Sunset Astronomical Society

The Sunset *Gazette*

Serving the Tri-Cities since 1975

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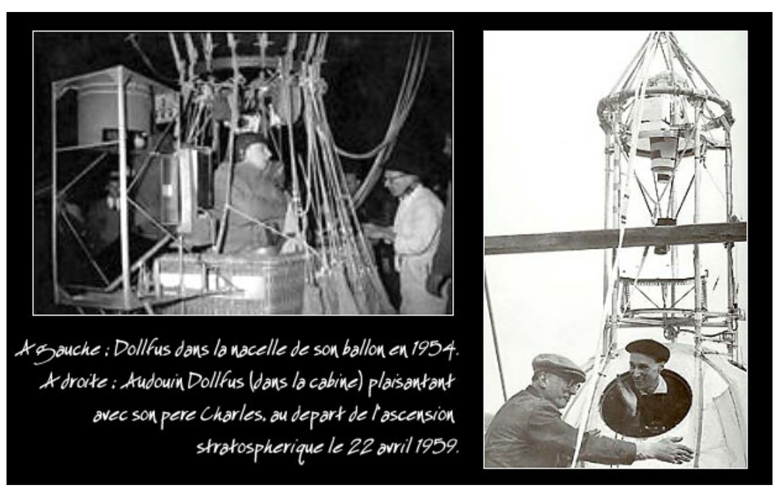
A Short History of Balloon Astronomy II

By Martin Grasmann

In the last issue we learned that the kind of astronomical experiment determines the heights a balloon must reach: For IR observations 33 km (108,000 feet) of height are sufficient but for UV astronomy balloons have to climb to altitudes of ca 42 km (138,000 feet). Another very important factor is that balloons do not stand still. During the mission the balloon telescope drifts, propelled by stratospheric winds, along the latitudes. The facts that the balloons should keep their height as long as possible and that any salvage should happen on solid ground imply that careful planning of the launch and landing points is necessary.

During a year the stratospheric winds change twice: on the northern hemisphere the wind blows from the east during the summer whereas in the winter the winds come from a western direction. This can easily be explained: at the begin of summer the air over the northern polar regions gets heated by the Sun and starts to expand and to move southwards. During that process the air masses increasingly fall behind the Earth's rotation: the wind blows then from the direction of the Earth's rotation = east. The speed of these winds is considerable. In 40 km height the speed can reach 62 miles/hour. In only one observing night the balloon can travel more than 630 miles from its point of ascendance!

Therefore suitable start points for a balloon experiment are always in the middle of large continents. This has the advantage that the place can be used twice a year. For example in the US a lot of balloons are launched form Palestine in Texas where they can drift over 600 miles to the east or west before they reach the Atlantic respectively the Pacific ocean. In much smaller France balloons are launched from Gap in the alps in the summer, whereas in the winter the starts happen from near the Atlantic coast. Very favorable are launches during the time when the stratospheric winds change direction which happens in May or September. During this time mission lengths of up to 50 hours are possible without the balloon moving to far from its launching site. Another point of concern is that during the rest of the year the much higher wind speeds will soon let the balloon will disappear behind the horizon due to the curvature of the Earth (despite its height of 30 km or more!).



A gauche : Dollfus dans la nacelle de son ballon en 1954.
A droite : Audouin Dollfus (dans la cabine) plaisantant avec son pere Charles, au depart de l'ascension stratospherique le 22 avril 1959.

Meeting information

Meetings are generally in the theater in the Delta College Planetarium in Bay City. The meetings will usually be on the 2nd Friday of each month at 7:00 PM. Watch the newsletter for changes in dates and times. Membership is not required to participate in meetings and activities. See last Page for this month's meeting site.

Membership Information

Our club has switched to e-mailing our newsletters. For those wishing to receive a hard copy mailed an additional dues of $10.00 per year is required.

Student / Senior: (17 years & younger, 65+ years)

1 year - $15 (mailed Newsletter add $10)

2 year - $20 (mailed Newsletter add $10)

Regular: (18+ years)

1 year - $20 (mailed Newsletter add $10)

2 year - $30 (mailed Newsletter add $10)

Family:

1 year - $25 (mailed Newsletter add $10)

2 year - $40 (mailed Newsletter inclusive)

Membership includes voting privileges, the newsletter and free admission into Delta College Planetarium shows.

Treasurer's address for renewals and subscriptions:

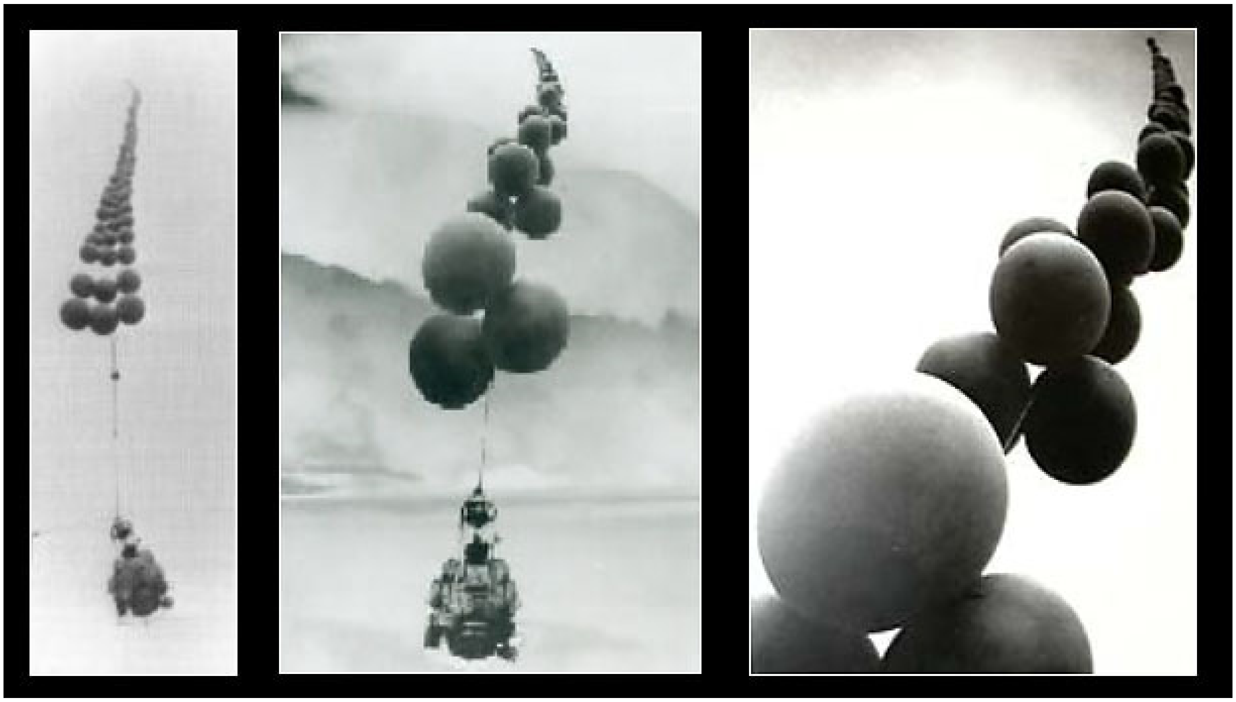
Tom Smith, 3423 Hidden Road,

Bay City, MI 48706-1243

Subscription Information

Subscription prices for "Sky and Telescope" Magazine or "Astronomy" Magazine are available at club rate with the purchase of individual or family membership. For prices please refer to the treasurer or the club's website:

http://www.sunsetastronomicalsociety.com/SASMembership.htm



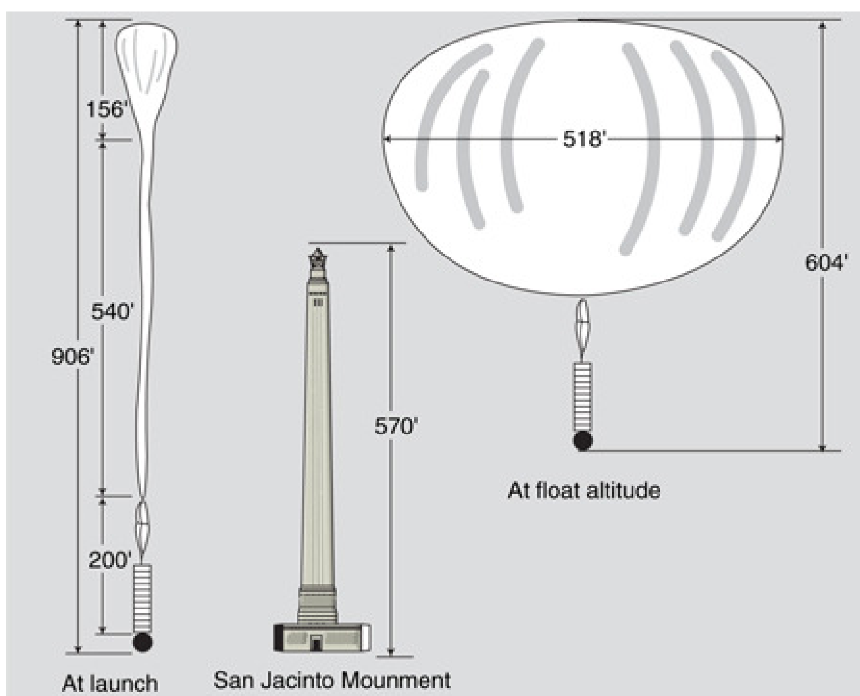
Picture on previous page: Audouin Dollfus shortly before two balloon launches in 1954 and 1959. The right picture sees him using a pressurized gondola.

Left Picture: A chain of 104 balloons is carrying the gondola to a height of over 13000 m.

In the past the balloon telescope would have lost radio contact with its mission control and further satellite control stations would be necessary along the flight path. Today the mission data can either be saved on-board or directly sent to the control station via a satellite connection.

Today's balloon experiments are all un-manned. The French astronomer Audouin Dollfus was the last who carried out a manned astronomy mission on-board a stratospheric balloon. In 1959 he ascended to a height of 13500 m (44,000 feet) in a pressure cabin which carried a 50 (20 inch) telescope on the outside of its hull. Instead of one balloon Audouin actually used 104! expandable balloons (see picture above). By rupturing the balloons and dropping ballast he was able to stabilize the balloon at a certain height and could then induce a gentle descend back to the ground. The experiment he was carrying out was the successful determination of water moisture in the atmospheres of Venus and Mars. Despite being successful it became clear that the telescope was much difficult to stabilize with a man on-board than without. So it was no surprise that the famous flights of the 'Stratoscope' in the 1960er (target was the study of planetary atmospheres and the granulation of the Sun) by Martin Schwarzschild were not longer manned missions.

Before the 1980's, when telescopes were increasingly used on space missions and put on dedicated satellites, balloon telescopes were used for the observation of all regions of the electromagnetic spectrum. In Germany the 'Spectrostratoskop' was used to explore the Sun, other instruments explored the cosmic radiation, there were instruments for X-ray, IR and UV astronomy. At large launching sites like Palestine, Texas scientist from many nations queued up to launch their telescopes. Especially in spring and autumn during the time when the stratospheric winds changed balloon starts became nearly a daily routine. The balloon telescope dedicated to gamma astronomy often got the longest mission times due to the low



An example how large stratospheric balloons are. The balloon is barely filled at the launch but will be completely expanded when it reaches is destined altitude.

intensity of the gamma ray sources and the lengthy observing time needed. Most of the balloon telescopes were build by the institutes themselves and, if all went well and the telescope was salvaged without too much damage, the instrument could be flown twice in the same observing season. These were good time for PhD students because such a project could be carried out in two or three years. This is a far cry from the 15 to 20 years it takes today to prepare and analyze a satellite instrument if it gets successfully of the ground and into orbit without a hitch.

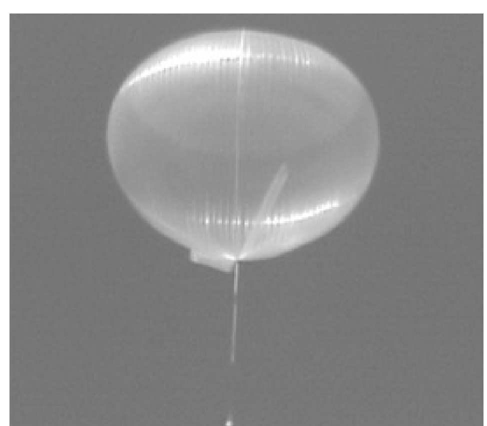
On the other hand modern space telescopes deliver thousands of times more data and can be run for many years. But they also cost several thousand times more. A lot of these costs is going into the effort to make these instruments work at a 90% success rate. This differs from the balloon instruments which only had about 50% successful flights but were easily repaired and improved and could be flown again.

How do you launch a balloon which measures 600 feet and more in length if you include the hull and the telescope? Usually the balloon gondola is suspended from a crane-car several meters above the ground. The rest of the set up, ropes, radar-reflector and balloon hull is laid out on the ground. The gondola is connected via a cut-off unit to the radar-reflector which is connected via a 300 feet rope to the balloon hull. The upper part of the balloon hull , about 300 feet in length, is then filled via plastic tubes with helium (in the US) or with hydrogen (in Europe). The balloon is released and raises over the gondola . At this moment the crane car can still make adjustment in case of adverse ground winds. As soon as the rope which connects the gondola to the balloon is taut the gondola is released. In about 3 to 4 hours the balloon reaches the envisaged height of 30 to 40 km. At the end of the observation a remote control command triggers a cut-off the balloon and the rest of the set up. The telescope first falls in free fall for about 10 km (33,000 feet) when with increasing air density and drag the parachute opens. The gondola lands with about 5 m/s on the ground with shock absorber limiting the negative acceleration to about 5 g when the telescope hits the ground. Landings and recovery can be difficult in more remote areas. Also there have been complete losses when the parachute fails or locals put bullet holes into the landing gondola to prevent alien invasions...

Upper picture: Filling of the balloon with helium or hydrogen. Left picture: The telescope is suspended on a crane. In the background the parachute (orange) and the balloon.

Left Picture: Lift off!

Right Picture: A fully expanded balloon. The tiny spec below is the gondola with the telescope.



The next part of "A Short History of Balloon Astronomy III" will be in the issue of the January newsletter.

SUNSET ASTRONOMICAL SOCIETY
THE SUNSET GAZETTE
SERVING THE TRI- CITIES SINCE 1975

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New (Old) Elected Officers for the SAS:

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This issue can be accessed in color on the website of the SAS!!!

http://sunsetastronomicalsociety.com

SAS Meeting

7 PM, December 10th, 2010

Delta Planetarium

1. **Welcome, new members**
2. **TBD**
3. **Break**
4. **Club Stuff**

What's up in the Sky

Dec 1 - 3: *Dawn*: Waning crescent Moon can be seen 8 deg on the lower right of Saturn on the 1st and 7 deg on the lower right of Venus on the 2nd and far below Venus on the 3rd.

Dec 2 - 3: Algol at minimum brightness for 2 h at around 2:35 am EST.

Dec 5: New Moon

Dec 6: *Dusk*: Occultation of Mars by the thin crescent Moon in bright twilight. See: www.skyandtelescope.com/Dec10Occult

Dec 13: 1st quarter Moon

Dusk: Mercury is ca 1 deg to the upper right of Mars very low in SW shortly after sunset. Binocular or telescope.

Dec 13 - 14: *Night:* Gemini shower peaks tonight.

Dec 18: *Evening:* Pleiades ca 3 deg left or upper left from Moon. Use binoculars.

Dec 20 - 21: *Late Night or Early Moring:* ***Total Eclipse of the Moon (Time = EST)!!!***

Penumbra first visible?: 12:55 am

Partial Eclipse begins: 1:33 am

Total Eclipse begins: 2:41

Mid-eclipse: 3:17 am

Total eclipse ends: 3:53 am

Partial eclipse ends: 5:01 am

Penumbra last visible? 5:35 am

Dec 21: Full Moon.

Dec 27: Last quarter Moon.

Dec 29: *Dawn:* Spica a few deg's above the Moon with Saturn to their upper right.

Dawn: Telescopes show 5.5 mag 20 Piscium just 4' SE of Jupiter