# It was Gerhana Matahari for Российские Planetarians

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Gerhana Matahari—these words meaning "solar eclipse"— became so popular in Indonesia in March of 2016 that its abbreviation GMT (solar eclipse total) was universally understood and used even more often than the full phrase. Astronomers mostly associate this abbreviation with the better-known term Greenwich Mean Time. This is merely a coincidence, but still it emphasizes the importance of the event.

Early in the morning of March 9, the shadow of the moon hit the road from the coast of Sumatra in western Indonesia, then crossed the largest island of Kalimantan (Borneo), touched Sulawesi and other smaller islands, and eventually escaped into the Pacific Ocean.

## Thousands descend on Indonesia

Solar eclipses are not only rare, but also spectacular astronomical phenomena. Therefore, thousands of amateur astronomers, "eclipse chasers" from around the world, gathered in Indonesia to enjoy the glorious sight once again and to take photographs of the solar corona, which are also scientifically useful.

As usual, the main plot twist was the weather. In Indonesia, it often rains in March and the sky is overcast. Almost everywhere along the shadow area, the probability of clear weather was 50%. Somewhere the chances were a little better, somewhere a little worse.

Most of the Russian observers went to the resort island Bali from where they could "leap" to the shadow zone. The Siberian team organized by the Irkutsk State University (including also members from Moscow and Novosibirsk) was divided into two parts. One group went to the easternmost island of Pulau Halmahera, where the duration of totality was to be 3 minutes 20 seconds.

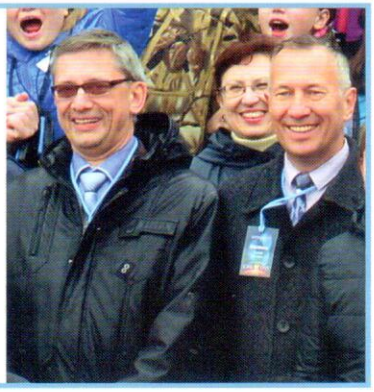
Another set off westward to the island of Sumatra, where it could only claim 1 minute 52 secconds of total darkness. The eastbound group included experienced "eclipse chasers" Serguei Yazev (scientific director of the Irkutsk Planetarium) and Michail Gavrilov (the founder of the International Astronomy Olympiad). The westbound group was headed by Serguei Maslikov (director of Large Novosibirsk Planetarium), who also had experience of several eclipses.

## Western group: Sumatra

Team Novosibirsk chose southern Sumatra for observation. There, the shadow area covered the ancient city of Palembang with more than a thousand-year history and a population of about 1.7 million. To get there, we had to take the route Novosibirsk-Hong Kong-Kuala Lumpur-Palembang.

Generally, Indonesia is visa-free for Russians. It is only true, however, when you travel to one of the tourist centers. In our case, we had to get visas upon our arrival in Palembang. The Novosibirsk team of four was almost the first to come there on March 6 and, surprisingly, was met at the airport two more fellow-countrymen.

We found ourselves in the hot and humid tropics, instantly becoming the object of attention from the local folk. This was



Authors Sergei Yazeb (left, in glasses) and Sergei Maslikov, among participants of Sibastro-2013 in Novosibirsk. Photo by Valeriy Cherepanov.

Sergei Yazev is a third-generation astronomer. He studied the sun professionally for 20 years using a chromosphere telescope and participated in three meteor and eight eclipse expeditions. A professor and writer, he also is the scientific director of the new Irkutsk Planetarium, the only planetarium in East Siberia.

Sergei Maslikov has been director of Novosibirsk Child-youth center Planetarium since 2011. Organizer of 10 annual Siberian astronomic forums "СибАстро" since 2006, he is interested in history of astronomy, particularly astronomic instruments and astrolabes.

Facing page: the dragon who swallows the sun during the festival in Palembang, embankment of Musi River. Below: the Ampera Bridge is filled by the public in the moment of eclipse. Both photos by Sergei Maslikov.

followed for us by three days of "stardom" when everybody wanted to greet us with "Hallo, Mister" and take a picture "for memory." The issue of the local newspaper on the next day published a large photograph of the "aliens." It almost seemed that outsiders had set foot on this island since the departure of the Dutch colonizers. The reinforcement of "pale-faces" that arrived the next day made it easier to become Siberians again.

Local authorities had been preparing for the great event well in advance. In March 8-9, a special festival called "Ogoh-Ogoh" was held to cast out evil demons, and the only bridge connecting two halves of the city and the main tourist attraction was closed and given to the observers. Incidentally, the bridge bears the resounding name of Amper, which has nothing to do with the French physicist; it commemorates a local politician.

Palembang was close to the central shadow area and the duration of the total phase of the eclipse was here 1 minute 52 seconds, some 13 seconds less than in the middle of the totality band.

The eclipse began ten minutes after sunrise and was observed low over the horizon. Because of this the observation point was chosen on the riverbank so as to take photographs of the sun on the background of the main bridge, which, in addition, was provided with spectacular backlighting turned on when it was dark. A day before the eclipse, our colleagues from other countries had also sized up this site.

Upon arrival at the observation site at five in the morning, an hour before sunrise, our observers realized that they had underestimated the interest of local people to see the eclipse. The bridge, at 22 meters wide and more than one kilometer long, was already densely crowded with people. Fortunately, it was still possible to find a comfortable place on the pre-selected site on the river embankment, and we installed there the photographic equipment. There was soon no room to swing a cat in this place- like everywhere else.

## Will it clear at dawn?

It was still dark. The Siberians were enjoying the wonderful backlighting of the bridge and kept anxiously glancing at the sky, which was covered with fast-moving cumulus clouds. On the previous days, mornings were also cloudy and it even rained, but the sky cleared at dawn. This was what everybody hoped for.

The dawn was gradually breaking, but it was too cloudy for the rising sun to be visible, so neither was it possible to see the partial phases of the eclipse. In the west, on the opposite side of the horizon, the sky was clearing up, but doing so very slowly.

Finally, 20 minutes before the total phase, the sun, which had turned into a narrow crescent resembling a boat, began occasionally to peek out from behind the clouds, each time causing a storm of delight from the audience. It was like a game of hide and seek.

Up to the very last minute, there remained a lingering hope for seeing the solar corona. It was rapidly growing dark. Then, in complete darkness, the backlighting of the bridge was turned on so that the entire city was carried off and exploded with delight.

Ampera Bridge is filled by the public during the moment of eclipse. Photo by Sergei Maslikov.

Alas, the main purpose of the expedition—the solar corona, visible only at the moment of totality—remained hidden behind the clouds. Ironically, as soon as the total phase was over and the dawn broke, the crescent emerged again. Now it was no longer a "little boat" but an "umbrella," an upward arc.

## Sun at the zenith: Strange sight

In this period of the year at the latitude of Palembang (3 degrees south of the equator), the sun passes exactly through the zenith. Its path begins in the east. It rises straight up, passes overhead, and lowers vertically in the west. The moon takes the same path. Therefore, the lunar phases seemed strange to us who reside at 55 degrees north of the equator.

Back at hotel and slightly depressed, Team Novosibirsk tried to find out whether the rest of the mission proved luckier. TV broadcasters kept repeating the catchphrase of the day—Gerhana Matahari Total—but it was impossible to understand the rest. In a while, we were contacted by our colleagues from the island Halmahera, which met the shadow half an hour later than we did.

## Eastern group: Pulau Halmahera

Team East also had its share of worries. As an observation site, they selected the settlement Bouley (not to be confused with Bali!) with a population of several thousand people on the east coast of the easternmost of this large Indonesian islands.

Bouley consists of several adjacent villages with alternating predominance of Christian (protestant) and Muslim populations. Children go to school together, boys and girls, Christians and Muslims. They all sit in classrooms next to each other and it was evident that they were friends; there was no tension in interfaith relations.

Everywhere the residents of Bouley welcomed the members of the expedition with friendly smiles and greetings of "Hallo, Mister!" They were eager to be photographed with the visitors and happily posed for photographs.

The members of the eastern group arrived in Bouley on March 6; their route was Irkutsk-Moscow-Singapore-Jakarta-Manado-Bouley. The next two days were spent to find the best place for the observation. The observers

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summer solstice, but the learner has to expend extra effort to decode the visuals—crammed into a rectangular screen in front of the class—to match the verbal description.

In the dome, by contrast, Group III students are aware egocentrically (relative to their own bodies) where the sun is at all times. They get to experience the daily and seasonal motions of the sun from multiple locations on Earth, witness for themselves which directions the sun is rising and setting, how high it rises by noon, and how long it is up in the sky. At the same time, the instructor's verbal lesson reinforces the location of the sun in summer with descriptions of the longer days that are occurring, the increased time that the ground is heated, the higher elevation angles of the illumination resulting in smaller shadows cast by objects on the ground, and the sunlight being less spread out over the surface. Group III students simply experience the positions and motion of the sun directly. Freed of having to interpret imperfect instructional visuals, a learner will have more cognitive resources to build a mental model of how Earth's seasons work from what she is seeing and hearing.

Demonstrating seasons by depicting the sun's changing positions accurately relative to the viewer is one of the key reasons why fulldome is effective for teaching this concept. Perhaps no other topic in astronomy is so suited to be taught in an immersive virtual environment. But are there other topics in other disciplines that are just as tailor-made for the dome? Can geology, physics, chemistry, molecular biology, or archaeology education benefit from this also? There are intriguing hints that computer simulations and immersive virtual environments can aid in teaching topics in other fields as well. How big of an educational role fulldome has in these other subjects will depend now on the interest of educators and vendors in our community.

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studied a small uninhabited island reached by a trimaran and explored various sites in Bouley and its neighborhood. As a possible observation point, the Bouley port pier was chosen and a special rope was purchased to cordon off the observation site.

The morning of March 9 was cloudy. It was quickly decided to deploy observation directly on the veranda of the hotel by the sea where Team East lodged. The observers succeeded in taking photographs of partial phases, but soon the sky became heavily overcast. It started to rain.

## Chasing the gap

Because there was a large gap between the clouds moving swiftly along the sky, which made it originally possible to see the initial phases of the eclipse, three team members went by car along the mountain road towards the village of Maba "chasing the gap."

The only member of the expedition who remained on the site was Mikhail Gavrilov, who managed to photograph the corona during the totality phase with different exposures, as well as capture Baily's beads and the "diamond ring" through another gap in the clouds which appeared a little later. Thus, the purpose of the expedition had been accomplished.

The group of observers in the car was not able to see the total phase as the narrow gap between clouds through which they photographed a narrow crescent a few minutes before the total phase then closed and the sun disappeared behind thick clouds. The team made video records of the glow ring during the total phase. Shortly after the end of the total phase, the sun was released from the clouds, which allowed capturing a series of final partial phases of the eclipse.

Now we could breathe a sigh of relief. The expedition task had been completed, largely due to the clever tactic of distributing the forces along the shadow area. Someone was bound to get lucky.

In addition to the eclipse itself, he travelers made a good catch of exotic impressions. The western group has learned something about the life of the local people who created a sort of Indonesian "Venice" along the banks of the full-flowing Musi River. The itinerary also included a visit to the planetarium in Kuala Lumpur (Malaysia) and to the popular science museum Petrosains in the famous Petronas Twin Towers in the same city of KL, as its residents prefer to call it.

The next total solar eclipse is expected on 2017 August 21 in the United States. Hopefully, better luck next time! ☆

From this issue's International New, we also learn that in addition to Team Novosibirsk, lead by S. Maslikov (west coast) and Team Irkutsk/Moscow, headed by S. Yazev (east coast), there was another group of four persons from Nizhny Novgorod, lead by A. Mitiugov, in the central part of the country.