

Solargraphy - Density of Time



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Plaça d'Espanya. 2 days.

What's solargraphy?

- Art
- Geography
- Sport
- Gambling game
- Psychology
- Sociology
- Biology
- Optics
- Gastronomy
- Chemistry
- Handicraft
- Geometry
- Meteorology
- Astronomy
- Logic
- Education

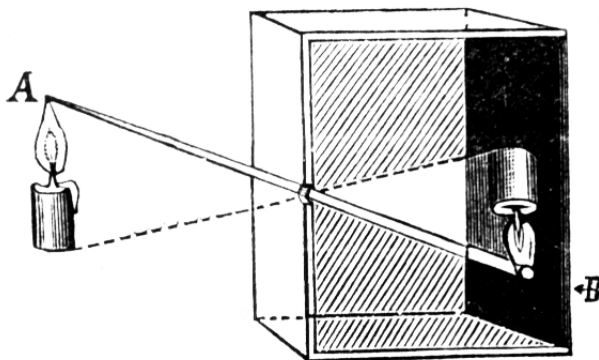
Solaris 2000 Project

- Inventors:
 - Paweł Kula (PL)
 - Sławomir Decyk (PL)
 - Diego López Calvín (ES)
- continuous, lasting a half-year record of the sky in different parts of the world
- home-made pinhole cameras

Solargraphy technique:

- camera obscura (pinhole photography)
- self-photosensitivity of a b-w photographic paper
- no chemicals

Camera obscura



Camera Obscura



My dark room

Preparation



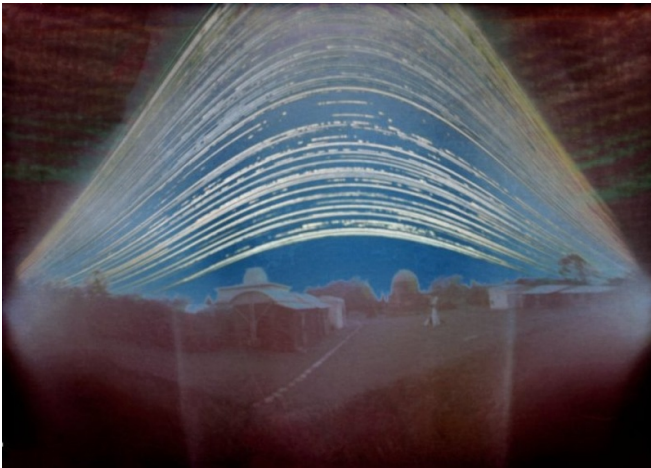
Solargraphy camera preparation from an aluminium 0.5l can.



Installed solargraphy cameras

After exposition

- Scanning
- Digital processing
 - Inversion
 - Flip
 - Color correction



Ondřejov Observatory, Czech Republic, June-December, 2008



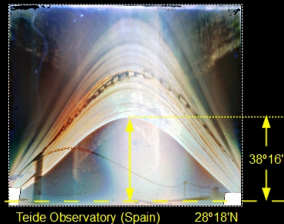
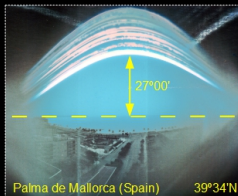
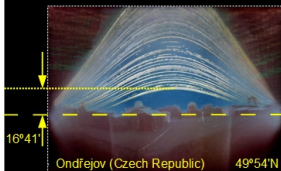
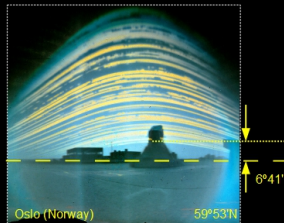
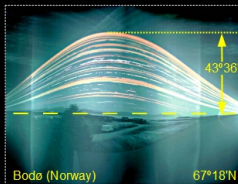
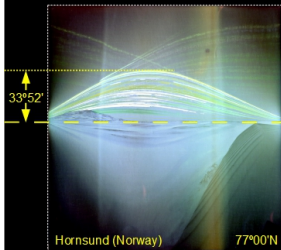
Reykjavik. Iceland. 9 days in February. 64°N

Credits: Tomasz Mrozek, Maciej Z.

Astronomy - Position of the Sun

Solargraphs in different locations

Compilation taken during period 2008-2015



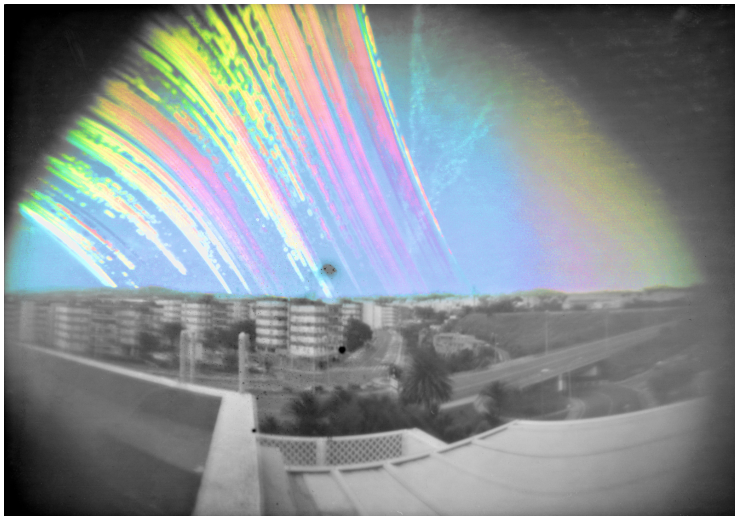
Credits: Hornsund - Daniel Kępski, Łukasz Mazurkiewicz, Łukasz Fajrowski, Piotr Modzel and Maciej Zapiór;
Bodo - Dawid Guzenda and Maciej Zapiór; Oslo, Ondřejov, Palma de Mallorca, Teide Observatory - Maciej Zapiór.
Thanks: Viggo Hansteen, Jan Stary, Ewa Klembek-Gomez, Pere L. Pallé.



Wrocław. Poland. 3 months (January 14 - April 24).

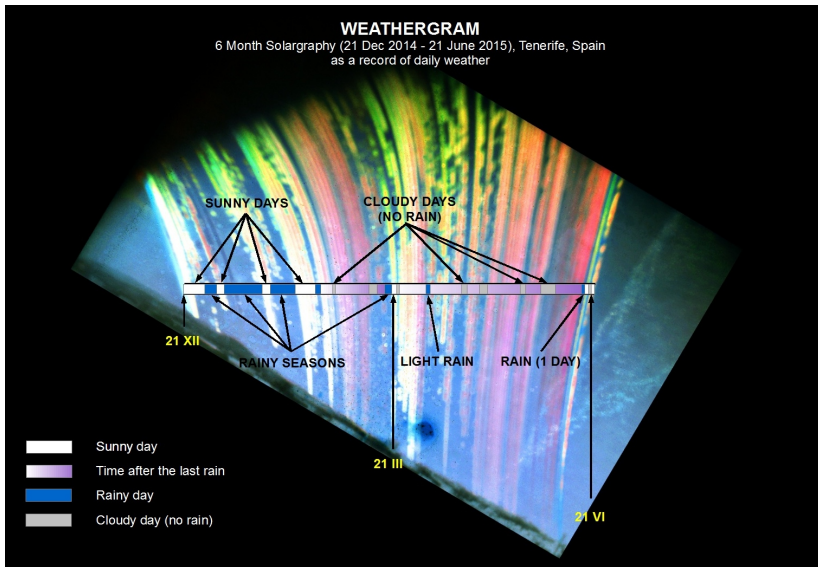
Jan - Apr sunshine hours: Wrocław - 384

Meteorology - rainy days

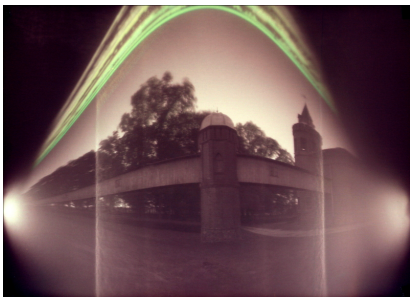


Tenerife. 6 months (21 Dec 2014 - 21 Jun 2015)
THX: Grzegorz Nowak (IAC)

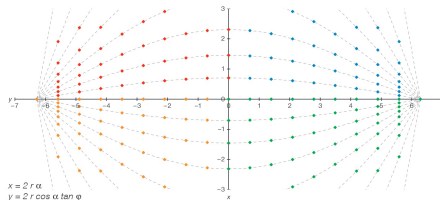
Meteorology - rainy days



Geometry/Optics - cylindrical projection



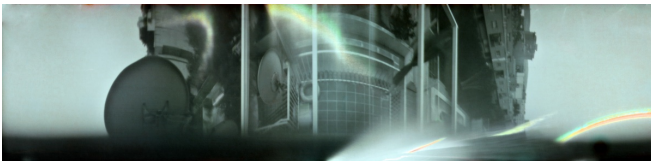
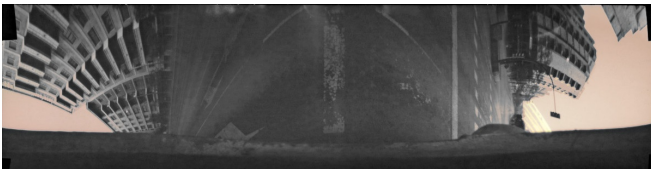
Białków, Poland. 2 months.



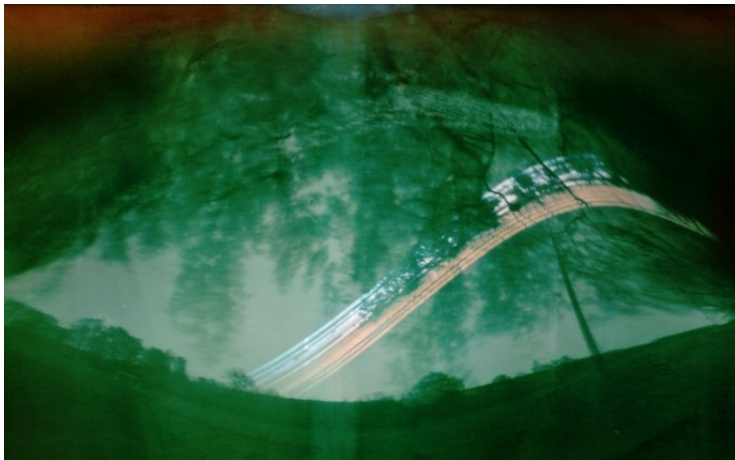
A representation of the projection of
altitude and azimuth in a cylindrical
pinhole camera.

Fosbury and Trygg, 2010.

Geometry/Optics - anamorphic projection



Biology - increase in biomass



Wrocław. Poland. 1 month (April 15 - May 15).

Psychology - single human activity



Wrocław. Poland. 1 month.



Palma. Spain. 2 months.



Białków Observatory. Poland. 5 months.

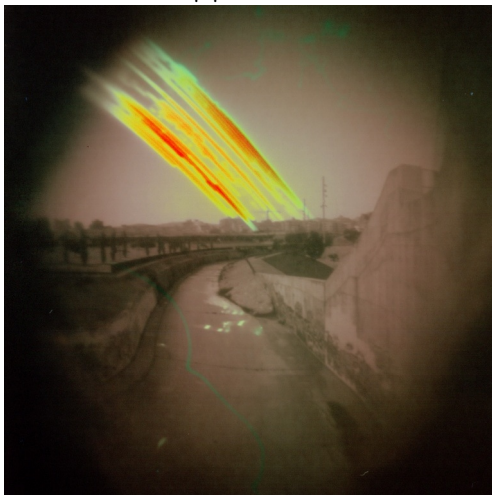


Wrocław. Poland. 1 month (February 16 - March 26).



Plaça Major. Palma. 1 month (September).

RAIN $\Rightarrow$ WATER $\cap$ SUN = SOLAR TRAILS



Parc sa Riera. Palma. 1 month (September).

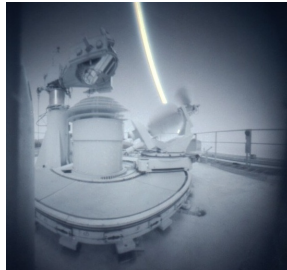
Solargraphy - what else?

- Handicraft
- Gastronomy
- Game
- Sport
- Art

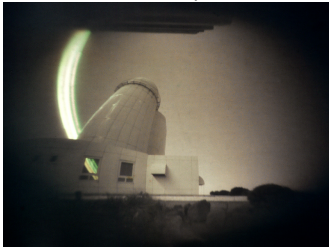
Solar Telescope, Ondřejov



VTT, Teide Observatory



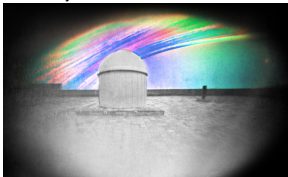
THEMIS, Teide Observatory



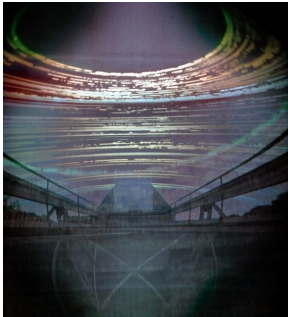
University of La Laguna



University of the Balearic Islands



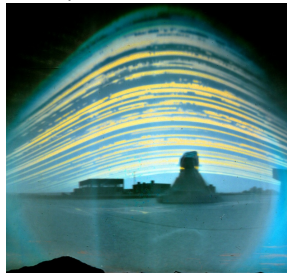
Large Coronagraph, Białków Observatory



Horizontal Telescope, Białków Observatory



University of Oslo



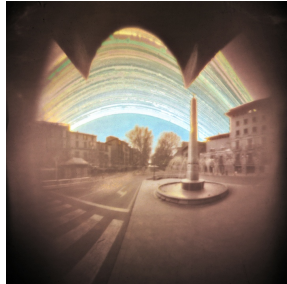
London



Prague



Wrocław

Palma de Mallorca

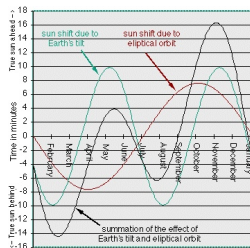
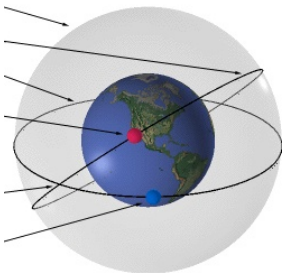
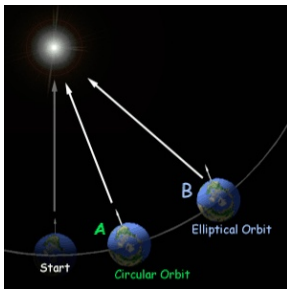


First succesful solargraphy analemma.

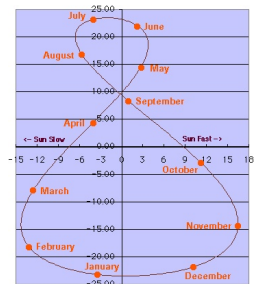
Wrocław, Poland (March 1, 2013 - March 1, 2014).

Credits: Maciej Z., Lukasz Fajfrowski; www.analemma.pl

Astronomy Picture of the Day; March 20, 2014



EQUATION-OF-TIME



ANALEMMA CURVE

The list of registered solar analemmas (not complete)

No.	Year	Author	Location	Method	No. of expositions	Remarks
1	1979	Dennis di Cicco	USA	analog	45	Single frame
2	1989	H.J.P. Arnold	UK	analog	40	Single + foreground
3	1991	Frank Zullo	USA	analog	38	Single + foreground
4	1999	Jack Fishburn	USA	analog	26	Single frame
5	1999	Vasilij Rumyantsev	Ukraine	analog	34	Single frame
6	2003	Anthony Ayiomamitis	Greece	digital	46	
7	2004	Juan Carlos Casado	Spain	analog	53	digitally processed
8	2005	Ivo Dinev	Romania	digital?	19	?
9	2006	Cenk E. Tezel & Tunç Tezel	Turkey	digital	32	composite
10	2008	Libor Judas (with: V. Dzedzicová, M. Krejčí, Š. Vejvančický)	Czech Republic	analog camera + digital processing	47	composite
11	2010?	Tamas Ladanyi	Hungary	digital	36	
12	2011	Paweł Janczaruk	Poland	analog, pinhole	30?	Single frame
13	2011?	Sharon F. Keisha	?	digital	21	
14	2012	Robert Pözl	Austria	digital		
15	2012	Thomas Hebbeker	Germany	digital	365	
16	2012	Tunç Tezel	Azerbaijan	digital	18?	composite
17	2013	Peter Hull	?	solargraphy	50	Single frame
18	2013	Robert Nufer	Schweizerland	movie	Every 1 minute	
19	2013	Pál Váradi Nagy	Romania	digital	26+1	composite
20	2013	Shiraishi	Japan	digital	50	
21	2014	Zapiór & Fajfrowski	Poland	solargraphy	365, 3 times a day	Single frame, 3 analemmas
22	2014	?	India	digital	26	
23	2014	György Soponyai	Hungary	digital	?	composite
24	2014	István Mátis	Romania	digital	?	composite
25	2014	Adrianos Golemis	Antarctica	digital	23	Composite. Only a half of the analemma visible, because of the polar night.
26	2014	Luca Vanzella	Canada	analog and digital	38+1	Single frame and composite

Solargraphy

- A new art (15 years). Need to be understood.
- May be used for educational purposes
 - Clearly shows the Sun position on the sky
 - Mean cloudiness may be deduced from a single image
 - Rainy periods may estimated
- It shows the world when our blink of an eye would last months or years
- Merges different techniques
 - camera obscura
 - photo-sensitivity of silver compounds
 - digital scanning and image processing
- Available for everybody

Further reading

- Zapiór: *Catch the Sun in a Can*, Sky & Telescope, 6/2015
- Fajfrowski and Zapiór: *O fotografowaniu analemy*, Urania - Postepy Astronomii, 6/2014
- Zapiór: *Solarygrafia - klamra czasu*, Urania - Postepy Astronomii, 3/2013
- Fosbury and Trygg: *Solargraphs of ESO*, The Messenger, (2010) **141**, 43
- www.analemma.pl

Thank you for your attention.

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