolls, we would have to make arrangements to stay with the local families before we would be allowed to book our flights. Rapa Nui may be one of the most remote and isolated islands in the world, but it is a tourist location, a fairly limited tourist destination, but still a tourist destination, and Tatakoto very rarely has had a tourist.

All in all I would estimate that about 300 or more eclipse chasers came to Tatakoto for the eclipse, some as day trippers, flying in from Tahiti to view the eclipse, and fly right back out on the same day after having a local lunch. Some stayed overnight, some stayed for two or three days. All of these people came in on airplanes chartered especially for the eclipse, and opposed to our flight which as was mentioned, is a regular flight. When we arrived we found one other independent eclipse chaser there, and the group from the University of Hawaii and Miloslav Druckmuller heading the MMV Tatakoto Expedition, who set up their tents and equipment on the soccer field.



Eleven images were combined here ranging from 1/200s to 2s, and processed with Fitzwork 3.0, © Larry A. Stevens

We discussed where we would view the eclipse. John Beattie had done preliminary scouting and thought that viewing from one of the motus would be a good choice as it could be possible to hop into a boat if it looked like we might need to move down the lagoon if clouds threatened the observing site. OK, time for definitions. An atoll is a coral reef (usually built up from a sinking volcano / mountain) that has only a rim left behind, and contains a lagoon inside. A motu is a very small separate island that lies along the edge of the atoll, and seawater is allowed to flow through and into the central lagoon. We followed in John's steps and checked out locations for potential observing. We traveled

from the town of Tumukuru on the west side of Tatakoto, all the way around to the far eastern end of Tatakoto, and on another day took a boat to the motu that belonged to Madeleine and her family.

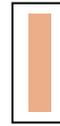
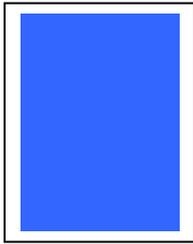
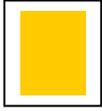
In the end, Bill stayed in town to view the eclipse near the church, where the streets were practically barren. With totality coming in the mid-morning hours, I needed as much time as I could get to set up my equipment and get it working properly, so for that reason I selected a site on the north shore of



Tatakoto, just north of the old church, and Michelle and I did our observations in relative seclusion from here. The rest of the group selected the more picturesque Tikahana motu, which turned out to be the largest motu on Tatakoto, and six of our group and the two boat drivers had it all to themselves. Immediately to the east was the primary Eclipse-City viewing site on Tahunatara Motu. Because of this, Michelle and I viewed the longest duration of totality seen from French Polynesia, 4m 28.6s, only 0.9 seconds longer than the others on Tikahana Motu, and 0.4 seconds longer than Dan McGlaun, who was fulfilling his desire to experience a total eclipse isolated from all others and to stand in the shadow alone (which he did for 2.1 seconds.)

John returned to Tahiti to view the eclipse aboard EFLIGHT2010 (see next article).

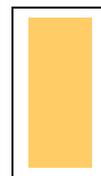
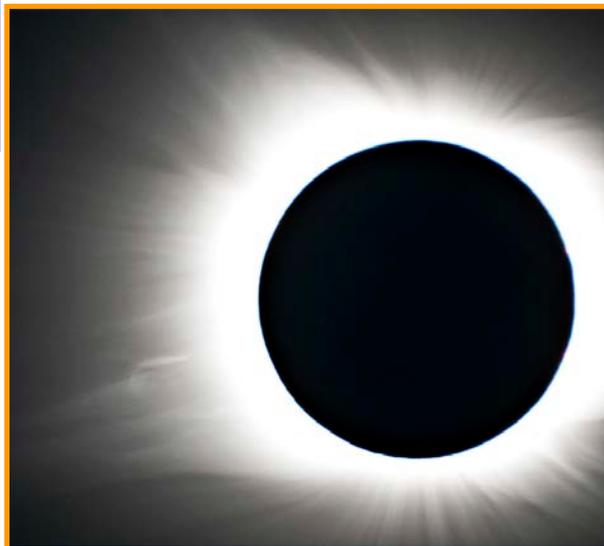
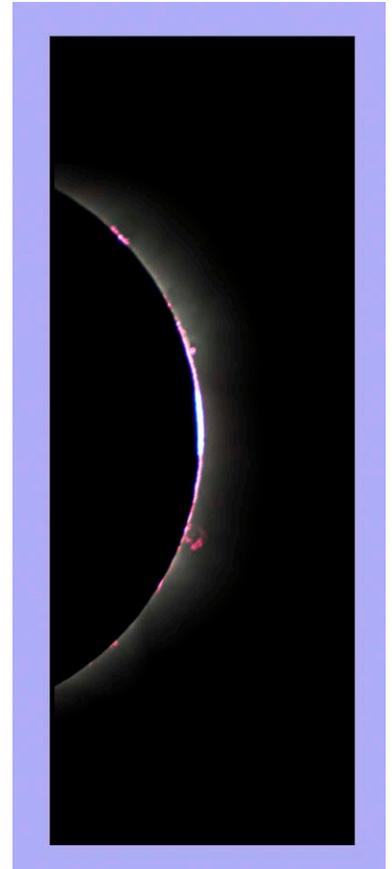
Totality from Tikihana Motu, Tatakoto. Photo used by permission and © Geoff Sims



Combining diamond rings from 2<sup>nd</sup> and 3<sup>rd</sup> contacts show the slight difference from being a few kilometers off the centerline (above).

The chromosphere at second contact (left) and third contact (right), shows also solar prominences that were visible.

After an extended lull in solar activity began to rise a few months before the eclipse, there was one small sunspot group visible, and the corona was well extended. Without a doubt I was able to image some of the best details ever in the solar corona. An ejection of solar material can be seen with a curve on its leading edge (below).



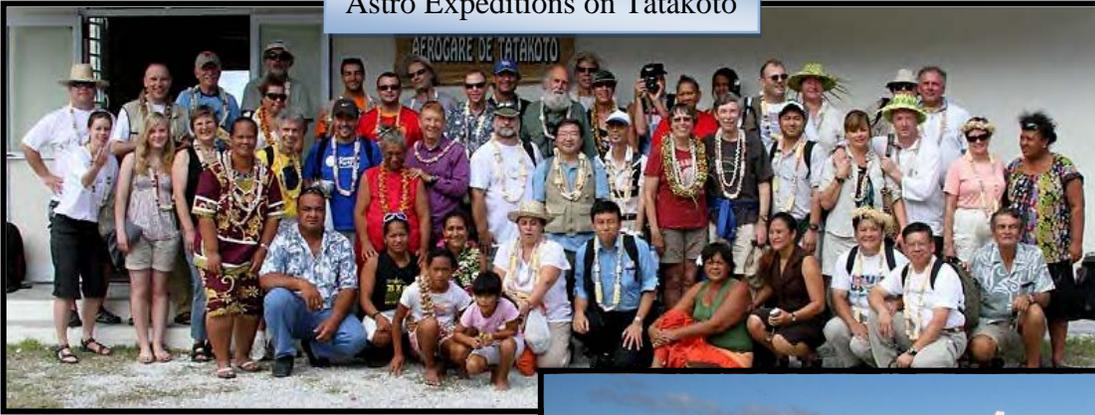
All images on this page © Larry A. Stevens



A 33 hour old Moon dances among the clouds and paired with Mercury seen near the image center between the two clouds

© Larry A. Stevens

## Astro Expeditions on Tatakoto



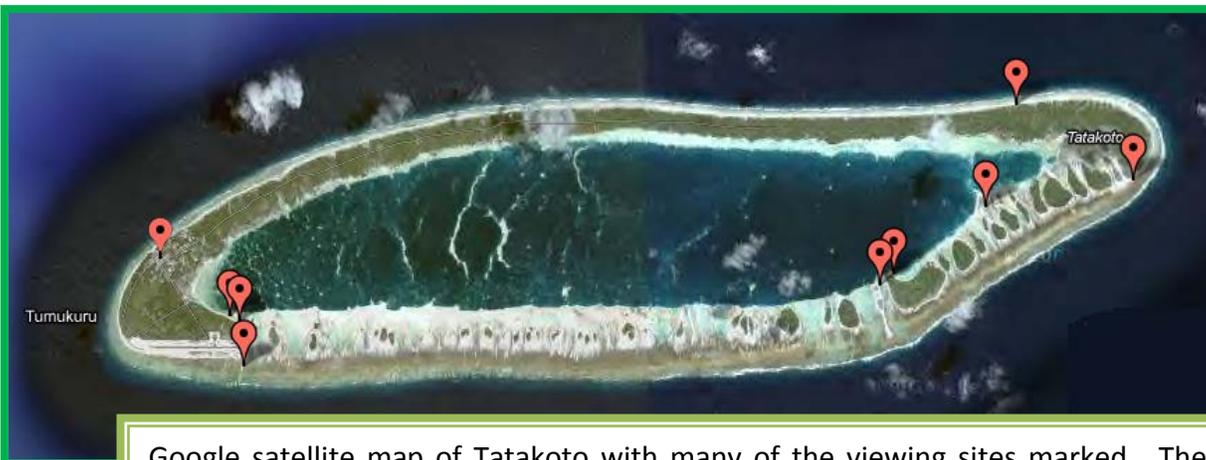
Eclipse-City had a primary observing group on Tahunatara Motu and a smaller group on on Garue Motu.



Eclipse City on Tatakoto, used by permission

Additional images and text from the Eclipse-City expedition on Tatakoto can be seen at:

[http://xjubier.free.fr/en/site\\_pages/solar\\_eclipses/TSE\\_20100711\\_pg03\\_Tatakoto\\_Tahunatara.html](http://xjubier.free.fr/en/site_pages/solar_eclipses/TSE_20100711_pg03_Tatakoto_Tahunatara.html)



Google satellite map of Tatakoto with many of the viewing sites marked. The southern edge of Tatakoto is made up of small motus where the ocean waters can enter into the lagoon. The northern edge of the atoll is where totality lasted longest. Diagram from Bill Kramer's Observers Log selection of his web site, found @ <http://www.eclipse-chasers.com/tseChaserLogSums.php>

### A few stats from French Polynesia

- Air Tahiti was to transport 949 people to Hao, Hikueru, Anna and Tatakoto
- Aranui was sold out with 200 passengers
- The Paul Gauguin was booked with 300 passengers
- 4500 tourists were booked on eclipse related tours
- 1536 tourists were confirmed at hotels in the Society Islands

# EFLIGHT2010 - 9m 23s



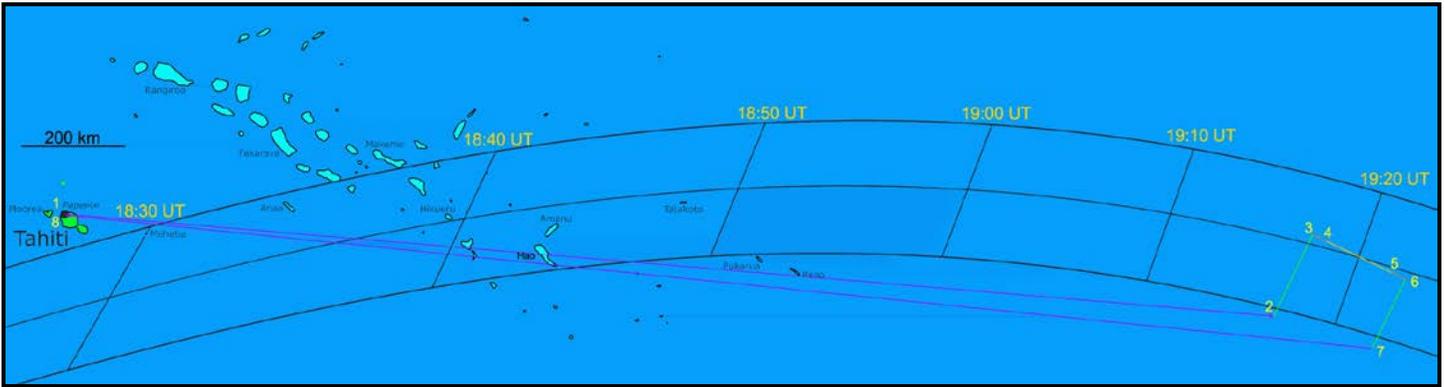
## An Unprecedented 9m 23s of Totality

Forty-three individuals were lofted into the stratosphere, and as a result they rose above the clouds, and extended the duration of totality by paralleling the Moon's orbital motion, and yes successfully were in the umbra for 9 minutes and 23 seconds, nearly 2 minutes longer than is physical possible from a single location on the surface of the Earth.

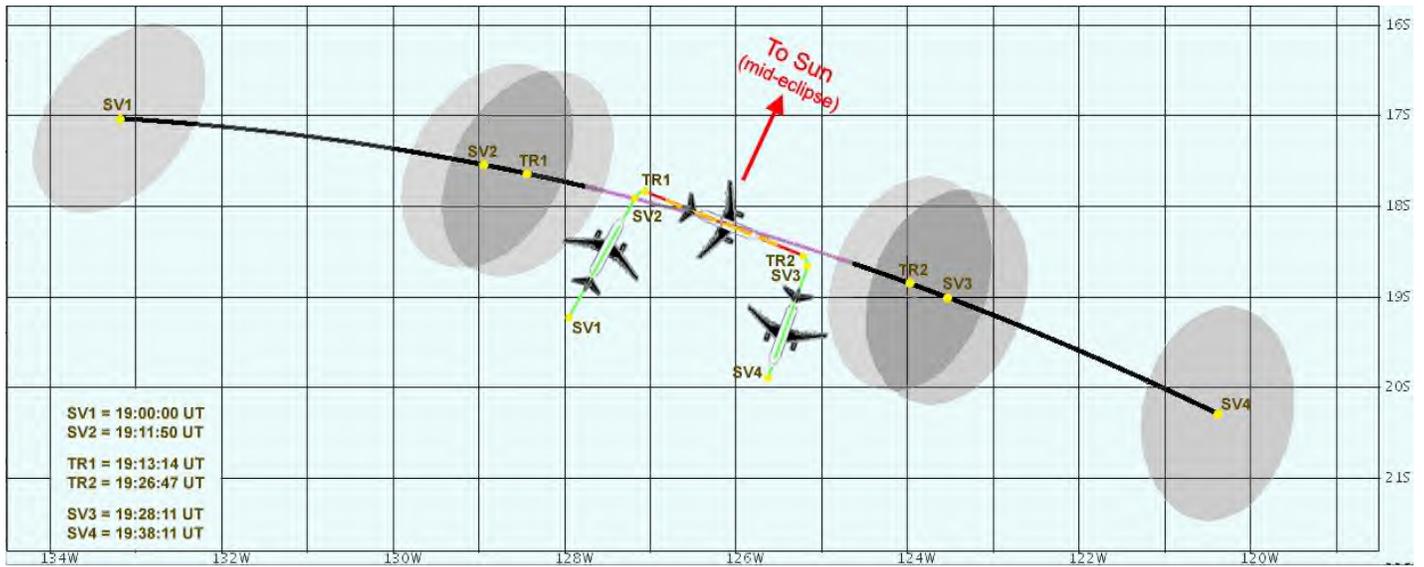
The trip was the result of months and months of planning and coordination by Glenn Schneider and Rick Brown, from a suggestion that originated from John Beattie. Arrangements came together only about 3 months before the eclipse, and there was a scramble to sell the seats on the plane, and the seats went for \$9000.USD per individual, or for observers sharing a single window, the price was \$13,000.USD. This was the price just for the flight to view the eclipse only. The Airbus A319 LR/ACJ had all of the passenger seats removed from the left side (Sun facing during totality) of the plane so it would be possible to view the Sun high in the sky, and allow improved access to the windows.

Mid eclipse came at about 19:20:00 UT and was centered on a position of Longitude: 126° 09.2' W, Latitude: 18° 10.8'S, and an Altitude of 39,000 feet, traveling slightly better than Mach 0.80. "Not only did we extend totality to 9 minutes 23 seconds, but the darkness of the sky, the contrast, the size of the corona, the prolonged diamond ring, the appearance of the shadow a good 15 minutes before C2, the clearly defined elliptical shadow receding over the cloud tops, all really spectacular," said veteran eclipse chaser Joel Moskowitz.

All diagrams and images used by permission and © by Glenn Schneider



EFLIGHT2010 took off from Papeete, Tahiti, and headed for the centerline about 2500 kilometers to the east.



**Organizers:** Glenn Schneider (Flight Planning, Organization and Operations) and Rick Brown (Ground Arrangements, Logistics and Implementation)

**Flight and Cabin Crew:** Captain Rex Booth (Pilot in Command), Dan Colborne (First Officer), Captain Terry Vickers (Chief Pilot), Jason Mifsud (Avionics Engineer), Steve Maden (Airframe Engineer), Felicity Rossiter (Flight Attendant), and Annalise Stanway (Flight Attendant)

**Umbraphiles:** Olav Andrade, Moshe and Valeria Bain, John Beattie, Sophean Bo, Janice Brown, Roland Burley, Charles Cooper, Fred and Pat Espenak, Jay Friedland, Karl Handelsman, Phos Heng, David Hill, Standfield Hill, Alan Kopp, Charlene Larson, Murray Larson, Mr. and Mrs. Michael Maunder, Mark Margolis, Joel Moskowitz, M.D., Derald Nye, Bernard and T. Rickenbacker, Daryl Russell, George Seig, Craig and Robyn Small

**French Polynesian Government:** Mrs. Tong Sang (First Lady of French Polynesia), Honorable Steve Hamblin (Minister of Tourism and Air Transport) and his wife, and Mme, Thea (Minister of Research). In all, 43 people viewed the eclipse above the clouds.



An image of totality taken and processed by Glenn Schneider aboard EFLIGHT2010

(Minister of Tourism and Air Transport) and his wife, and Mme, Thea (Minister of Research). In all, 43 people viewed the eclipse above the clouds.

# RAPA NUI

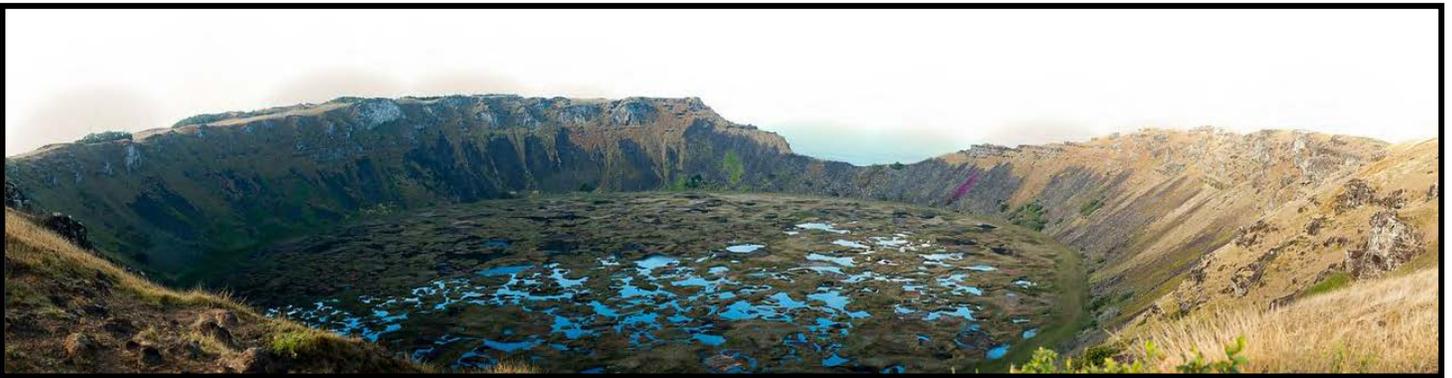
## TOTAL SOLAR ECLIPSE OVER EASTER ISLAND

DAVE KODAMA

Images and text © David A. Kodama  
used by permission



Although weather prospects for Easter Island were not promising for the 2010 eclipse (50-50 chance of clouds), the chance to also see the mysterious Moai stone statues on the same trip made it an easy decision to take our chances. For this special eclipse, our plans and anticipation started some 4+ years ago!



Kano Rao Crater



< Moai under excavation in Rano Raraku Crater

In order to make sure we had time to explore the island we arrived a week early with our friends Greg and Vicki Buchwald. We had a great time doing hikes to remote parts of the island, sampling the local food, and meeting friendly locals, but the weather looked doubtful from the first day of our arrival. Strong winds, frequent showers, and infrequent patches of sunshine were the general pattern each day. While this was cool and refreshing for hikes, the changeable weather thwarted my plans to do some night photography of the southern sky. My medium format film equipment never made it to the point of being unpacked since I just couldn't be assured of the 20-30 minutes of clear sky I would need for each shot. At best, I was able to shoot a few time-lapse sequences with my digital camera for a few hours on a couple of nights. This clearly shows how quickly large clouds were

blowing by, accompanied by frequent rain showers.



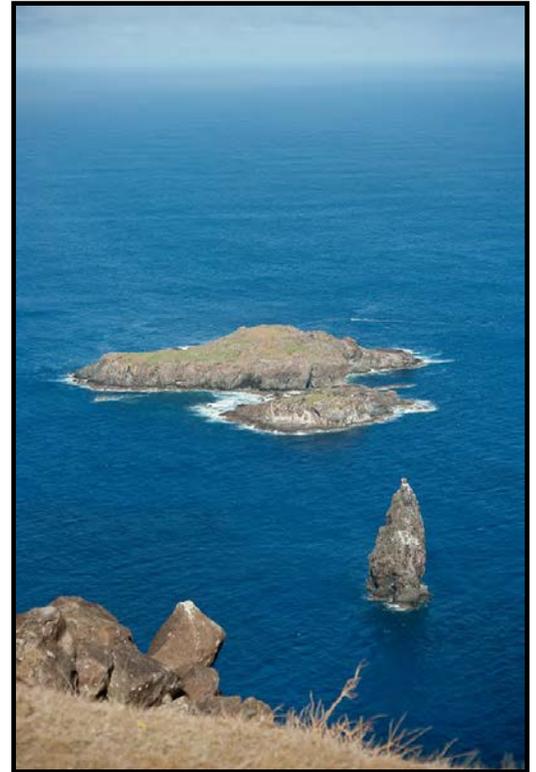
On Saturday, the skies looked more threatening than ever. Nearly solid overcast and even more rain during the day were topped by a torrential downpour and wild winds all night. Lying in bed that night, listening to the rain and wind, I was already rationalizing that even though I certainly wouldn't see the eclipse, the trip to Easter Island had exceeded my expectations already.

< Southern Milky Way

By sunrise, however, it looked like a miracle might occur. Although the winds were still blowing, they had abated a bit and the rain had scaled back to occasional drizzles. The sun lit up a sky still crowded with rapidly moving clouds, but with large clear blue breaks. After breakfast, things looked good enough to optimistically begin setting equipment up, even though the wind continued to gust and we had to constantly be on the watch for drizzles. Other optimists began joining us in setting up their equipment in the grounds around the Altiplanico Hotel, and amazingly, the sky continued to clear.

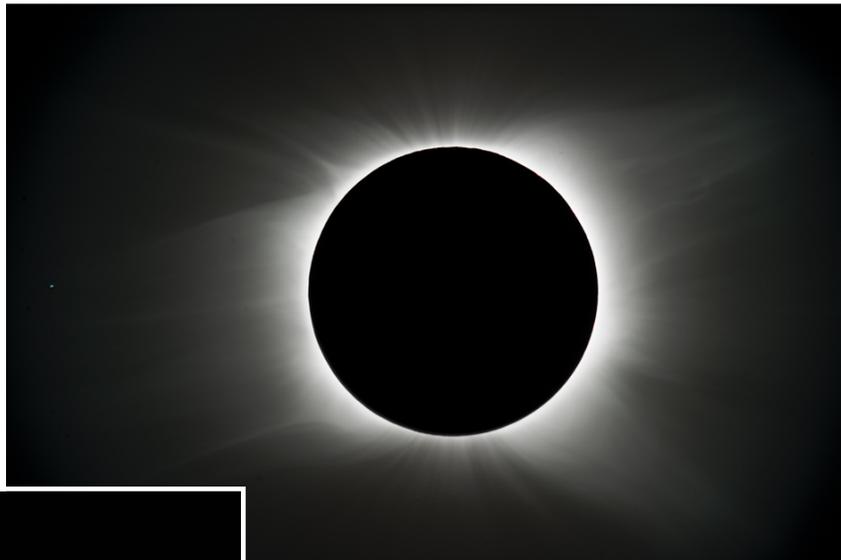


Tongariki Beach Moai



Birdman Island

As the time for first contact came and went, it was clear that a miracle had indeed occurred, and we would see something of this eclipse. However, the large clumps of rapidly blowing clouds still meant that things would have to work out just right for us to see an unobstructed totality phase. As the eclipse progressed through the partial phase, we were still getting clumps of clouds periodically blotting out the sun. When the sun was clear of clouds, however, the sky was truly clear, with none of the high haze that plagued us on our 2009 eclipse trip to China. So now Jean had great conditions for her pinhole projection shots.



***CORONA***



***2<sup>ND</sup> CONTACT***



***3<sup>RD</sup> CONTACT***



***CRESCENT MOAI***



When the time for second contact (start of totality) approached, it was clear that a major miracle had occurred! A large blue sky patch was perfectly positioned to allow us to see second contact without any cloud interference! When second contact arrived, there was the expected shouting and clapping, but perhaps with more enthusiasm than at most eclipses. As a bonus, we had not only the extended coronal streamers of a quiet sun, but also bright red prominences in the areas of both second and third contact. Mercury, Venus and some bright stars were also visible in the sky, though only Venus is obvious in the wide-field shot.

The miracle continued right up to the third contact (end of totality). Just after the diamond ring formed, clouds moved in and momentarily blocked the sun. Perfect timing! All around us there were congratulatory hugs and backslaps for having miraculously gone from what appeared to be a certain washout to unbelievable success in the space of a few hours!

To see more pix of Dave's eclipse pix;

<http://kodama.smugmug.com/Astronomy/2010/Eclipse-Over-Easter-Island/>

And to see photos of Dave's trip in Chile and more of Easter Island;

<http://kodama.smugmug.com/Trips/July-2010-Chile-Easter-Island/>

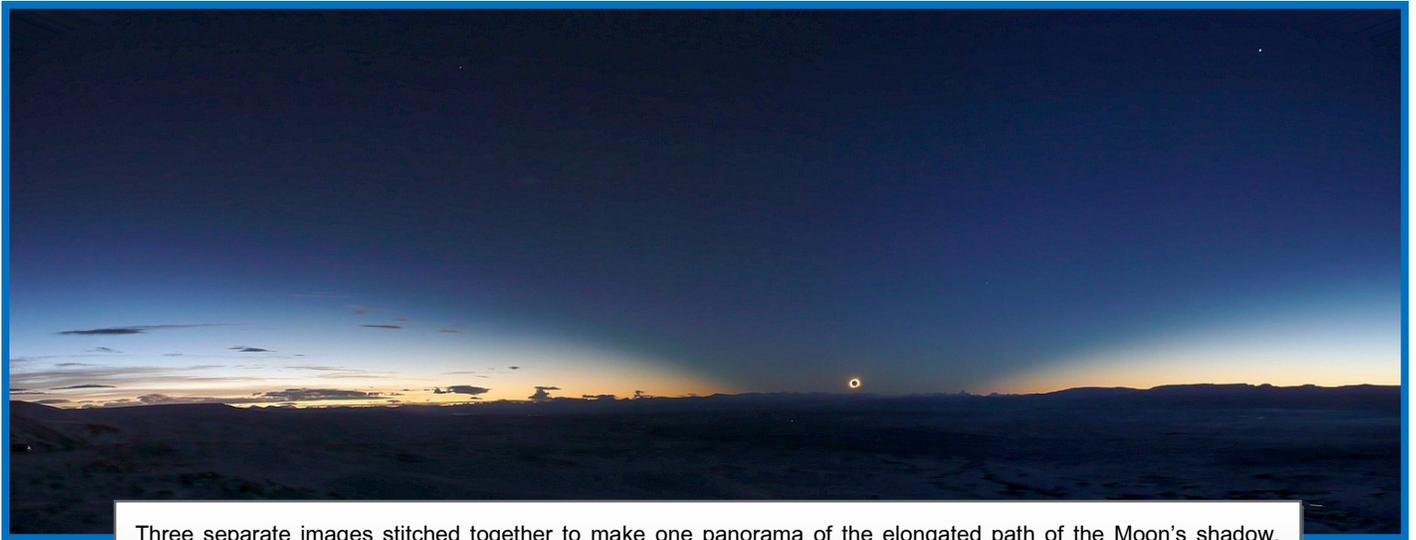
# EL CALAFATE

In contrast to the eclipse in the tropics, where t-shirts and shorts was the clothing of choice, the eclipse was in the southern hemisphere's winter, comparable to January in the northern hemisphere. But far out of the tropics, southern Argentina was a sharp contrast to the rest of the eclipse path and bundling up was necessary to keep warm 50 degrees south of the equator.

## Impossible eclipse at the end of the world

Text and images by Daniel Fischer (DE)

originally posted on the SEML 2010.07.12



Three separate images stitched together to make one panorama of the elongated path of the Moon's shadow, visible only from the end of the eclipse path. Venus can be seen near the top right of the image, and if you magnify your page, Mercury can also be seen about 1/3 the distance between the eclipsed Sun and Venus. This and all eclipse images with this article were made with a Panasonic DMC-TZ2 (point and shoot) with a 10x optical zoom (35 mm equivalent focal lengths = 28 mm to 280 mm), © Daniel Fischer.

And then the shadow came, racing towards us with supersonic speed, almost grazing the Earth's surface and about to lift off into space again after having swept through a vast stretch of the Pacific Ocean in the hours past. The Sun was ten minutes from setting, a dazzling orange beacon hugging the horizon under a deep blue sky, devoid of any clouds except some in the far distance over the isolated Andes Mountains. And this sky was about to change in a swift and dramatic fashion only experienced during total eclipses and only when they take place with the Sun a mere few degrees above the horizon. Most astonishingly, however, we were there to witness it all, perhaps a hundred right here [at this site]: amateur astronomers having travelled half-way around the world and locals alike. In the middle of winter, 80 km east of the little town of El Calafate in Argentina's Santa Cruz province in the heart of Patagonia - and, the most unexpected turn of events of all, with perfectly clear weather. The place was the Mirador, just a small parking lot at a kink of route 11 where the panoramic view of the Andes was best - that's the reason people normally stop here. For the grand finale of the total solar eclipse of 2010 this spot at over 800 meters elevation overlooking lower steppe and the Lago Argentino towards the northeast had become one of very few locations all around from where the fully eclipsed Sun would be seen well clear of the Andes peaks: our tour planner had found out about it via Google Earth, the locals knew it anyway.

There had been hardly any advance news coverage of the eclipse - coinciding with the final game of the world cup - in the Argentinian media, and so just a handful had flown in from the North. It was mainly individual

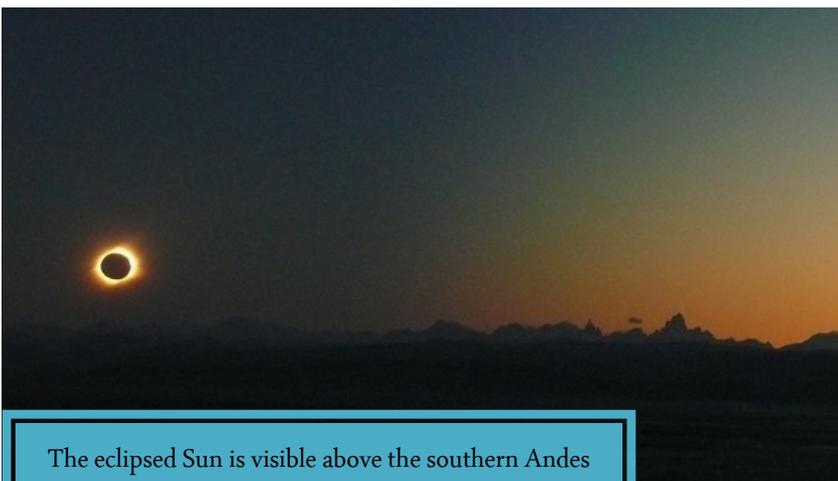
eclipse chasers and tour groups from distant countries that had converged here, foregoing the even more remote

2<sup>nd</sup> contact is only seconds away with the Corona already visible during the diamond ring, the Sun not even a degree above the distant mountains, © Daniel Fischer

and expensive islands in the Pacific the Moon's umbra would touch and settle for a totality practically at sunset, something few have ever seen. Let alone with clear enough skies to see the major features of totality - the corona, chromosphere and prominences - well. It had happened in an Australian desert in 2002 and in Antarctica in 2003, though, but under very different conditions: in Oz the umbral cone was extremely narrow as the Moon and Sun had almost the same angular size, in Antarctica the eclipse happened practically at midnight, with the corona grazing the horizon. Apart from the vague expectation that a big-umbra eclipse near the horizon might provide similar effects, little did we know about what would happen now in frozen Patagonia. Before arriving in El Calafate hopes had been kept in check anyway. 'Official' weather reports showed mainly dull days with snow or rain, and adding in the low solar elevation there simply would be no chance for any clear view of the eclipsed Sun. Funny sky illumination effects maybe, but anything beyond that?



Alas when we arrived late on July 9th, fellow eclipse chasers told of dazzlingly bright sunsets and even had HD video to prove it. After horrendous snowfalls in late June, July had seen several extremely clear days, and the eclipse would have been seen well perhaps every other day or so! Both the 10th and 11th had ample sunshine indeed in the mornings (with sunrise at 9:45 local time, a strange experience), though on the 11th it had become overcast around noon. Yet after the - invisible - sunset the clouds had gone away, and e-day then had stayed clear throughout. Very clear indeed: From our vantage point mountain tops 160+ kms away were clearly seen, and the Sun, even sinking lower, just turned a bit yellow but hardly lost any brilliance. First contact came at 16:44 local time, with 64 more minutes to go until totality: Combined with the slowly sinking of the Sun towards the Andes, it took a long time until the eclipse could be 'felt'. A general fading of the light beyond a typical late afternoon was evident around 17:30 perhaps, and the temperature - until then surprisingly bearable - started to fall. All that was not too different from a 'normal' total eclipse of the Sun higher in the sky, but eventually new phenomena appeared in the sky I had never seen before.



The eclipsed Sun is visible above the southern Andes Mountains, seen here both in the Moon's shadow, and in the twilight of the Eclipse, © Daniel Fischer

The Sun was now sitting in the west-northwestern direction, about 2 degrees high - actually it should have been around 1°, but refraction and being on high ground added another degree or so. To the right (North) of it the Andes peaks were seen silhouetted against a normal evening sky. But to the left of the Sun, looking about due west, the sky color pattern had turned drastically different. Here now the mountains (and isolated clouds above them) were in darkness, seen against much more dramatic sky colors with intense green and orange hues

veterans would recall from earlier 'high' eclipses. But above that a sharply defined finger of darkness arose - the very lunar shadow itself! With high eclipses you may note a

general darkening of the sky in the direction from where the umbra is coming or perhaps feel a dark wall approaching - but this was totally different. And, despite the much broader umbra, surprisingly similar to what was seen in Australia in 2002. Now everything happened at once (and I make use of my photographs to order my recollections): The solar photospheric crescent shrinks to a dot, the brilliant last diamond, while the inner corona is already detectable. The umbral finger grows and moves towards the right - and at the moment of 2nd contact the photosphere vanishes and the umbra swallows the Sun.



Corona above the Andes, © Daniel Fischer

During the following minute - it has become pretty cold now and fiddling with cameras and binoculars becomes problematic - the great show in the sky turns more and more symmetrical until the eclipsed Sun resides in a huge dark sector centered on it and reaching to the horizon. But to the left and right of it two sharply defined wedges of light of different colors mark the edges of the umbra, which has also, when you turn around, darkened the sky opposite to the Sun dramatically. The Sun's corona is surprisingly well visible, with all its streamers and even some prominences: badly squashed by refraction and reddened a bit but without much loss of detail. From now on the show reverses (while the Sun still sinks closer to the horizon), and soon the chromosphere appears again, near its lower edge - and ruddier than ever thanks to the extra reddening by the atmosphere. Then suddenly, the 2nd diamond ring, the umbra collapsing again into a broad finger moving to the right (north), and the horizon color pattern reappears in reverse.

Totally stunned by what we had just witnessed - and also pretty frozen by now - we still couldn't call it quits: some minutes later the Sun would set behind the Andes as a thin crescent, with both horns up! And now - and only now - the extreme transparency of the atmosphere had an actually negative impact: You couldn't look at the Sun even at the exact horizon without a pretty dense filter nor photograph it even with the shortest exposure time. While setting more interesting atmospherically optics phenomena were triggered in that thin orographic clouds (of no absorption power whatsoever) behind the Andes peaks shone up brightly by forward-scattering the last sunlight. And when the Sun - still in deep 2<sup>nd</sup> partiality - was gone more wild sky colors appeared, making this a brilliant dusky sky that would have brought out the cameras even without an eclipse. At that time we were already moving home to El Calafate - where, intriguingly, the skies clouded up completely in the following hours. And later we would learn that skies as clear as we had had them on 11 July 2010 are seen perhaps five times a year in Patagonia.



Against all odds, the skies were pristine in El Calafate, Argentina, veteran eclipse chaser Daniel Fischer (GER) came back with awesome images from a point and shoot digital camera. The view of the Moon's shadow and its movement was quite obvious as the Sun was minutes before setting.



All photos © Daniel Fischer and taken with a Panasonic DMC-TZ2 (point and shoot) with a 10x optical zoom (35 mm equivalent focal lengths = 28 mm to 280 mm)

See more pictures at Daniel's site at; <http://tse2009.ts.funpic.de/pataintro.html>

# SHADOW BANDS IN THE SKY

Shadow bands, are one of the elusive phenomenon visible at solar eclipses, that often is forgotten as totality approaches, maybe more so by eclipse photographers as they are preparing to take images of the Diamond Ring, Baily's Beads and lower chromosphere, both before 2<sup>nd</sup> contact and after 3<sup>rd</sup> contact. Often they are visible at these two intervals, and it has been difficult to even photograph them.



With just seconds to go before 2<sup>nd</sup> contact, the solar corona almost blends with the Shadow Bands here, but they are easily seen in front of the Moons disk, but are also quite noticeable to the upper and lower right of the Sun. Note that they are parallel with the remaining edge of the photosphere. The contrast and brightness were stretched in Photoshop to help accentuate the shadow bands. Imaged on Tatakoto and used by permission, © Fred Bruenjes.

During TSE2010, eclipse photographers in a few locations became unwitting witnesses to a phenomenon hereto for never seen, where the shadow bands manifested

themselves on the low, thin cloud layer that was visible at some locations in the South Pacific. They were visible for only a few seconds when the brightness of the photosphere was not too much to overwhelm the tenuous veil. And what better place to put them. Most observers are looking up in the sky at the time anyway, not down at the ground.

The reports of standard shadow bands are rather varied across the path of totality. Some report seeing some of the more obvious shadow bands they have ever seen, including [as reported earlier in this issue] Thomas Goodey, who observed a 99.5 % partial eclipse from the southeast corner of the island of Tahiti. Some of those who observed shadow bands under clear skies said the shadow bands were quite distinct, but there were others watching for shadow bands under clear skies that saw nothing. For those that watched the eclipse, few people actually observed this phenomenon as it occurred because everyone's attention was on the "Diamond Ring," Baily's beads, chromospheric and prominence phenomenon. Rather, it was widely captured with still or video cameras, and for obvious reasons, the phenomenon was not visible on the ground in these locations



Above; Shadow bands at 2<sup>nd</sup> contact on Tatakoto, © Larry A. Stevens

This phenomenon was imaged on Hao, 300 kilometers to the east on Tatakoto, and also over 3000 kilometers away by eclipse chaser Matt Ventimiglia on Easter Island during 3<sup>rd</sup> contact. The only individual that I have heard a descriptive report from to have visually observed this was Xavier Jubier who viewed from Tahunatara Motu on Tatakoto where he says, "The observation to the naked eye was very impressive, but fleeting, and seemed to highlight a certain three-dimensional structure similar to waves on the ocean."



Somewhat easier to see in this exposure, after 3<sup>rd</sup> contact the thin clouds persisted and the shadow bands once again emerged when the photosphere again became visible. As in the previous photo, the contrast and brightness were stretched in Photoshop to help accentuate the shadow bands. Imaged on Tatakoto and used by permission © Fred Bruenjes.

Photos taken by your editor from the northeast shore of Tatakoto showed the phenomenon only proceeding 2<sup>nd</sup> contact, however Fred Bruenjes, who was observing from the western side of the lagoon (near the west side of the atoll), obtained excellent images that show the phenomenon at both 2<sup>nd</sup> and 3<sup>rd</sup> contacts. The clouds were moving in a westerly direction from my location, and must not have cleared off on the western side of the atoll before totality was over. In my photos, the decreasing brightness of the Sun caused the shadow bands to be rendered invisible about 2 seconds prior to 2<sup>nd</sup> contact. If the exposures on the camera would have been of longer duration, likely it would have recorded the bands right up until 2<sup>nd</sup> contact, but since we are imaging for the chromosphere at this point in the eclipse, the phenomenon likely was not imaged by anyone showing it immediately before 2<sup>nd</sup> contact. And of course, without the Sun being directly visible, the bands are completely gone during totality, even if the clouds still persisted during the entire eclipse like that viewed by Fred as the bands reappeared after 3<sup>rd</sup> contact.

This could be the only known occurrence of this, but observers will be looking to see if they can identify this kind of phenomenon at future eclipses, and past eclipse chasers are scrutinizing photos from previous eclipses to see if it may have occurred previously, but went undetected. So who said there is nothing new to discover at solar eclipses?

Fred was able to identify the shadow bands on the clouds in 11 images taken before 2<sup>nd</sup> contact and 8 images after 3<sup>rd</sup> contact. This is his initial note;

“I have a number of still images of the possible shadow bands phenomenon at 1.7 arcsec per pixel from Tatakoto. It is visible both at C2 and C3. See especially 6805, 6808, then 6918, 6920 at the link below for the strongest signatures. I was at 17d 21.138' S, 138d 26.542' W. I did not look for shadow bands on the ground”

“In 2009 I experienced similar cloud conditions off Marakei, Kiribati. In looking through those images, I see one or two images where there might be a similar signature, but it's so faint I can't be sure it's real.”

“I was on the flight that landed on Tatakoto about three hours before totality. While descending I was watching the cloud heights vs the altitude on my GPS. Tops of the highest clouds were 13,000 to 15,000 feet. Base was 2,000 to 3,000 if I recall. From what I remember during totality, I would guess those clouds were at around 3-4,000. What we had were the remnants of cumulus that were rapidly dissipating with the cooling. The low clouds were moving out of the southeast.”

You can view all of Fred's images of the Shadow Bands at;  
<http://www.moonglow.net/eclipse/2010jul11/ShadowBands/>



Remarkably, 3000 kilometers away from Hao, shadow bands on the clouds were visible even on Easter Island at 3<sup>rd</sup> contact as imaged by eclipse chaser Matt Ventimiglia ©, used by permission.

# ½ Lunation Interval Solar and Lunar Eclipses

After watching the Total Lunar Eclipse (TLE) of 2010.12.21, I had never really thought much about the duration of a TLE, but being a [solar] eclipse chaser, I got to wondering about this. So where else do I go but the NASA 5K Catalog. Some stats had already been compiled and a few summaries of the longest and shortest eclipses for each century was already



Total Lunar Eclipse of 2010.12.21 © Larry A. Stevens

visible at a glance. I compiled a list bringing both solar and lunar eclipses together so I could see what kind of matches they made together, at least for the next 40 years. I found some very interesting patterns, and some info you might not yet know when correlating between Lunar and Solar eclipses.

But first a bit about the duration of lunar eclipses. In the 5K catalog, the longest duration of a lunar eclipse was that of the 0318 May 31 eclipse with a duration of 1h 46m 36s, and the shortest-longest duration is only a few years from now, 2018 July 27, with a duration of 1h 42m 57s. As you can see, there is very little difference between the duration of long duration totalities, with a difference of only 3m 39s.

Only when the Moon is extremely near the edge of the Earth's shadow does the duration significantly change. Like a short duration solar eclipse, the shortest lunar totality would be 1s, but in the 5K catalog the shortest listed occurred on 1529 October 17 with a duration of 1m 41s. The shortest total lunar eclipse of the 21<sup>st</sup> century is only a few years off, on 2015 April 04, and will be 4m 43s. This particular eclipse occurs only a half a lunation after TSE2015 on March 20, so indeed you can have a TLE and a TSE back to back and only a half a lunation apart. Only 6 other eclipses are shorter than this in the 5K catalog, and one of shorter duration will not occur again until 2155 Sep 11, where it will be 2m 36s long (or is it short).

So now I was interested in knowing how many TLE/TSE eclipses occur back to back like this one, just ½ a lunation apart. In the period from 2011 to 2051, a 40 year duration, there are 11 occurrences like this, pairing a TLE with central solar eclipses; there are 1 hybrid, 4 total and 6 annular solar eclipses, with the common denominator being a total lunar eclipse.

184 eclipses in the next 40 years, 2011 – 2051;  
92 Lunar; 38 Total, 22 Penumbral, 21 Partial  
92 Solar; 33 Partial, 29 Annular, 25 Total, 5 Hybrid

## BACK TO BACK 1/2 LUNATION CENTRAL SOLAR & TOTAL LUNAR ECLIPSES 2011 - 2051

2014 APR 15 = Total Lunar	2015 MAR 20 = Total Solar	2021 MAY 26 = Total Lunar
2014 APR 29 = Annular Solar	2015 APR 04 = Total Lunar	2021 JUN 10 = Annular Solar
2026 FEB 17 = Annular Solar	2032 APR 25 = Total Lunar	2033 MAR 30 = Total Solar
2026 MAR 03 = Total Lunar	2032 MAY 09 = Annular Solar	2033 APR 14 = Total Lunar
2043 MAR 25 = Total Lunar	2044 FEB 28 = Annular Solar	2050 MAY 06 = Hybrid Solar
2043 APR 09 = Total Solar	2044 MAR 19 = Total Lunar	2050 MAY 20 = Total Lunar
2043 SEP 19 = Total Lunar	2044 AUG 23 = Total Solar	
2043 OCT 03 = Annular Solar	2044 SEP 07 = Total Lunar	

As you can see, 2043 and 2044 will be remarkable years that will keep eclipse photographers busy. Each year will have 1 annular [solar], 1 total solar, and 2 total lunar eclipses.

## TRIPLE ECLIPSES OF 1/2 LUNATION INTERVALS 2011 - 2051

2011 Jun 01	Partial Solar	2013 Apr 25	Partial Lunar
2011 Jun 15	Total Lunar	2013 May 10	Annular [Solar]
2011 Jul 01	Partial Solar	2013 May 25	Penumbral [Lunar]
2018 Jul 13	Partial Solar	2020 Jun 05	Penumbral [Lunar]
2018 Jul 27	Total Lunar	2020 Jun 21	Annular [Solar]
2018 Aug 11	Partial Solar	2020 Jul 05	Penumbral [Lunar]
2027 Jul 18	Penumbral [Lunar]	2029 Jun 12	Partial Solar
2027 Aug 02	Total Solar	2029 Jun 26	Total Lunar
2027 Aug 17	Penumbral [Lunar]	2029 Jul 11	Partial Solar
2031 May 07	Penumbral [Lunar]	2036 Jul 23	Partial Solar
2031 May 21	Annular [Solar]	2036 Aug 07	Total Lunar
2031 Jun 05	Penumbral [Lunar]	2036 Aug 21	Partial Solar
2038 Jun 17	Penumbral [Lunar]	2047 Jun 23	Partial Solar
2038 Jul 02	Annular [Solar]	2047 Jul 07	Total Lunar
2038 Jul 16	Penumbral [Lunar]	2047 Jul 22	Partial Solar
2049 May 17	Penumbral [Lunar]		
2049 May 31	Annular [Solar]		
2049 Jun 15	Penumbral [Lunar]		

2038 is the next year with 7 eclipses, 3 central solar eclipses (1 total and 2 annular), and all of the lunar eclipses, of which there are 4, are penumbral. The last year with 7 eclipses was 1982, and the next will not be until 2094

TOUR LISTINGS WILL RETURN WITH  
ISSUE 12, ALONG WITH ARTICLES  
ABOUT ASE2012 AND TSE2012

# ECLIPSE SPECIALTY TOUR GROUP Web Sites ...

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## **A Classic Tours Collection**

<http://aclassictour.com>

## **Eclipse City**

<http://www.eclipse-city.com/>

## **Far Horizons**

<http://www.farhorizon.com/2006-solar-eclipse.htm>

## **Mayhugh Travel – Astronomy Vacations**

<http://astronomyvacations.com/>

## **MWT Associates (Astronomical Tours)**

<http://www.melitatrips.com/>

## **Ring of Fire Expeditions**

<http://www.eclipsetours.com>

## **Sirius Travel**

<http://www.siriustravel.com/>

## **Sita World Tours - Solar Eclipse Tours**

<http://www.eclipsetours.net/>

## **Spears Travel**

<http://www.spearstravel.com/astronomy/>

## **TravelQuest International**

<http://www.tq-international.com/index.htm>

## **Travel Wizard**

<http://www.travelwizardtravel.com/astro.htm>

## **Winco Eclipse Tours, Inc.**

<http://www.wincoeclipsetours.com>

## Other Useful Eclipse Web Sites . . .

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NASA Eclipse Home Page

<http://eclipse.gsfc.nasa.gov/eclipse.html>

Fred Espenak's Web Site

<http://www.mreclipse.com/>

Jay Anderson – Eclipse Weather Predictions

<http://home.cc.umanitoba.ca/~jander/>

Xavier Jubier's Google Earth Eclipse Maps

[http://xjubier.free.fr/en/site\\_pages/SolarEclipsesGoogleMaps.html](http://xjubier.free.fr/en/site_pages/SolarEclipsesGoogleMaps.html)

International Astronomical Union - Solar Eclipse Working Group

<http://www.eclipses.info/>

Jay Pasachoff – Past Eclipse Expeditions

<http://www.williams.edu/Astronomy/eclipse/>

Sheridan Williams's Web Site

<http://www.clock-tower.com/>

Eclipses Online – HMNAO, CCLRC

<http://www.eclipse.org.uk/>

Glenn Schneider: Umbraphile

<http://nicmosis.as.arizona.edu:8000/UMBRAPHILLIA.html>

Bill Kramer's – Eclipse Chasers Web Site

<http://www.eclipse-chasers.com/>

Dan McGlaun's – Eclipse2017.org

<http://www.eclipse2017.org/>

Jeffrey R. Charles – Eclipse Chaser Journal

<http://www.eclipsechaser.com/>

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Some future issues will occasionally use photos that have been posted to web sites that are saved at 72 dpi, and likely will not be as sharp as others posted at 128 dpi.

Please send any correspondence, suggestions or submissions to [TOTALITYnewzine@aol.com](mailto:TOTALITYnewzine@aol.com).

Photo submissions can also be sent to the [TOTALITYnewzine@aol.com](mailto:TOTALITYnewzine@aol.com); please format @128 dpi.

