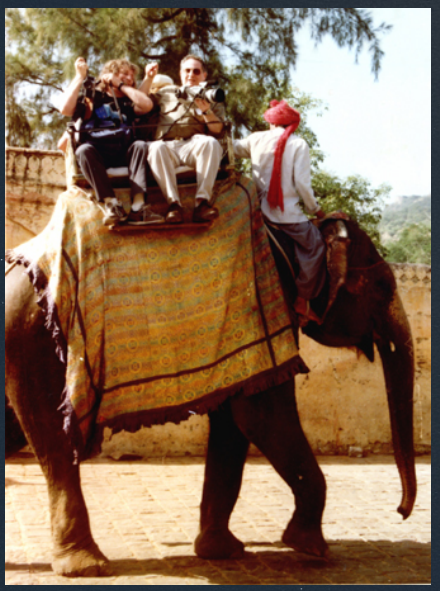
Umbraphilic Esoterica: A Retrospective Beyond Science & Technology

WARNING: Eclipse chasing is addictive. There is no cure.



Dr. Glenn Schneider
Steward Observatory, University of Arizona
Tucson, Arizona 85721 USA

center image by M. Druckmuller

This talk is dedicated to the memory of

Prof. David Peck Todd

(1855 – 1939)

The Eclipse-Chaser's Eclipse-Chaser

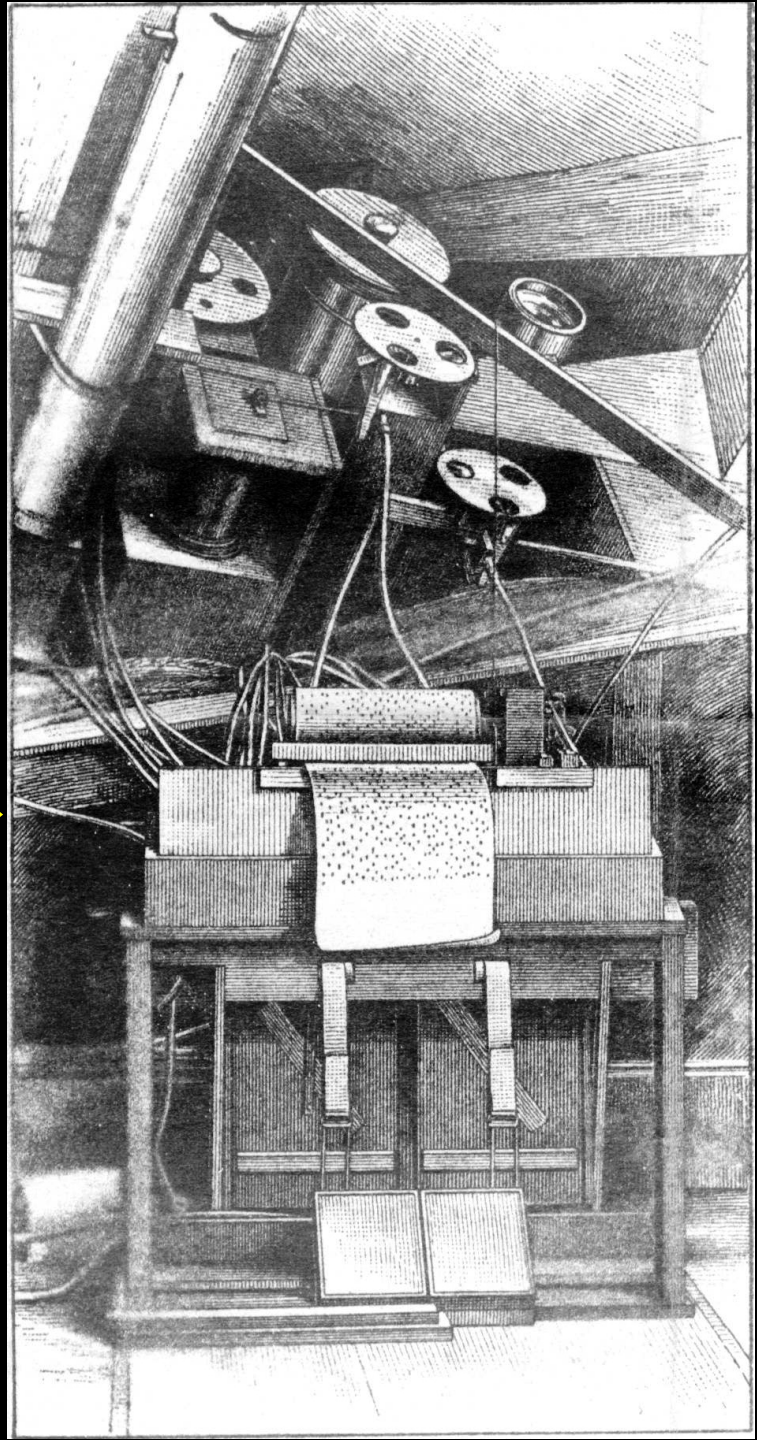
and inventor of

Automatic Eclipse Photography

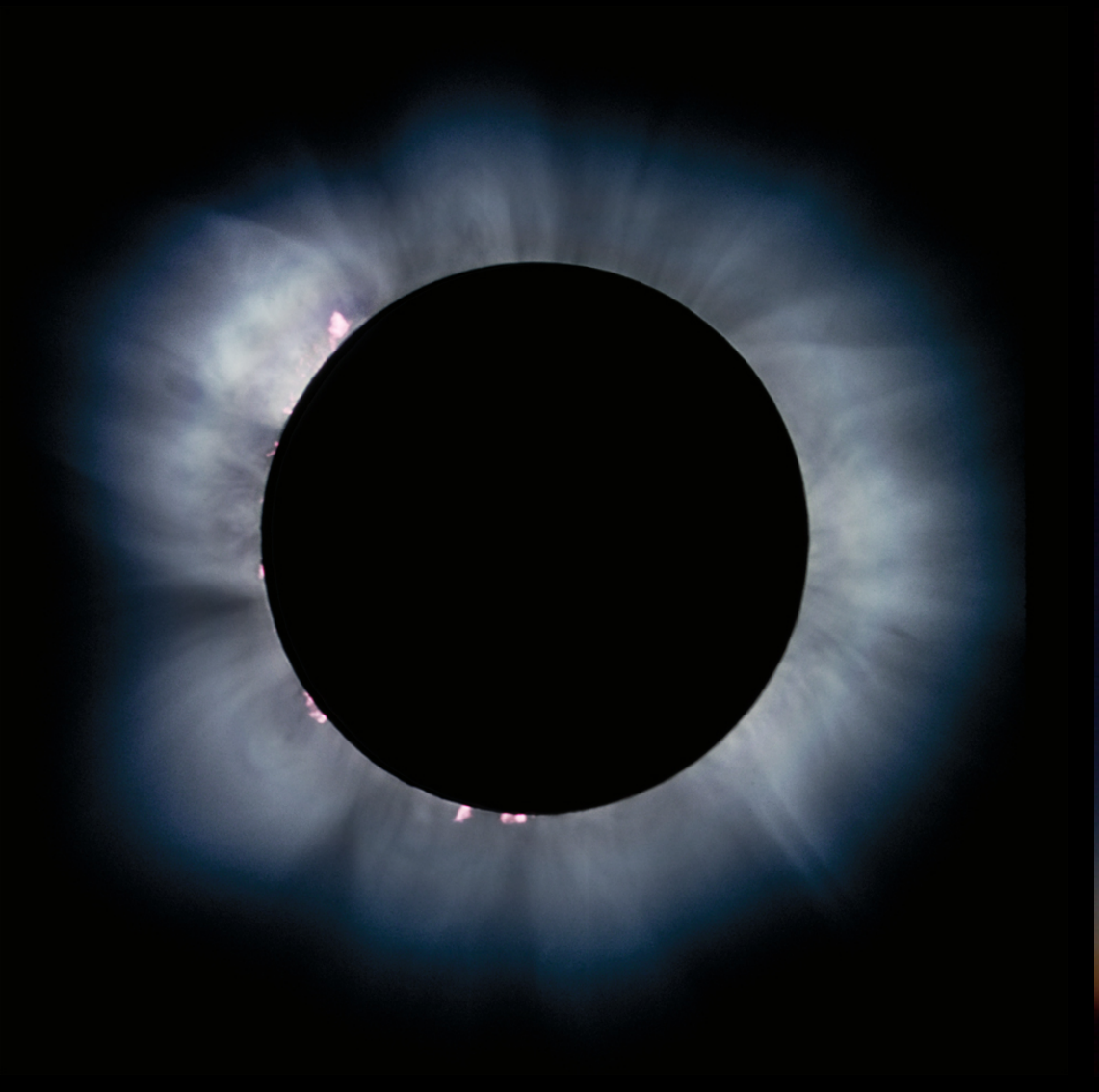
and

Radial Gradient (coronal) Imaging

(and much more…)



Science aside… A TOTAL Solar Eclipse is arguably *THE* most impressive and awe inspiring re-occurring natural phenomenon that humans can witness




The MOST Viscerally Dramatic
And Dynamic of ALL Celestial
Shadow Events

Ominous Beginnings

Umbra*phobia*

Total Solar Eclipses in Antiquity

- Universally Regarded as Portents of Dark Times
- Trans-culturally perceived as fearsome phenomenon
- "Predicted" to be forewarned not welcomed!

Intentionally "Chasing" the Moon's shadow INTO the "path of totality" is a relatively new endeavor in the course of human history

Enlightenment in the
Darkness of the Lunar Umbra

But
Things Don't Always
Go As Planned…

(the "early" days of eclipse chasing)

Intentionally "Chasing" the Moon's shadow INTO the "path of totality" is a relatively new endeavor in the course of human history

27 October 1780 AD – "Long Island", Penobscot Bay, Maine

HARVARD COLLEGE EXPEDITION

- Behind Enemy Lines During American Revolutionary War
- Eclipse path & circumstances calculated by Prof Samuel Williams
- Expedition financed by Board of War
- General court of Mass. Provided a State Galley (ship) for transport
- Instrumentation*: Multiple telescopes, chronometer, micrometer, thermometer…

*preserved in the Collection of Historical Scientific Instruments – Harvard University

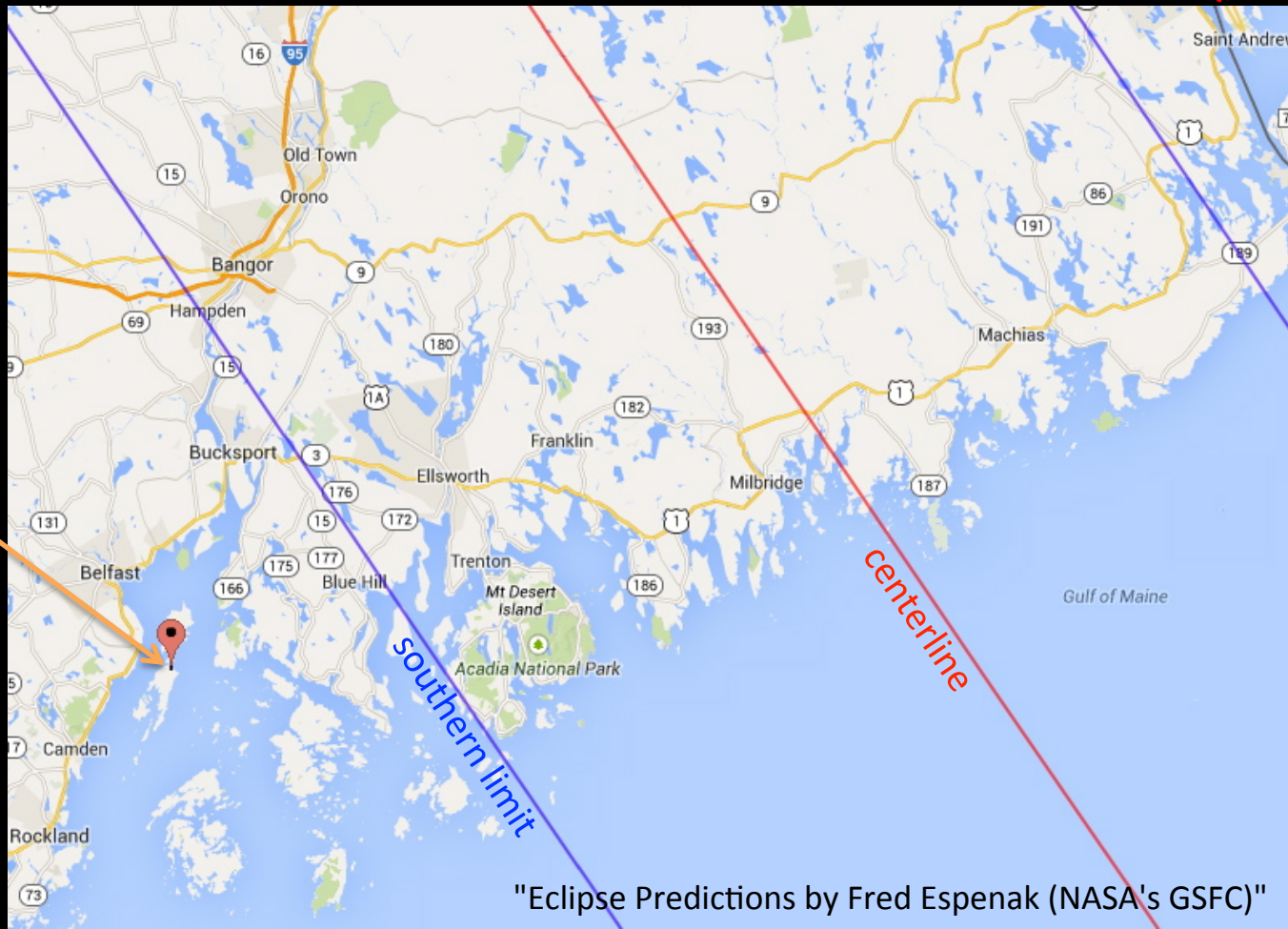
Intentionally "Chasing" the Moon's shadow INTO the "path of totality" is a relatively new endeavor in the course of human history

27 October 1780 AD – "Long Island", Penobscot Bay, Maine

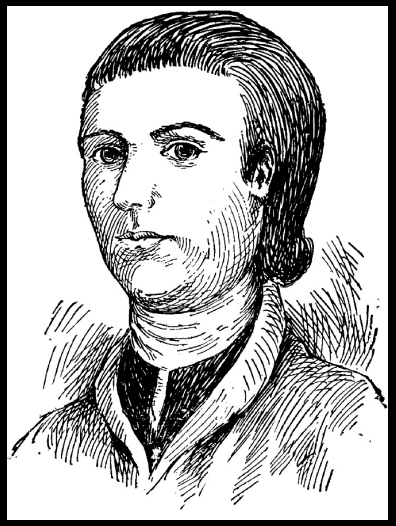
MISCALCULATED! - Outside Path of Totality

Iseslborough
"Long Island"
Penobscot Bay
Maine

max eclipse: 16:49:42 UTC
max obscuration: 99.6%
max magnitude: 0.994



Intentionally "Chasing" the Moon's shadow INTO the "path of totality" is a relatively new endeavor in the course of human history


Samuel Williams

27 October 1780 AD – "Long Island", Maine

"The greatest obscuration was at 12 hours, 30 degrees 12 minutes {?}, at which time the sun's limb was reduced to so fine a thread, and so much broken, as to be incapable of mensuration…

"From the beginning of the eclipse unto the time of the greatest obscuration, the color and appearance of the sky was gradually changing from an azure blue to a more dark or dusky color, until it bore the appearance and gloom of night. To this we may add, so unusual a darkness, dampness and chill, in the midst of day, seemed to spread a general amazement among all sorts of animals. *Nor could we ourselves observe such unusual phenomena without some disagreeable feelings.*"

Samuel Williams, "Observations of a solar eclipse, October 27, 1780, made on the east side of Long Island, in Penobscot-Bay," *Memoirs of the American Academy of Arts and Sciences* 1 (1785): 86-102.

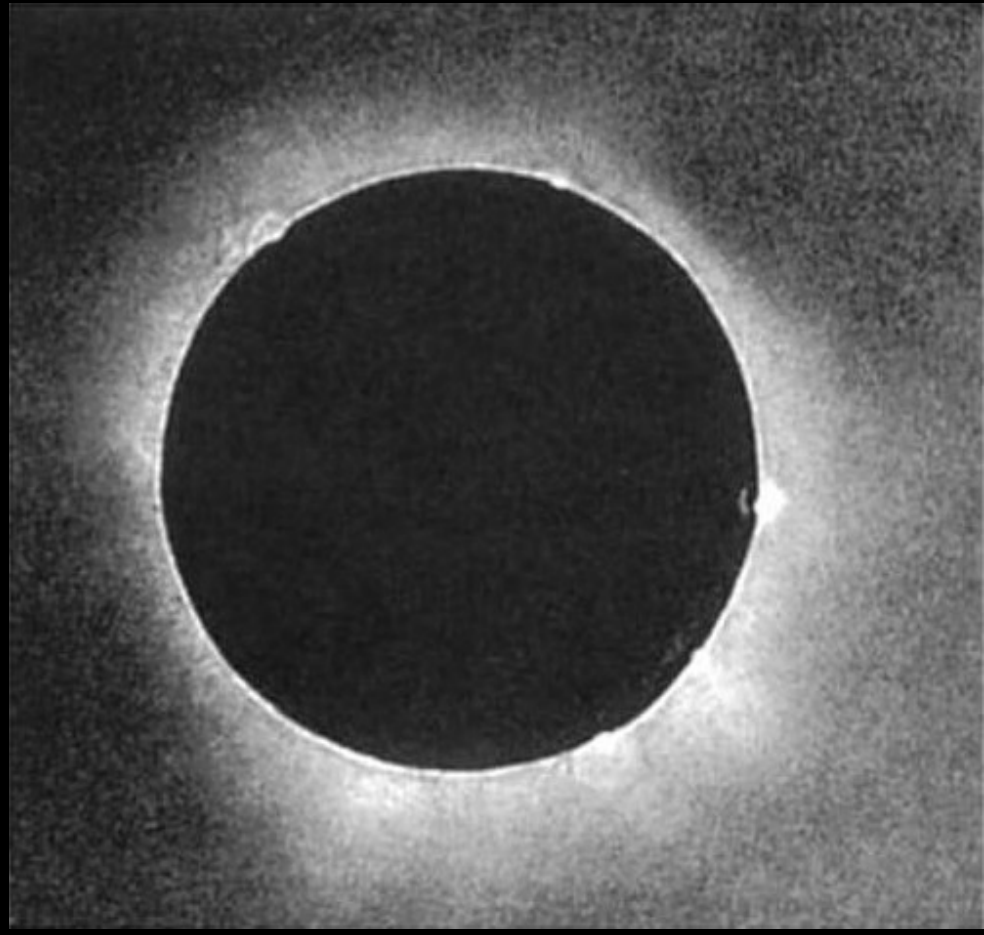
Enlightenment in the Darkness of the Lunar Umbra

The Age of Eclipse Photography 1851 — …

28 July 1851 (Konigsberg)

The Berkowski Daguerreotype

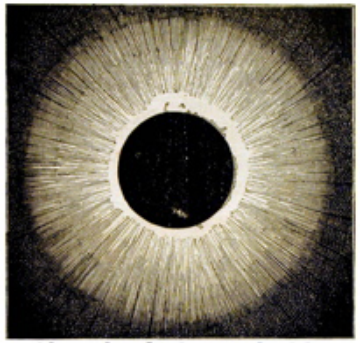
- The 1st known "*correctly exposed**" photograph (daguerre-otype) of the solar corona
- Single 84-second exposure
- D = 6.1 cm f/13.3 refractor on a clock driven mount
- Original plate: D_{moon} = 7.9 mm
- (Well) recorded corona and five prominences



But, for decades still to follow, sketches would continue to "compete" with fledgling photographic technologies.

*Schielicke & Whitman, Acta Historia Astronomiae, 25, 128 (2005)

Representative coronal sketches following the 1851 TSE daguerrotype

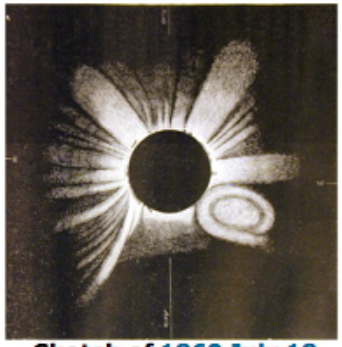


Sketch of 1851 July 28
(Secchi)

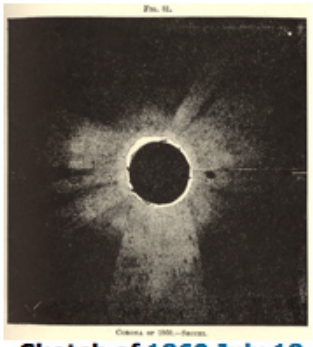
Sketch of 1853 November 30
(Moesta in Peru)

Sketch of 1857 March 25
(Emmanuel Liais in Mexico)

Sketch of 1858 September 7
(Emmanuel Liais in Brazil)



Sketch of 1860 July 18
(Tempel / Raynard
from Torreblanca, Spain)



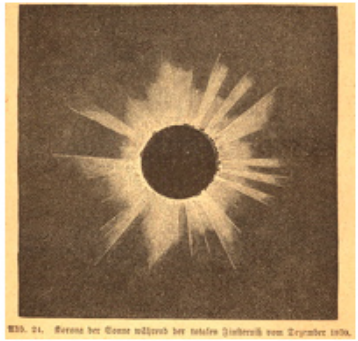
Sketch of 1860 July 18
(Secchi in Spain)

Sketch of 1860 July 18
(de La Rue
from Rivabellosa, Spain)

Sketch of 1867 August 29
(Grosch in Chile)

Sketch of 1868 August 18
(Bullock in the Celebes Sea)

Sketch of 1869 August 7
(Schott from Springfield IL, USA)



Sketch of 1870 December 22
(Janssen from Oran, Algeria)

Sketch of 1871 December 12
(Janssen from Shoolor, India)

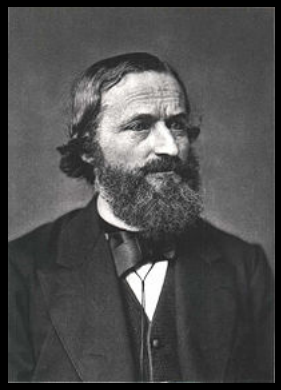
Images collected by X. Jubier: http://xjubier.free.fr/en/site_pages/solar_eclipses/Solar_Corona_Shape_pg01.html

Enlightenment in the Darkness of the Lunar Umbra

The Age of Eclipse Spectroscopy 1868 — …

Intentionally "Chasing" the Moon's shadow INTO the "path of totality" is a relatively new endeavor in the course of human history

The "Golden Age" of the Late 19th Century Professional Expeditions



G. Kirchoff
1824 - 1887

In 1858 Gustov Kirchoff theorized that "Fraunhoffer lines" seen in the *solar spectrum* were fingerprints of chemical elements in the Sun.

Intentionally "Chasing" the Moon's shadow INTO the "path of totality" is a relatively new endeavor in the course of human history

The "Golden Age" of the Late 19th Century Professional Expeditions

18 August 1868 Guntoor, India

Observed by Jules Janssen with a spectroscope.

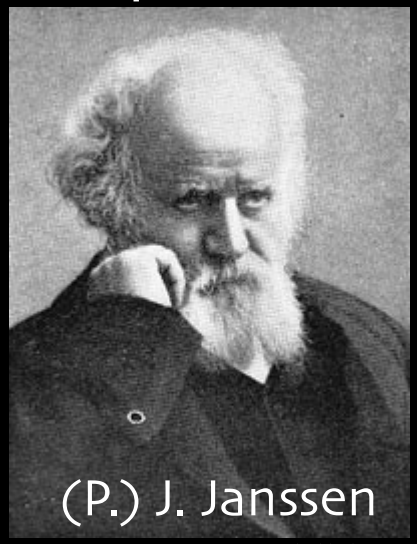
Goal: To study the nature of solar prominences.

- Spectroscopically identified super-hot Hydrogen

but also…

- a NEW chemical element then known on Earth: "Coronium"

(later "Helium" for the Sun God Helios).



(P.) J. Janssen
1824 – 19XX

Later (1895) identified on Earth as emanating from Uranium ore.

Today we know He on the Sun is Created by "nucleosynthesis": H->He

On Earth by nuclear decay. E.g., Uranium 238 → Thorium 234 + He 4

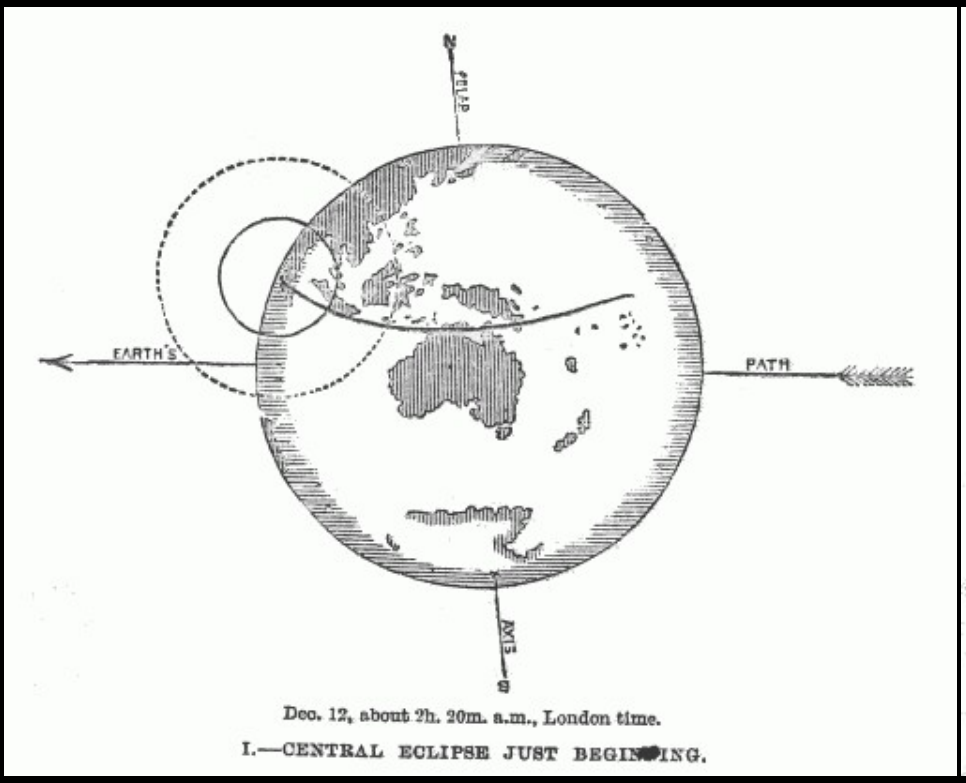
British/French TSE 1868 expedition to Thailand invited by King Rama IV

Intentionally "Chasing" the Moon's shadow INTO the "path of totality" is a relatively new endeavor in the course of human history

The "Golden Age" of the Late 19th Century Professional Expeditions

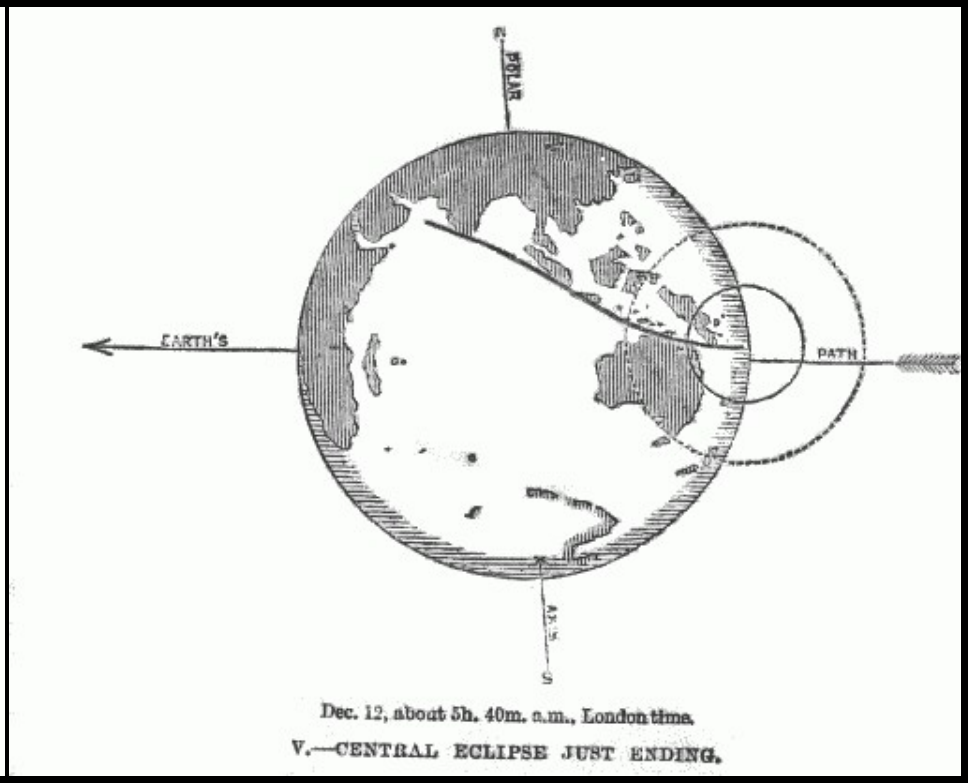
12 December 1871

International Deployments to Ceylon, India, Java, and Austalia to allow intercomparison of observations with similar instruments



Dec. 12, about 2h. 20m. a.m., London time.

I.—CENTRAL ECLIPSE JUST BEGINNING.



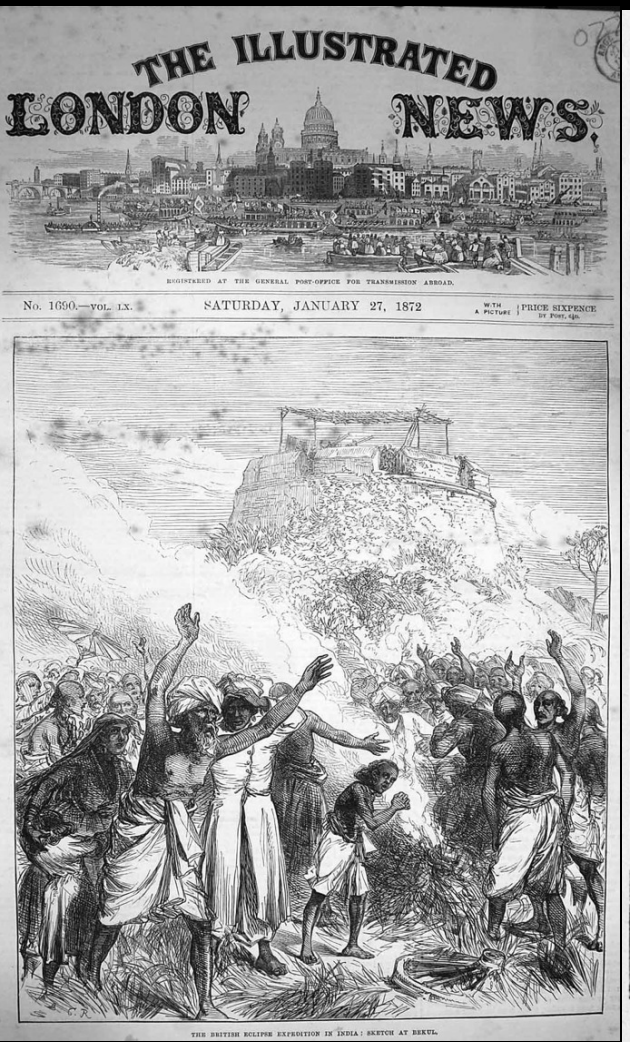
Dec. 12, about 5h. 40m. a.m., London time.

V.—CENTRAL ECLIPSE JUST ENDING.

Intentionally "Chasing" the Moon's shadow INTO the "path of totality" is a relatively new endeavor in the course of human history

The "Golden Age" of the Late 19th Century Professional Expeditions

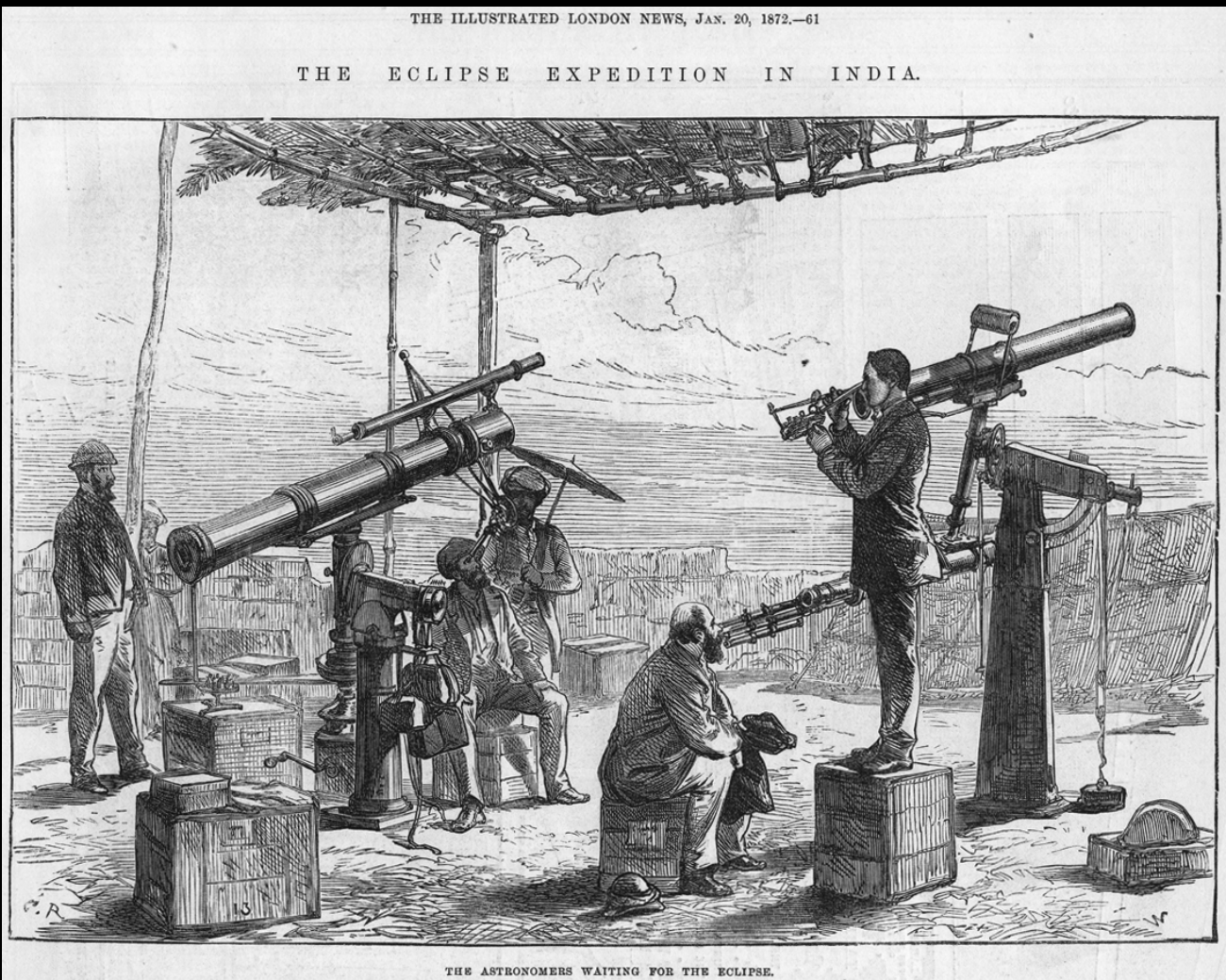
12 December 1871 – British Eclipse Expedition to India


THE ILLUSTRATED LONDON NEWS

REGISTERED AT THE GENERAL POST-OFFICE FOR TRANSMISSION ABROAD.

No. 1690.—VOL. LX. SATURDAY, JANUARY 27, 1872 WITH A PICTURE | PRICE SIXPENCE By Post, 6½d.

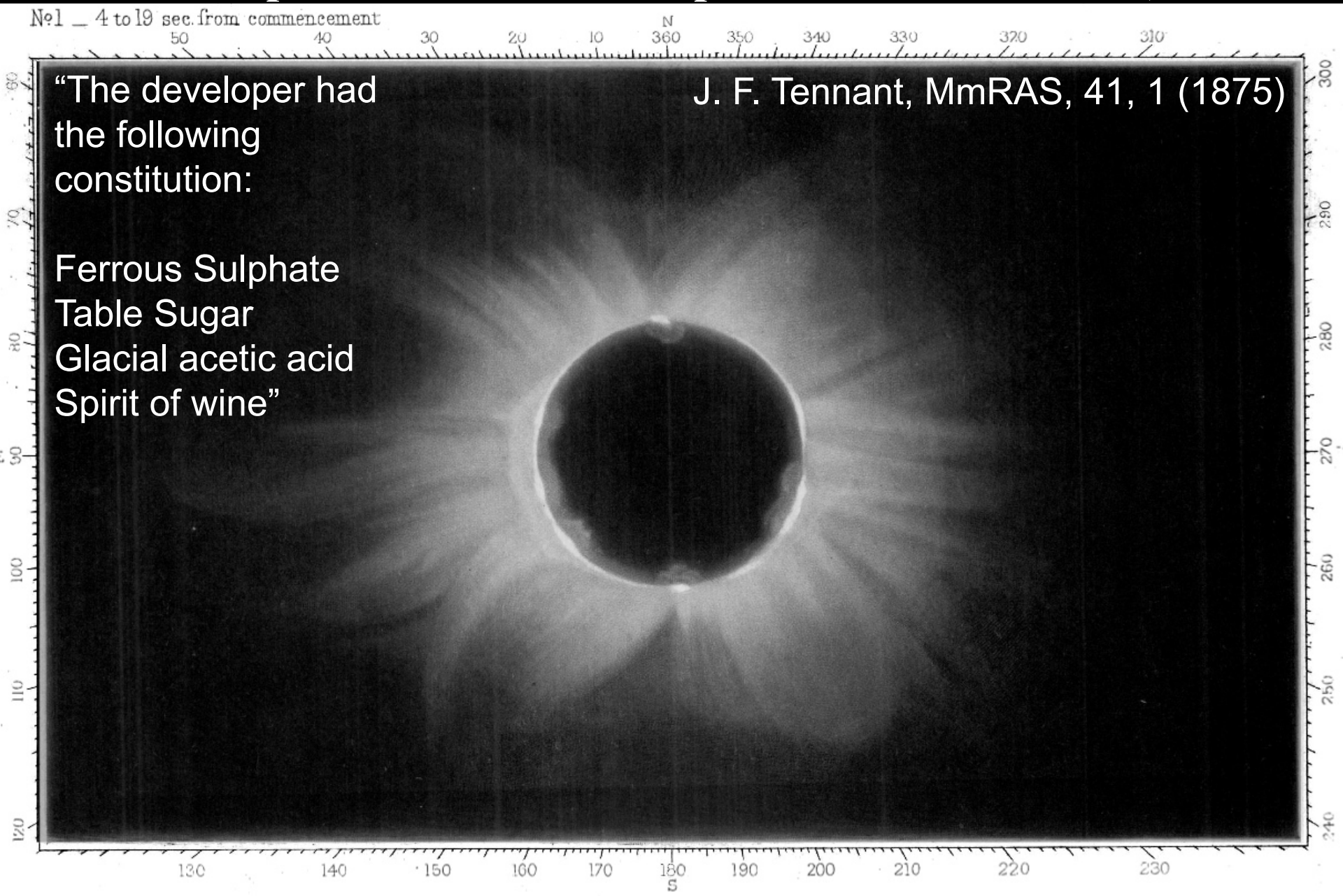
THE BRITISH ECLIPSE EXPEDITION IN INDIA: SKETCH AT BEKUL.


THE ILLUSTRATED LONDON NEWS, JAN. 20, 1872.—61

THE ECLIPSE EXPEDITION IN INDIA.

THE ASTRONOMERS WAITING FOR THE ECLIPSE.

Report on TSE 1871 from Dodabetta, India (2m 08s totality)
One of 6 plates obtained. 15s exp soon after CII. D = 4”, f/8.3



“The developer had the following constitution:

Ferrous Sulphate
Table Sugar
Glacial acetic acid
Spirit of wine”

J. F. Tennant, MmRAS, 41, 1 (1875)

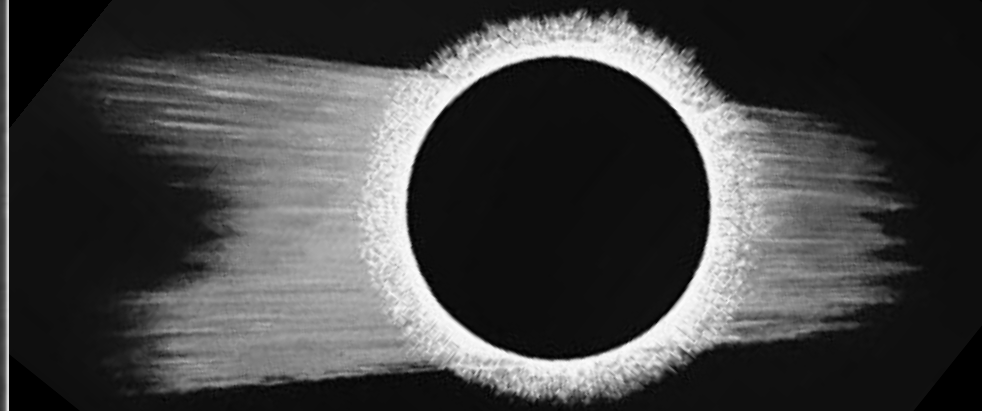
29 July 1878 – Fort Worth, Texas USA (near today's DFW airport)

The "Fort Worth Eclipse Party" … "recording such phenomena as might aid in establishing the correct theory of the corona … seen surrounding the sun during the moments of total solar eclipse".

29 July 1878 – Fort Worth, Texas USA (near today's DFW airport)

The "Fort Worth Eclipse Party" … "recording such phenomena as might aid in establishing the correct theory of the corona … seen surrounding the sun during the moments of total solar eclipse".

Best of three photographic images obtained (48" EFL, 17s exp) by Leonard Waldo



Naked-eye view of the corona drawn by Prof. S. H. Lockett

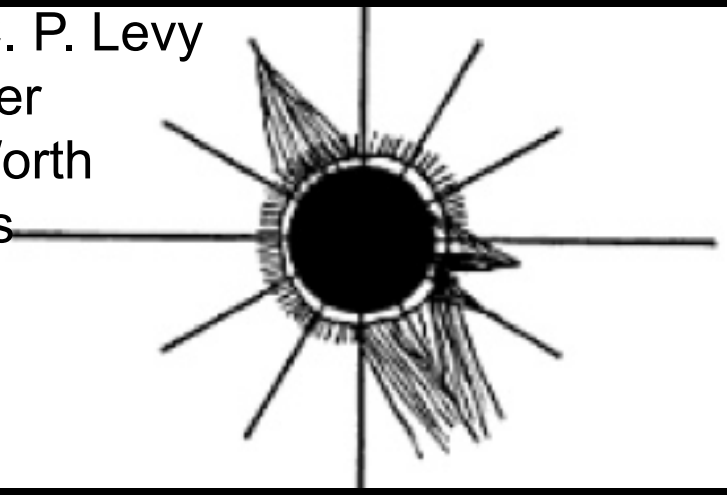
photography was still challenging!

"Report of Observations Made of the Total Solar Eclipse, July 29, 1878, Made at Fort Worth, Texas, ed. Leonard Waldo, Cambridge: Press of John Wilson and Son (1879)

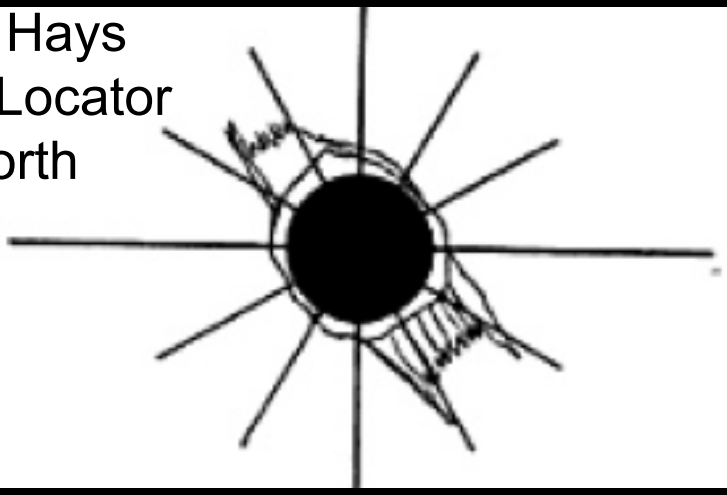
29 July 1878 – Fort Worth, Texas USA (near today's DFW airport)

The "Fort Worth Eclipse Party" … "recording such phenomena as might aid in establishing the correct theory of the corona … seen surrounding the sun during the moments of total solar eclipse".

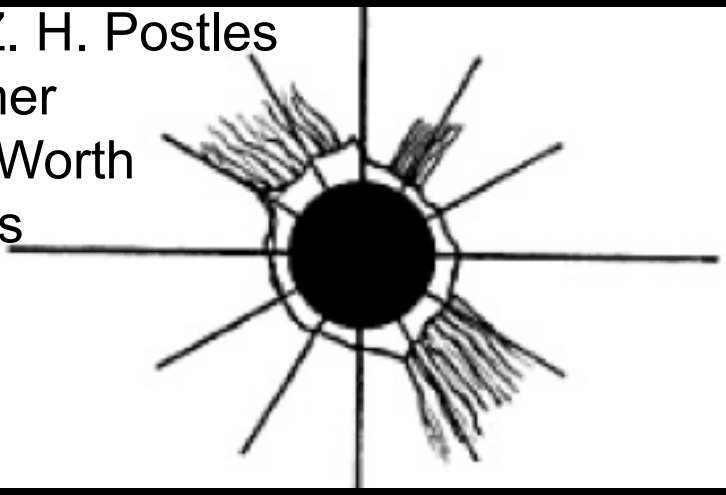
Mr. C. P. Levy
Builder
Ft. Worth
Texas



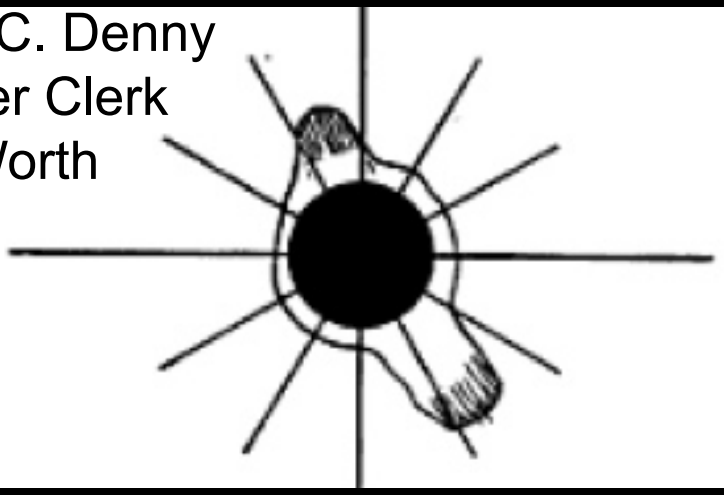
Mr. J. Hays
Land Locator
Ft. Worth
Texas



Mr. Z. H. Postles
Farmer
Fort Worth
Texas



Mr. J. C. Denny
Lumber Clerk
Fort Worth
Texas

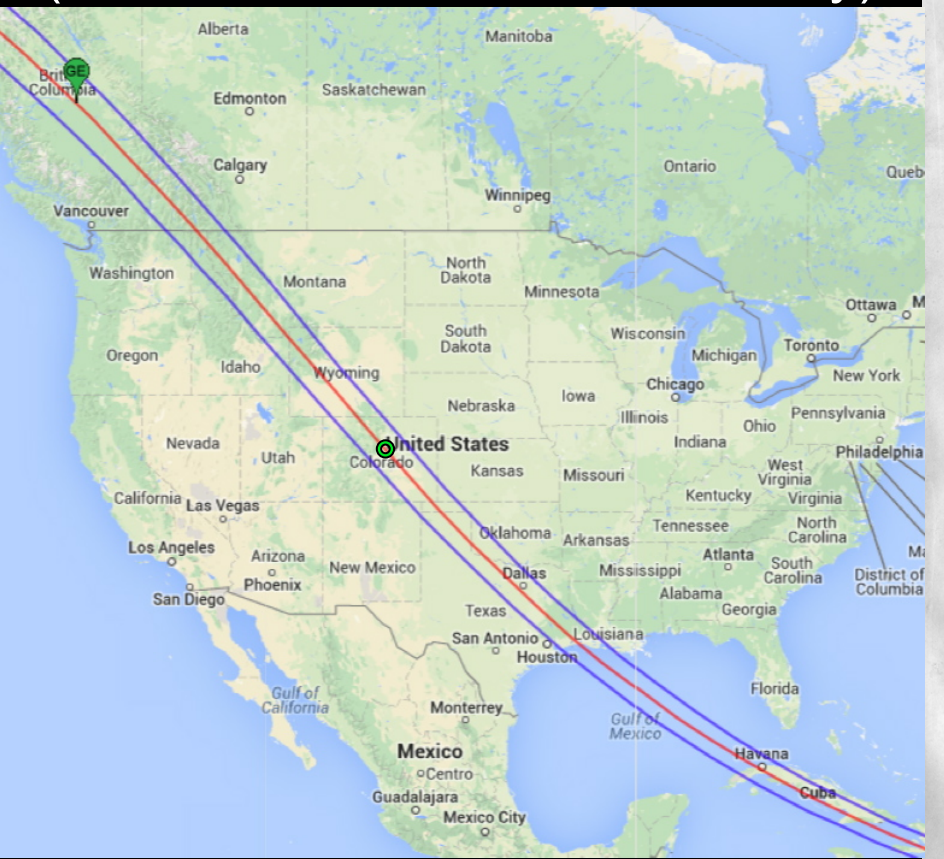


A 19th Century "Pro-AM" Collaboration

29 July 1878 – cross-country USA

"Eclipse Chasing" not yet in the contemporary lexicon, but serendipity (and the press) sparked viewing opportunites for many.

Snake River Pass, Colorado USA
(2,750 m AMSL, 2m 52s totality)



Though coronal photography was proving itself throughout the late 1800's as an enabling investigative technology. E.g.:

But, with the expanding quest for more (imaging) data…

"*The operation of 20 or 30 {photographic} instruments by hand is out of the question, even if human nerves were infallible.*"

– David Peck Todd 1897 (Astrophysical Journal, 5, 318)

Prof. David P. Todd (1855 – 1939)

USNO (1875 – 1878)
USNAO (1878-1881)
Amherst College (1881-1917+)

<u>Organized/Lead TSE RESEARCH EXPEDITIONS:</u>

29 JUL 1878	New England Expd. To Texas
19 AUG 1887	U.S. Expd. To Japan
22 DEC 1889	West Africa
09 AUG 1896	Amherst Exps. to Japan
28 MAY 1900	Lowell Expd. to Tripoli
18 MAY 1901	Amherst Expd. to Dutch East Indies
30 AUG 1905	Tripoli
21 AUG 1914	Amherst Expedition to Russia
08 JUN 1918	Florida
29 MAY 1919	Brazil/Argentina

Chief Astronomer at Lick Observatory @ 1882 Transit of Venus

Prof. David P. Todd (1855 – 1939)

In "On the Use of Electric Telegraph During Total Solar Eclipses", The Observatory, 4, 198 (1881)

"One of the most intractable considerations in the study of the Sun and its surroundings lies in the small amount of time which is availble for the prosecution of that study.

"Most of the phenomena in the neighborhood of the sun can be investigated only when the sun itself is hidden during eclipse.

"If we suppose a single observer to be prepared for the observation of all total solar eclipses in a century, … the entire amount of time … will not differ much from an hour.

We may be sure, then, of the expediency of any scheme whereby the rare moments of these {total solar} eclipses may be utilized to their utmost extreme."

Prof. David P. Todd (1855 – 1939)

In "Automatic Photography of the Corona", The Astrophyscial Journal, 5, 319 (1897)

"My attention was first called to this subject… on the return of the government expeditions to Washington {from TSE 1887 in Shirakawa, Japan}. Excellent photographs had been obtained, but the number of instruments available … and photo-graphs obtainable by hand-exposure struck me as exceedingly meager for an occasion… like a total eclipse of the Sun."

"the money value of a single second is often hundreds of dollars"
{*inflation: $100 from 1878 to 2014 → $ 2300 in RY2014 $ USD*}

"this would be true even if the human mechanism remained unperturbed under the strain of totality; but sad experience shows its frailty… no matter how constantly rehearsed."

Prof. David P. Todd (1855 – 1939)

The "father" of automatic eclipse photography
Inventor of the "Eclipse Commutator"

In "Automatic Photography of the Corona", The Astrophyscial Journal, 5, 319 (1897)

{regading TSE 1889, West Africa} "The operation of 20 or 30 instruments by hand is out of the question, even if human nerves were infallible to accomplish the desired end by mechanical devices…"

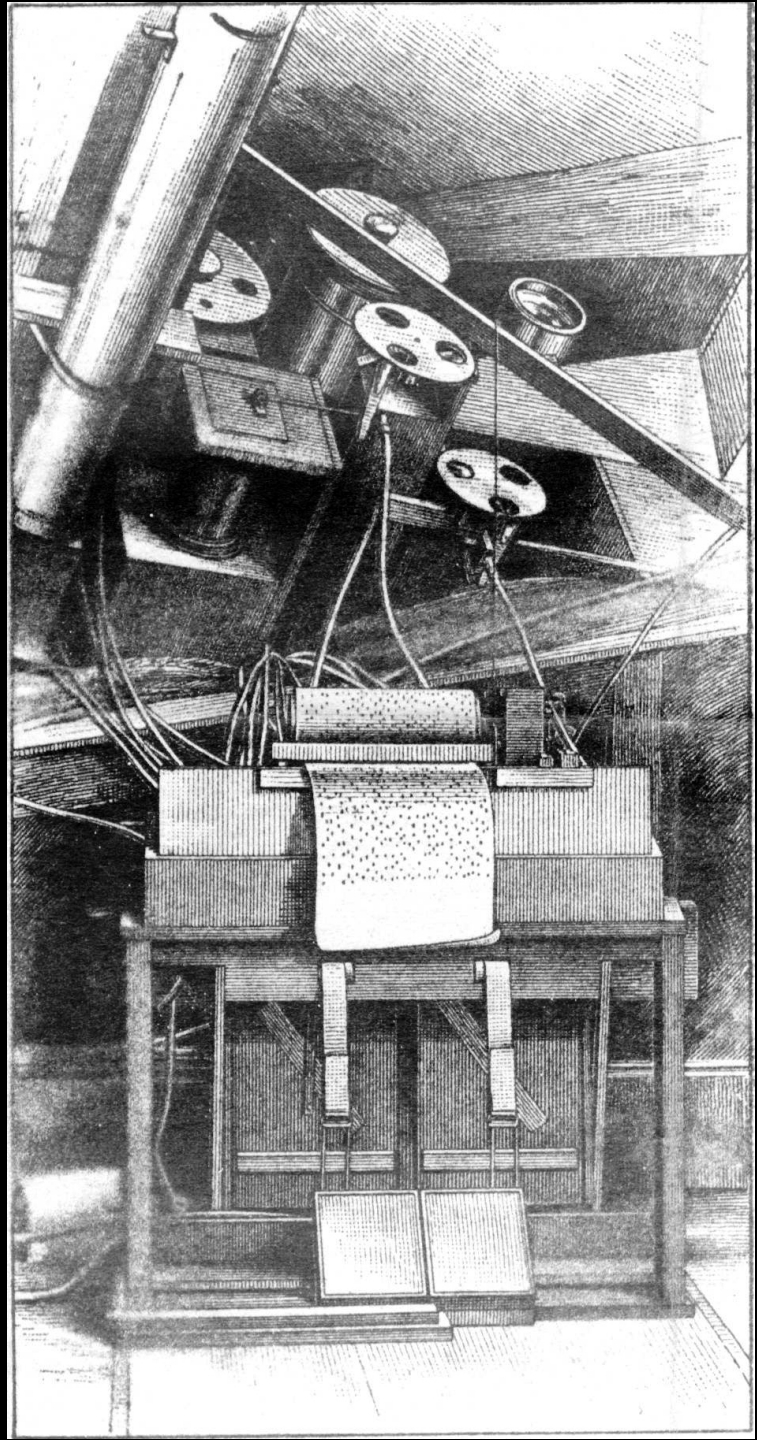
"a *complete pneumatic system of automatic instruments** had been worked out and constructed {and} demonstrated for the 1st time practicable for a few observers in the field ." – D. P. Todd (ApJ, 5, 319)

* "The principle of the device was a pneumatic commutator which exercised perfect and automatic control over a score of telescopes and cameras for different purposes." – M. T. Bingham (P.A., 33, 631)

The Pneumatic Commutator and Photographic Battery of Eclipse Instruments as mounted at Cape Ledo, Africa for TSE 1889

- 23 (mostly photographic) instruments
- ALL co-mounted and co-aligned on a single polar axis drive
- Using punched-paper "music roll" with digital program to control camera shutters, aperture wheels, plate mechanisms, etc.
- Using player pump-organ and pneumatic tubes for air pressure delivery and operation
- worked *perfectly* – but: "*unfortunately an accident of the day in the shape of an un-timely cloud precluded totality-pictures*"

– D. P. Todd (ApJ, 5, 319)

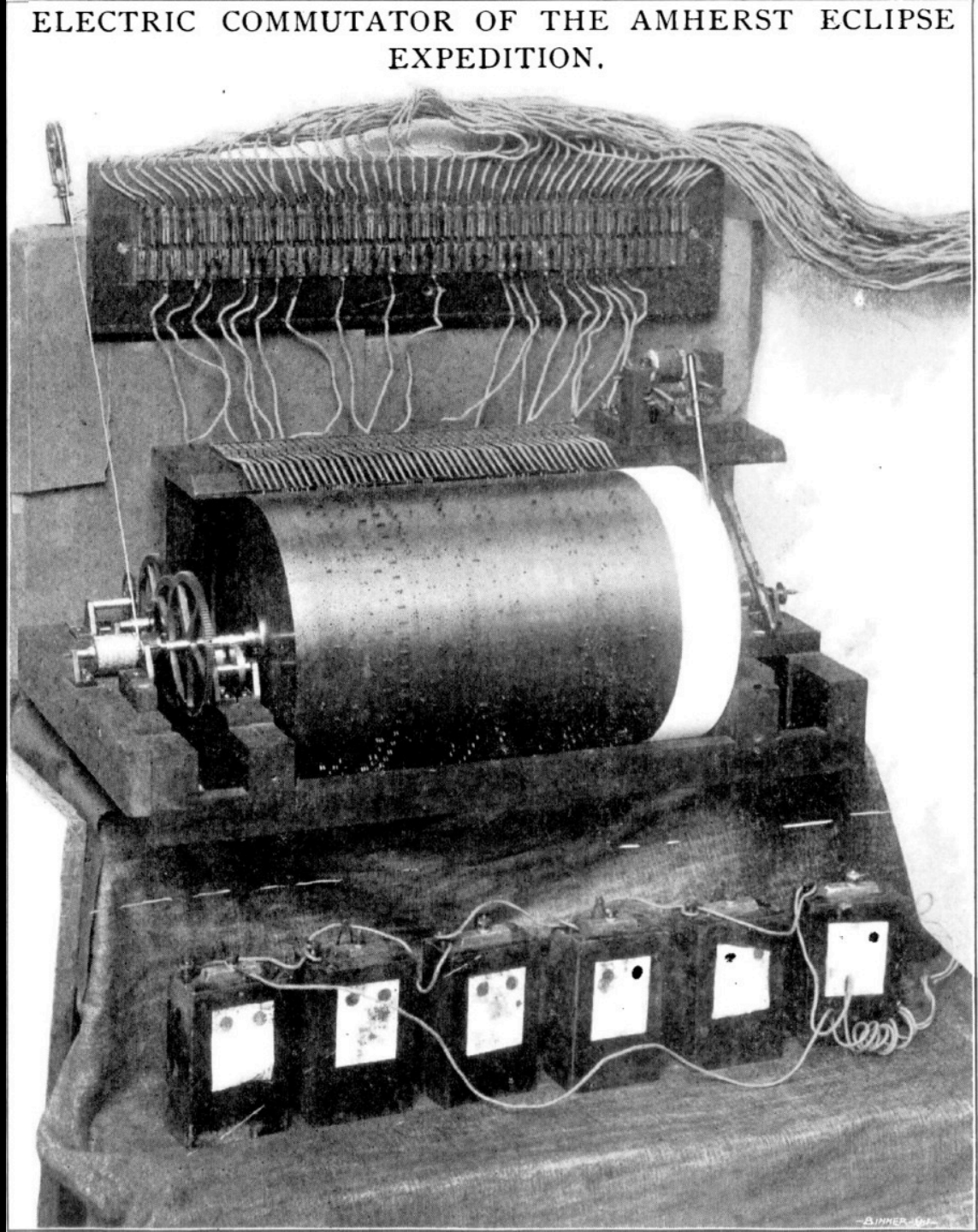


Prof. David P. Todd

- TSE 1896 (Japan):
  Pneumatic system replaced by electrical.
  Pipes → Wires
  Valves → Relays/Actuators

  Simplified construction and operation.

"perfectly competent to operate any number of eclipse Instruments… accurately, positively & <u>makes a time record</u> of every automated movement."

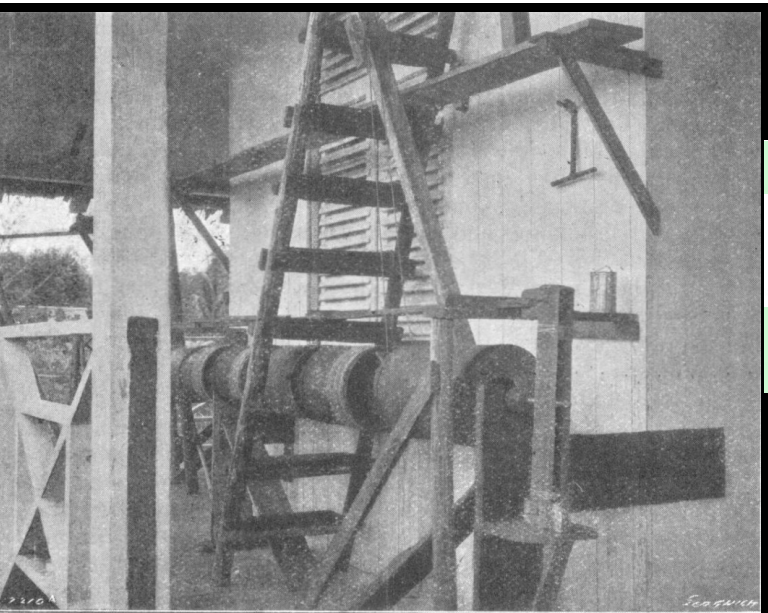


TSE 1901 (6m 20s; Sinkep) and the Mechanical Commutator

"The Amherst Eclipse Expedition… of 1901 led rather unexpectedly to the devising and construction of a modified type of commutator for operating eclipse instruments automatically."

But before setting to work, I had to be sure that the necessary wood and metal were present, on an island remote from supplies,

Prowling about the shops for mechanical plunder, I discovered the company's junk-heap, and its quiescent equatorial slumber was soon broken. A dozen 12-in. oil-drums mounted axially upon a 2-in. steam-pipe, 15 feet long, formed the basis of the commutator. Each drum was fitted with a collar and set-screw,



Here, then, was a commutator of the clumsiest possible type, but very positive in its results, as a Malay discovered to his sorrow one day when the strong cord, which unwound from its axle to drive the jackscrew under the equatorial mounting, pinched in two of his fingers, greatly to his chagrin and equally to the delight of the Chinese who built it.

- JBAA, 12, 169 (1902)

Prof. David P. Todd

"Fifty years have now elapsed since the Sun's corona was first daguerreotyped… it {is} an open question whether … wet-plate pictures of the corona will ever be surpassed … except by the adoption of some device for reducing the actinic effect of the innermost corona."

– MNRAS, 61, 531 (1901)

TODAY (163 years since…):

- High Dynamic Range Imaging with Electro-Optical Detectors.
- Digital Image Combination for High Signal-to-Noise Recovery
- Numerical Spatial-Filtering in Image Post-Processing

E.g., TSE 2013, M. Druckmuller, M2V Project

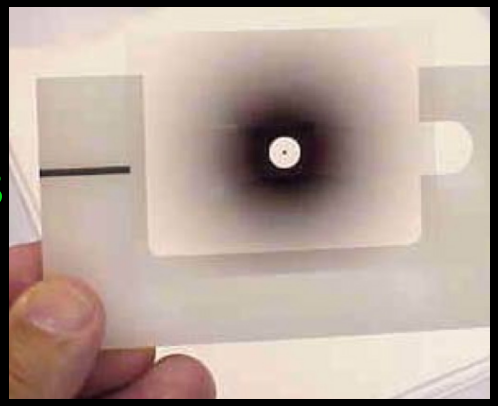
Prof. David P. Todd

"Fifty years have now elapsed since the Sun's corona was first daguerreotyped… it {is} an open question whether … wet-plate pictures of the corona will ever be surpassed … except by the adoption of some device for reducing the actinic effect of the innermost corona."

– MNRAS, 61, 531 (1901)

Circa 1970 – 1990 (film imaging):

- Radial deposition on glass substrate filters
- Transmissivity matching average coronal radial brightness profiles
- Mounted in image plane



E.g., TSE 1999, W. Carols & J. Kern

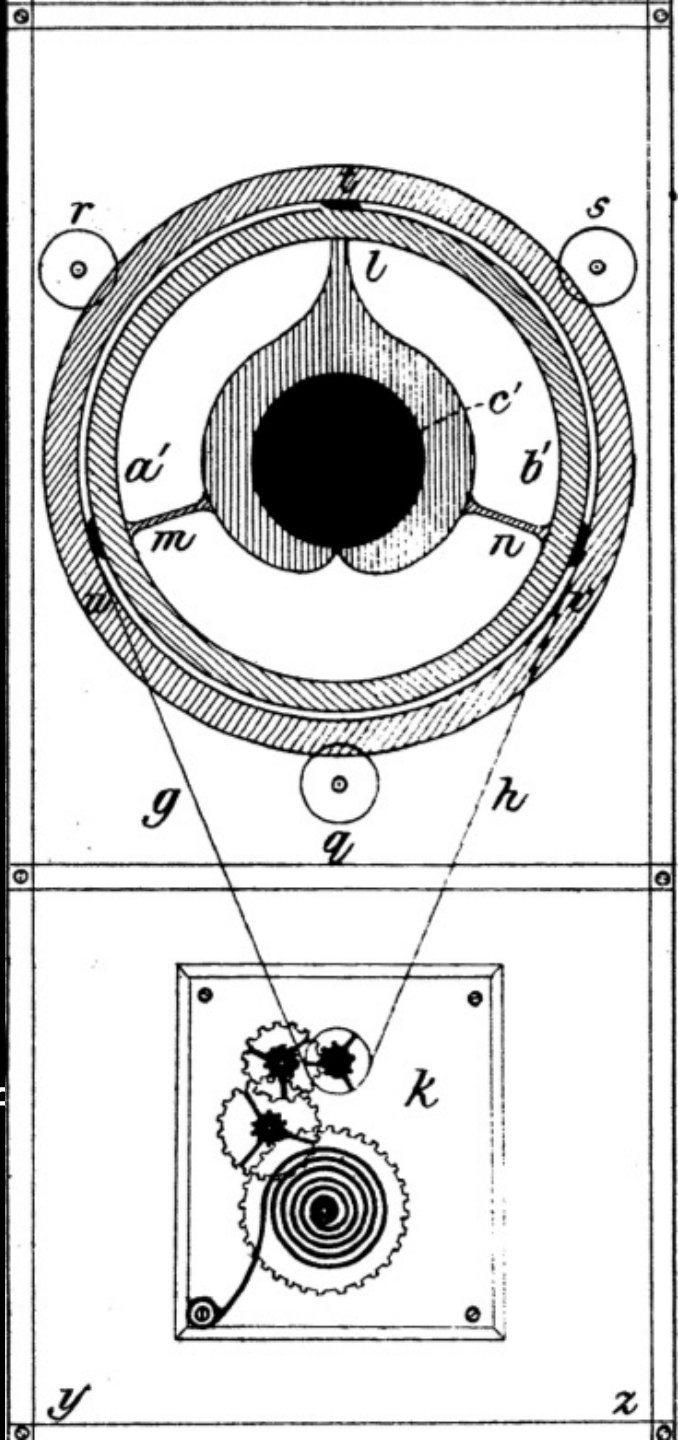
Prof. David P. Todd

- Also, designed the 1st radial gradient (focal plane) "filter"!

"On a Modified Form of the Revolving Occulter for Adapting the Exposure of the Sun's Corona to it's Actinic Intensity at All Distances from the Moon's Limb."

– MNRAS, 61, 531 (1901)

"Fifty years have now elapsed since the Sun's corona was first daguerreotyped... it {is} an open question whether ... wet-plate pictures of the corona will ever be surpassed ... except by the adoption of some device for reducing the actinic effect of the innermost corona."



Intentionally "Chasing" the Moon's shadow INTO the "path of totality" is a relatively new endeavor in the course of human history

28 May 1900

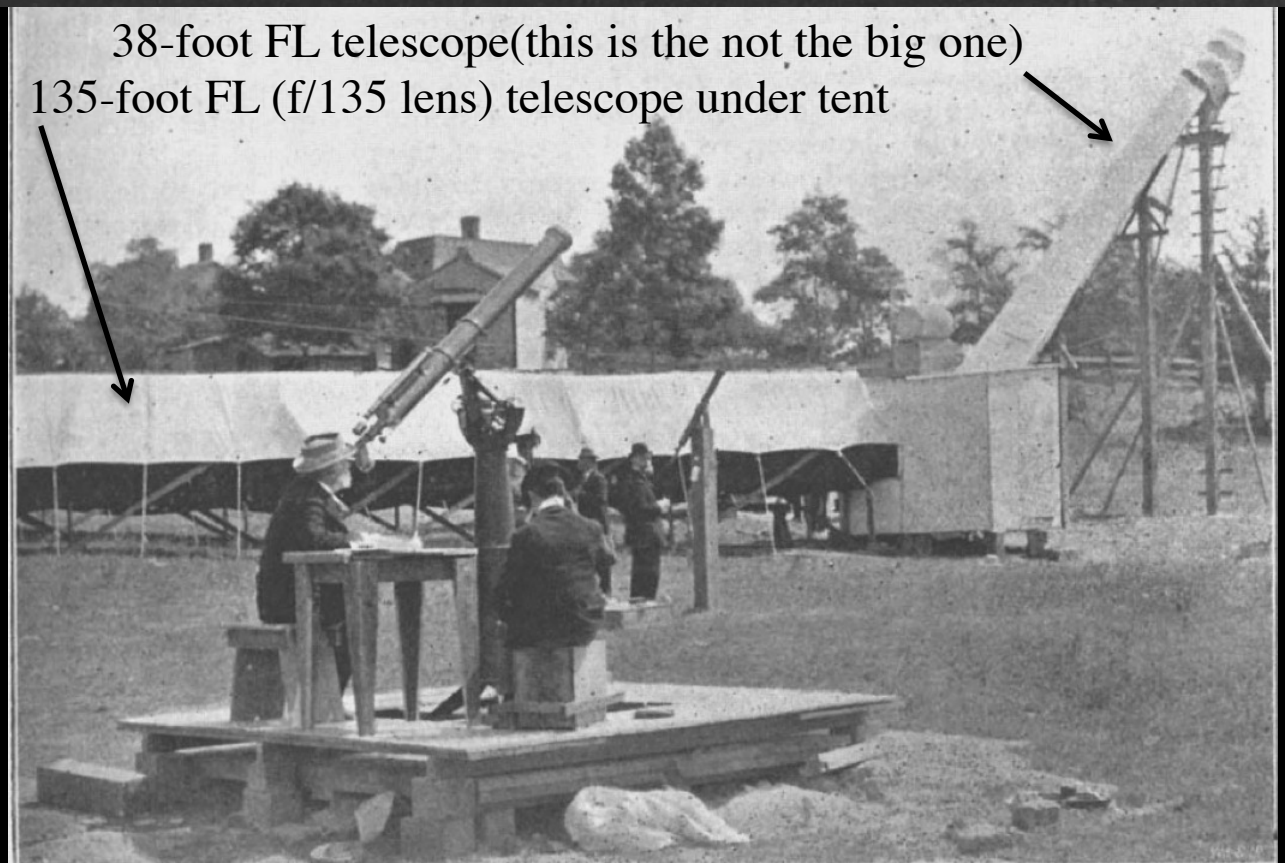
Smithsonian Institution Expedition

Wadesboro North Carolina USA

Goal: High Resolution Photography: Corona and Intra-Mercurial Planets

The Age of "Big Glass" and Big Plates

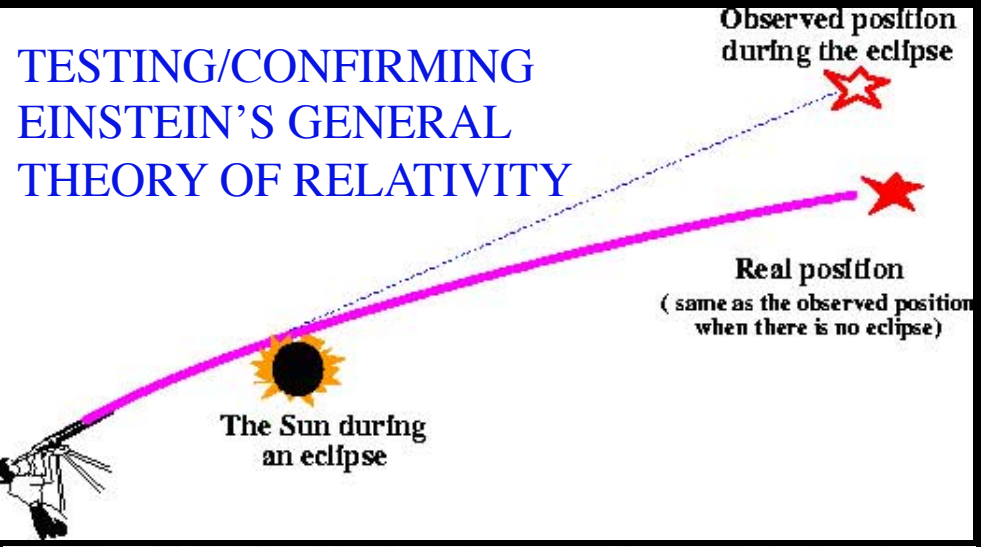
15-inch dia. Prime focus lunar disk image

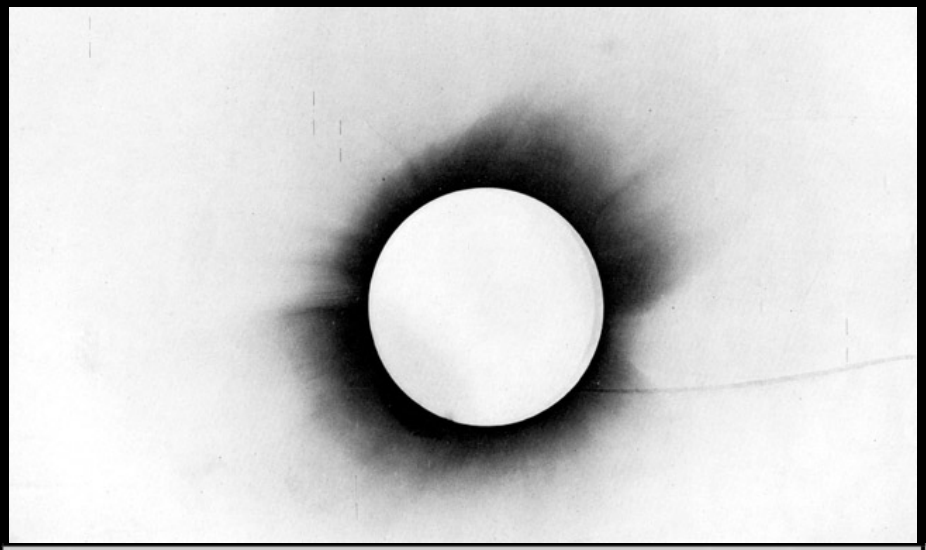


Intentionally "Chasing" the Moon's shadow INTO the "path of totality" is a relatively new endeavor in the course of human history

The Age of "Big Science"

TESTING/CONFIRMING
EINSTEIN'S GENERAL
THEORY OF RELATIVITY





Eddington Expedition
Sobral Brazil
May 29, 1919

40 ft Camera
Eight Mile Beach
NW Australia
Sep. 21, 1922

Egalatarian Eclipse Chasing In the 20th Century

The Three Great Transformational Technologies Introduced in The 20th Century Enabling "Egalitarian" Eclipse-Chasing

The Airplane

1903

- Easy, Rapid, Global Deployment
- Altitude: Rise Above Clouds
- Speed: Prolong Totality
- Contingency Mobility

2003

The Airplane

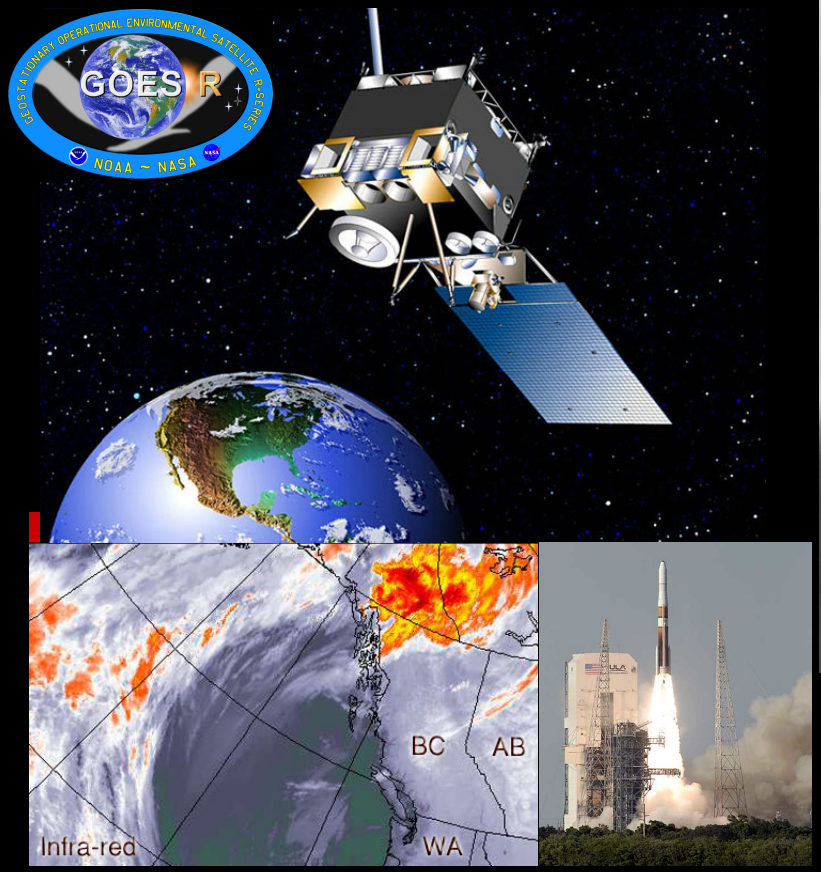
The Three Great Transformational Technologies Introduced in The 20th Century Enabling "Egalitarian" Eclipse-Chasing

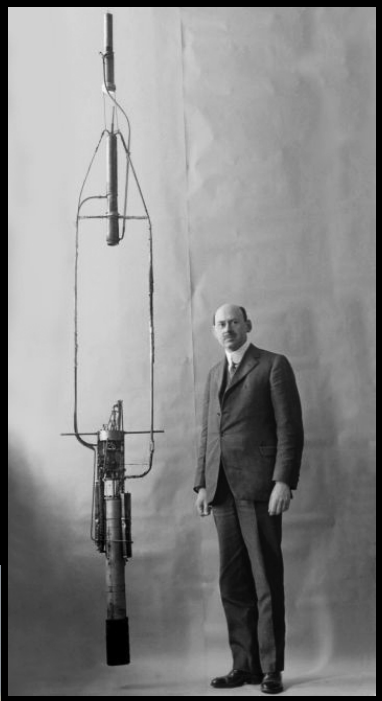
Aircraft also Provide a New, High-Altitude Vista for Observing Solar Eclips Phenomenon

The Three Great Transformational Technologies Introduced in The 20th Century Enabling "Egalitarian" Eclipse-Chasing

Modern Rockets

Weather Monitoring & Informed Forecasting





1926

Global Positioning & Precision Navigation

Instantaneous Global Telecommunications

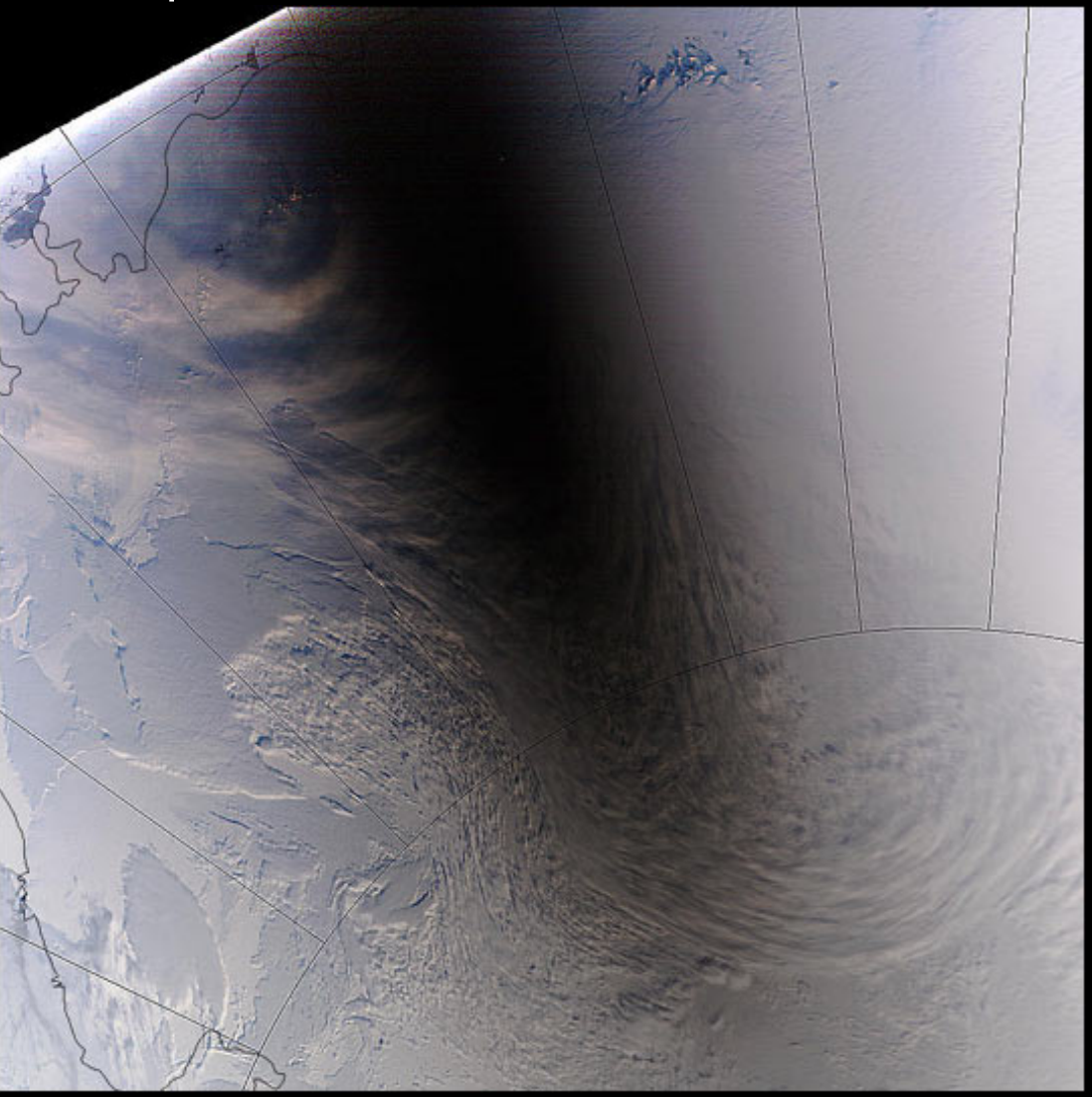
ISRO Eutelsat W2M

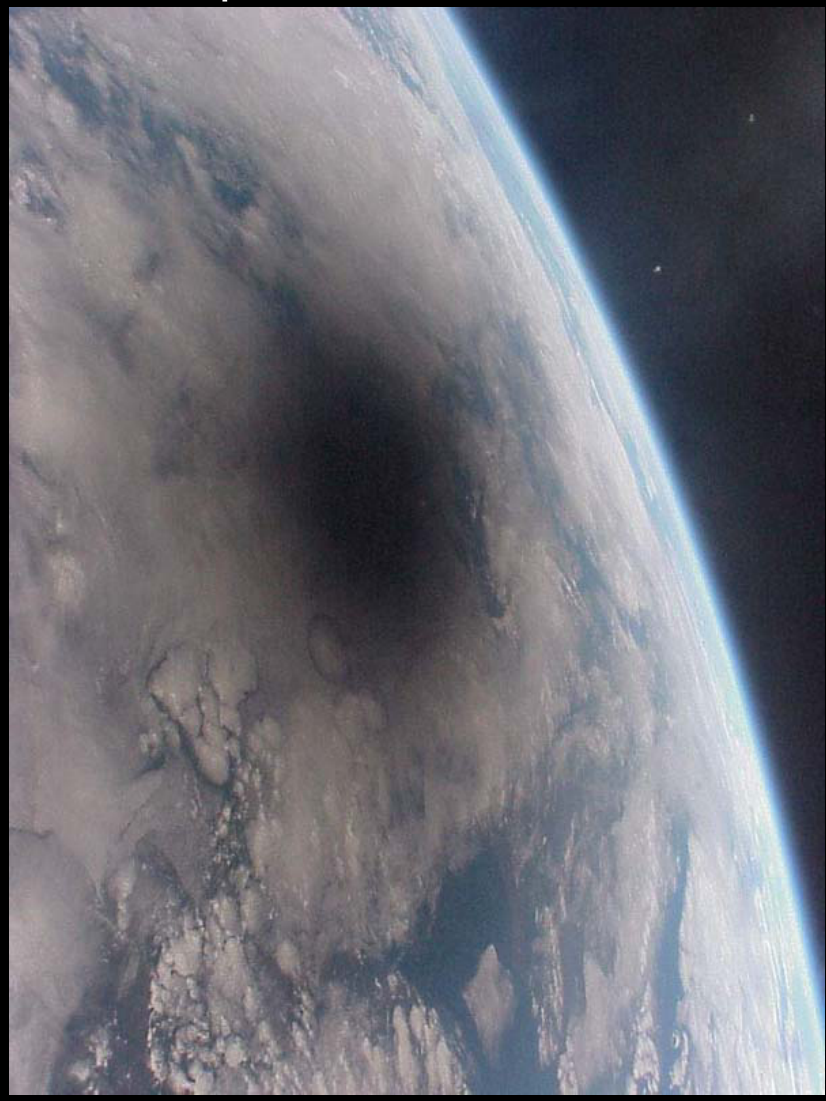
Enabled Deployment of Space Assets

(increasing reliant on micro-electronics)

The Three Great Transformational Technologies Introduced in The 20th Century Enabling "Egalitarian" Eclipse-Chasing

Space Assets also Provide a "New View" of SE Impacts on the Earth

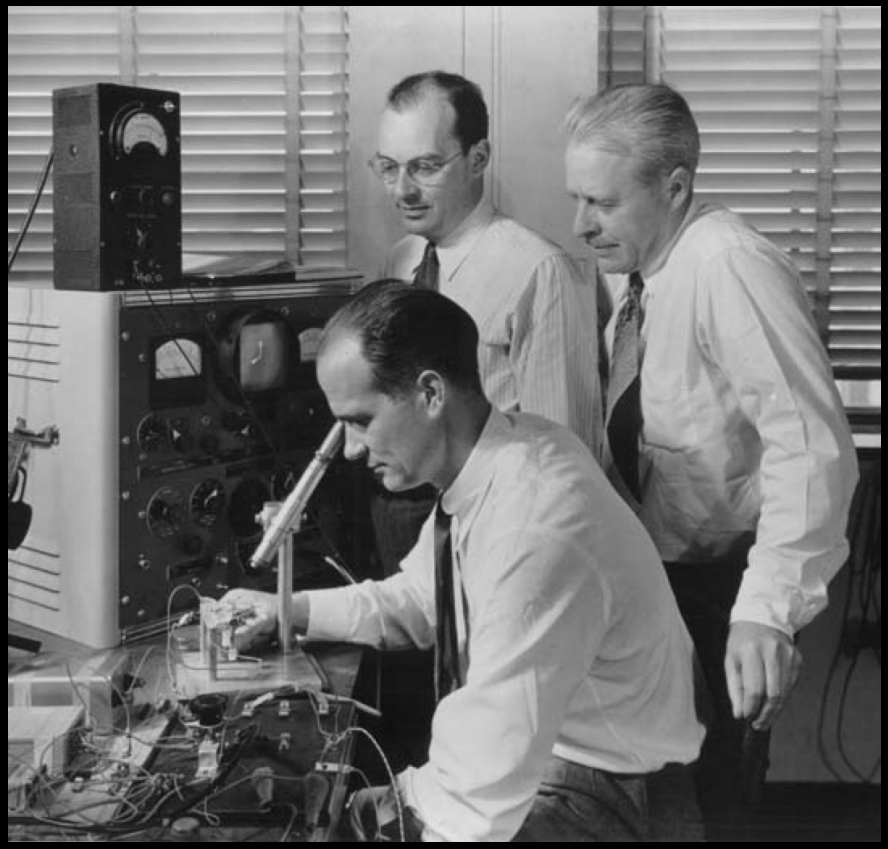


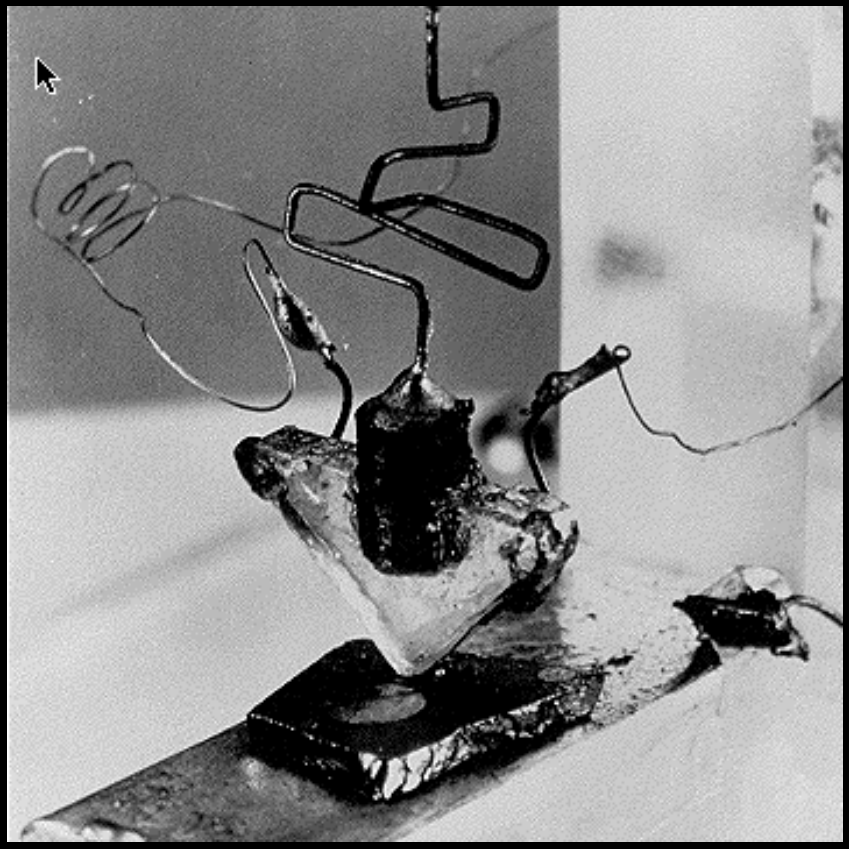


The Three Great Transformational Technologies Introduced in The 20th Century Enabling "Egalitarian" Eclipse-Chasing

The Transistor

1947



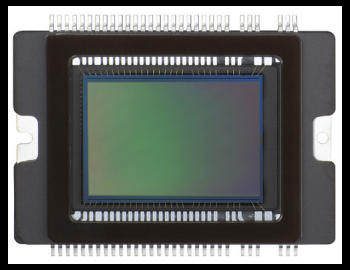


Basis for all Micro-Electronic (and "Consumer") Devices to Follow

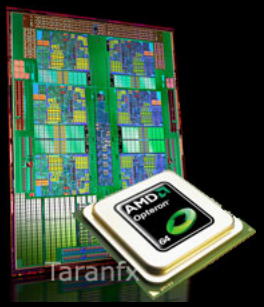
The Three Great Transformational Technologies Introduced in The 20th Century Enabling "Egalitarian" Eclipse-Chasing

2014

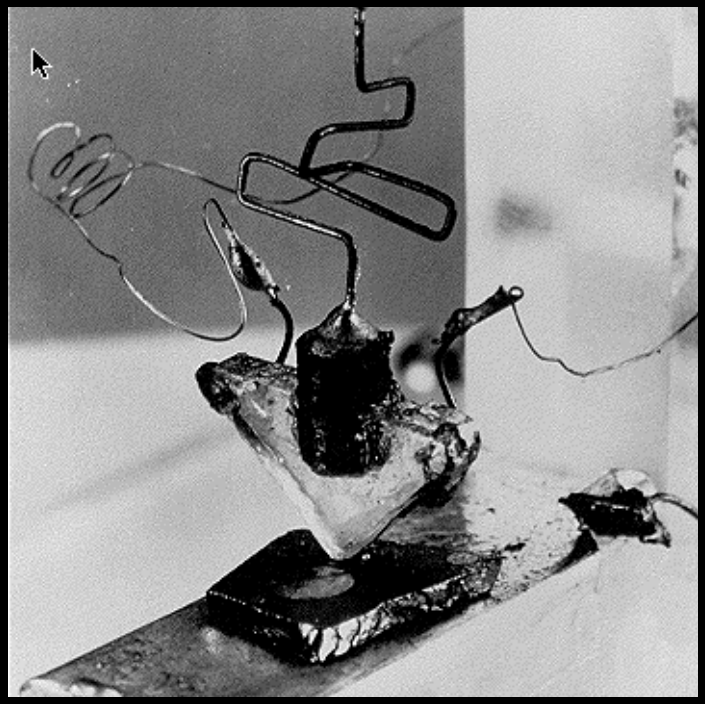
Imaging Detectors



Micro-Processors



1947



The Transistor

consumer (eclipse-chaser) products

Umbraphilic computational capabilities for:

- *High-Precision Eclipse Ephemerides and Circumstances*
- *Mapping & Visualization Tools*
- *Autonomous Camera Control and Data Acquisition*
- *Image Reduction, Calibration, Processing & Analysis*

Early 1970's – Transformational Socio-Economic Umbraphilic Events Spawning the "MODERN" Age Eclipse-Chasing

1972 – 1ST *Commercial* Eclipse Cruise TSS Olympia

a unique invitation from ECLIPSE 72

A floating scientific hotel will be launched to observe and record one of nature's most spectacular sights—the July 10, 1972 total eclipse of the sun.

Departing from New York City a luxurious ocean going vessel, the TSS Olympia, will cruise into the narrow path of totality which will be located off the coast of Nova Scotia.

On Monday afternoon, July 10, the voyagers aboard the floating observatory will experience a memorable sight that once seen will surely never be forgotten.

The eclipse cruise promises to be a scientifically rewarding adventure as well as a highly enjoyable social event.

Eclipse 72 will provide anyone who so desires with an opportunity to sail into the path of totality.

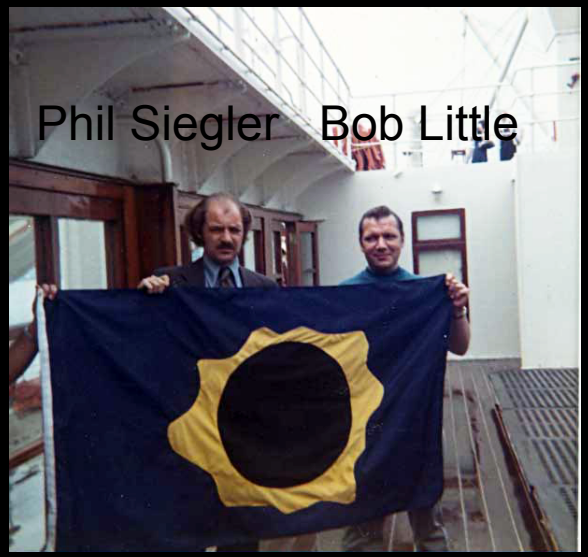
scientific highlights

- A spectacular view of the eclipse from the North Atlantic
- Seminars and lectures by leading scientists
- Short courses in eclipse photography, navigation, star study, and meteorology
- Individual and group devices for viewing the eclipse
- Continuous satellite weather forecasting along the path of totality
- Maneuverability of vessel to maximize ideal viewing conditions
- Films, slides and multi-media presentations
- Ample deck space for passengers and scientific instruments

The narrow path of Eclipse 72 totality CANNOT BE SEEN FROM THE CONTINENTAL UNITED STATES. The next readily accessible total solar eclipse will not be visible from North America until the year 2024.

"A floating scientific hotel…"

800 PAX, 900 mi. e of NY



Onboard photos courtesy of Bill Kramer

Early 1970's – Transformational Socio-Economic Umbraphilic Events Spawning the "MODERN" Age Eclipse-Chasing

1973:

2nd Commercial Eclipse Cruise
HMS Canberra, 3000 PAX
NW African Coast

7+ minute Pro/Amateur
Expedition(s) to NW Africa

Concorde used 1h 13m totality
supersonic eclipse chase

Early 1970's – Transformational Socio-Economic Umbraphilic Events Spawning the "MODERN" Age Eclipse-Chasing

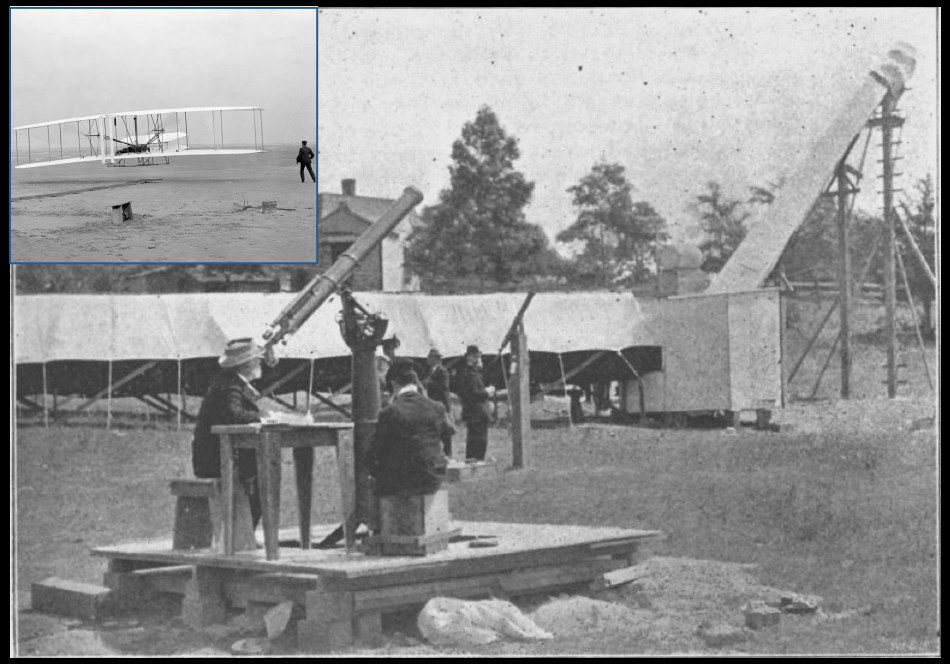
1974 – 1ST *Commercial* Eclipse Flight

Ansett Airlines B-727

Onboard photos courtesy of Wendy Carlos

The New Millenium

What a difference a century makes!



Turn of the 20th Century

Turn of the 21st Century

(But: 'The "*Moore*" things change, the more they stay the same'…)

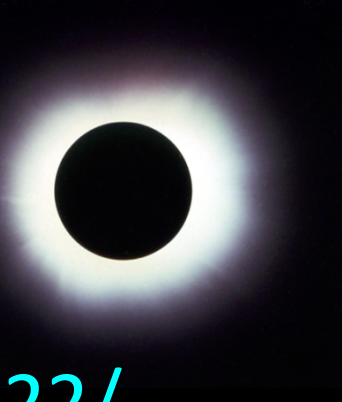
Despite Technological Advances:

A TOTAL Solar Eclipse is arguably remains *THE* most impressive and awe inspiring re-occurring natural phenomenon that humans can witness

The MOST viscerally dramatic and dynamic of ALL predicatble celestial events

Contemporary
Eclipse Chasing
a.k.a.
"UMBRAPHILIA"

WHO CHASES SOLAR ECLIPSES?



The Demographics of Umbraphillia

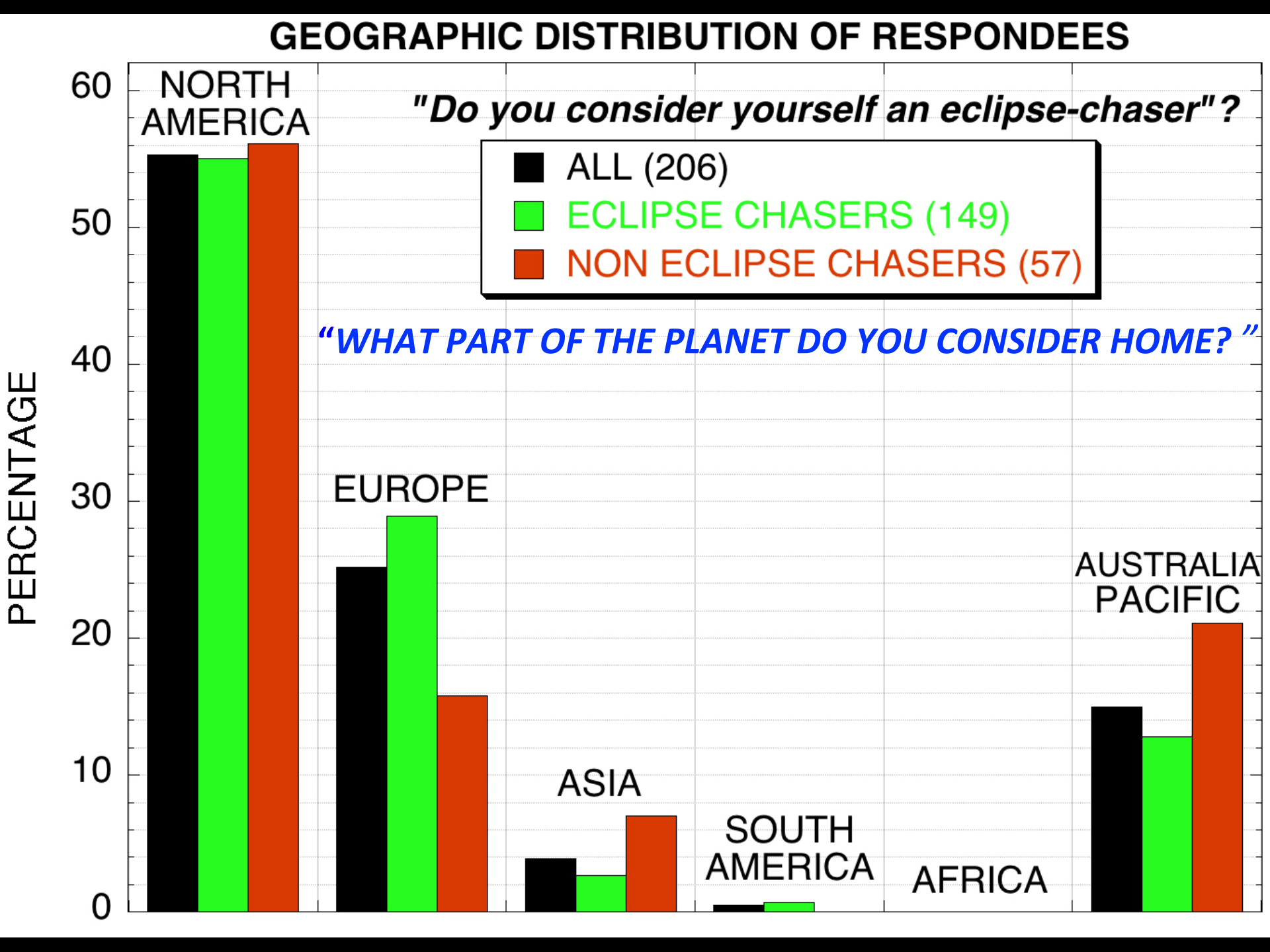
http://www.misterpoll.com/polls/596222/

206 Responses (at time of compilation)

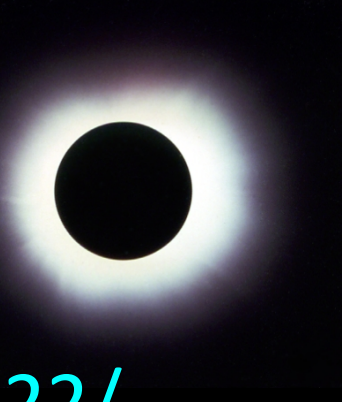
"DO YOU CONSIDER YOURSELF AN ECLIPSE-CHASER?"

149 YES

57 NO


GEOGRAPHIC DISTRIBUTION OF RESPONDEES
"Do you consider yourself an eclipse-chaser"?
ALL (206)
ECLIPSE CHASERS (149)
NON ECLIPSE CHASERS (57)
"WHAT PART OF THE PLANET DO YOU CONSIDER HOME? "
PERCENTAGE
60
50
40
30
20
10
0
NORTH AMERICA
EUROPE
ASIA
SOUTH AMERICA
AFRICA
AUSTRALIA PACIFIC

ECLIPSE-CHASER "EXPERIENCE"

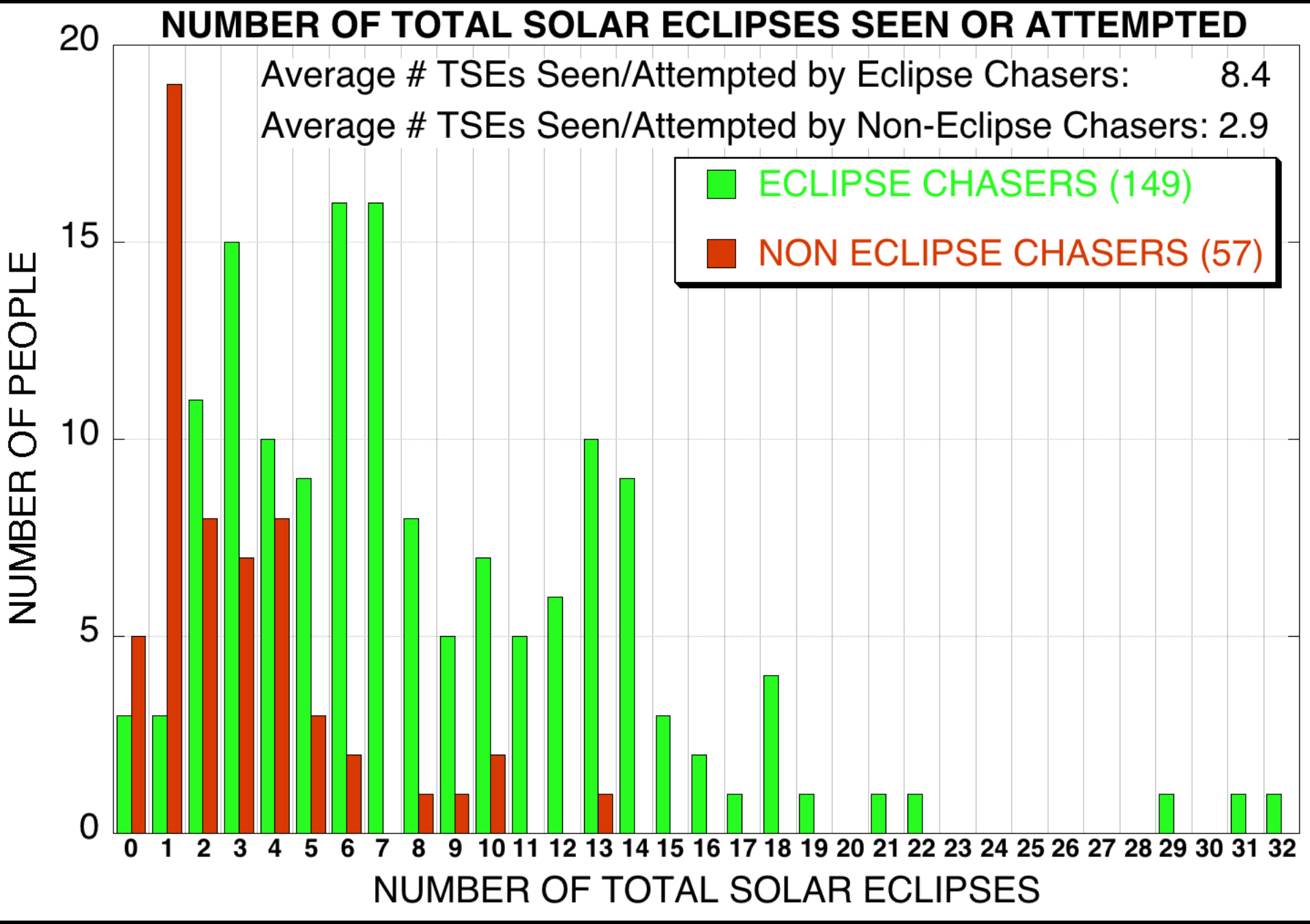


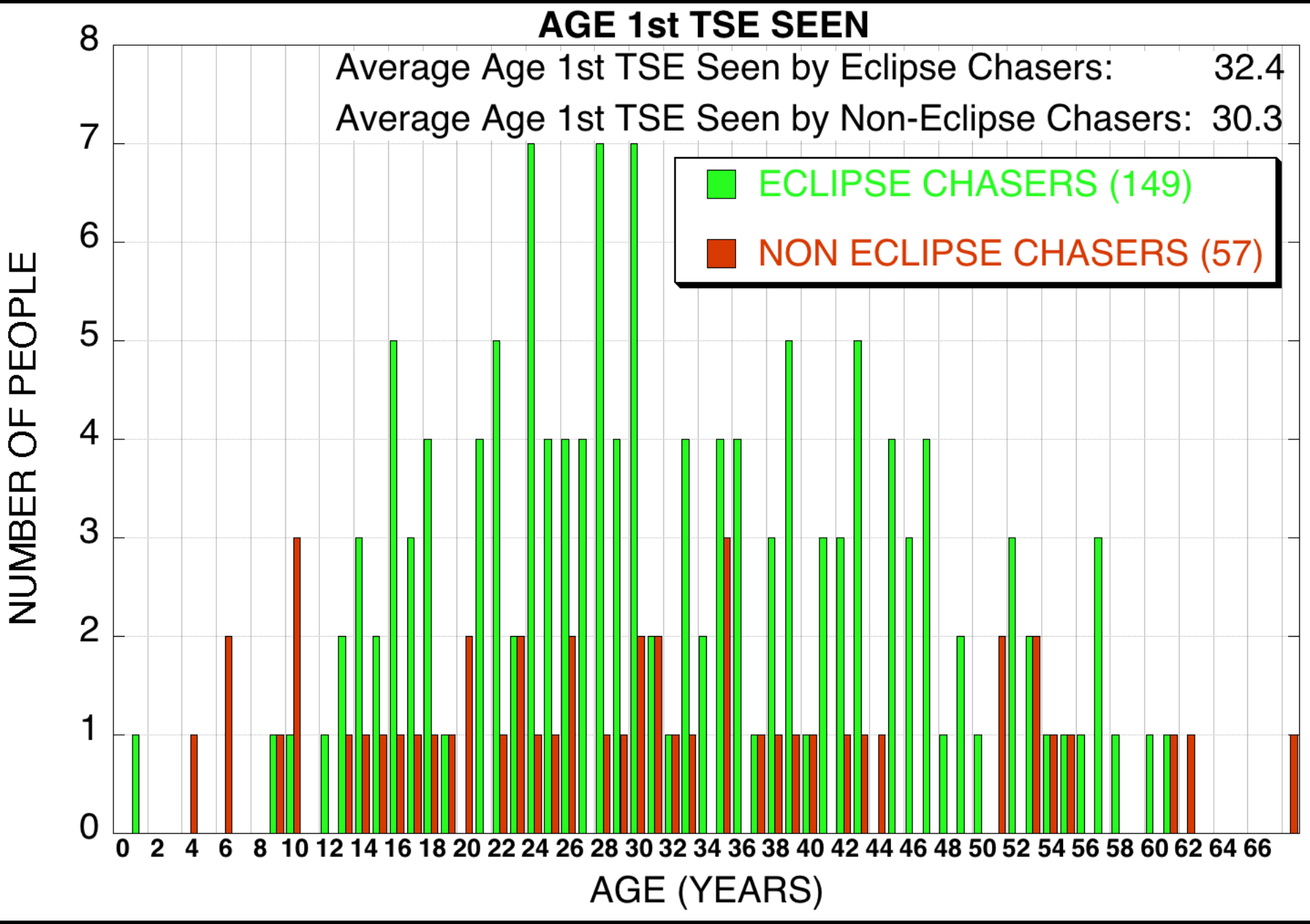
The Demographics of Umbraphillia

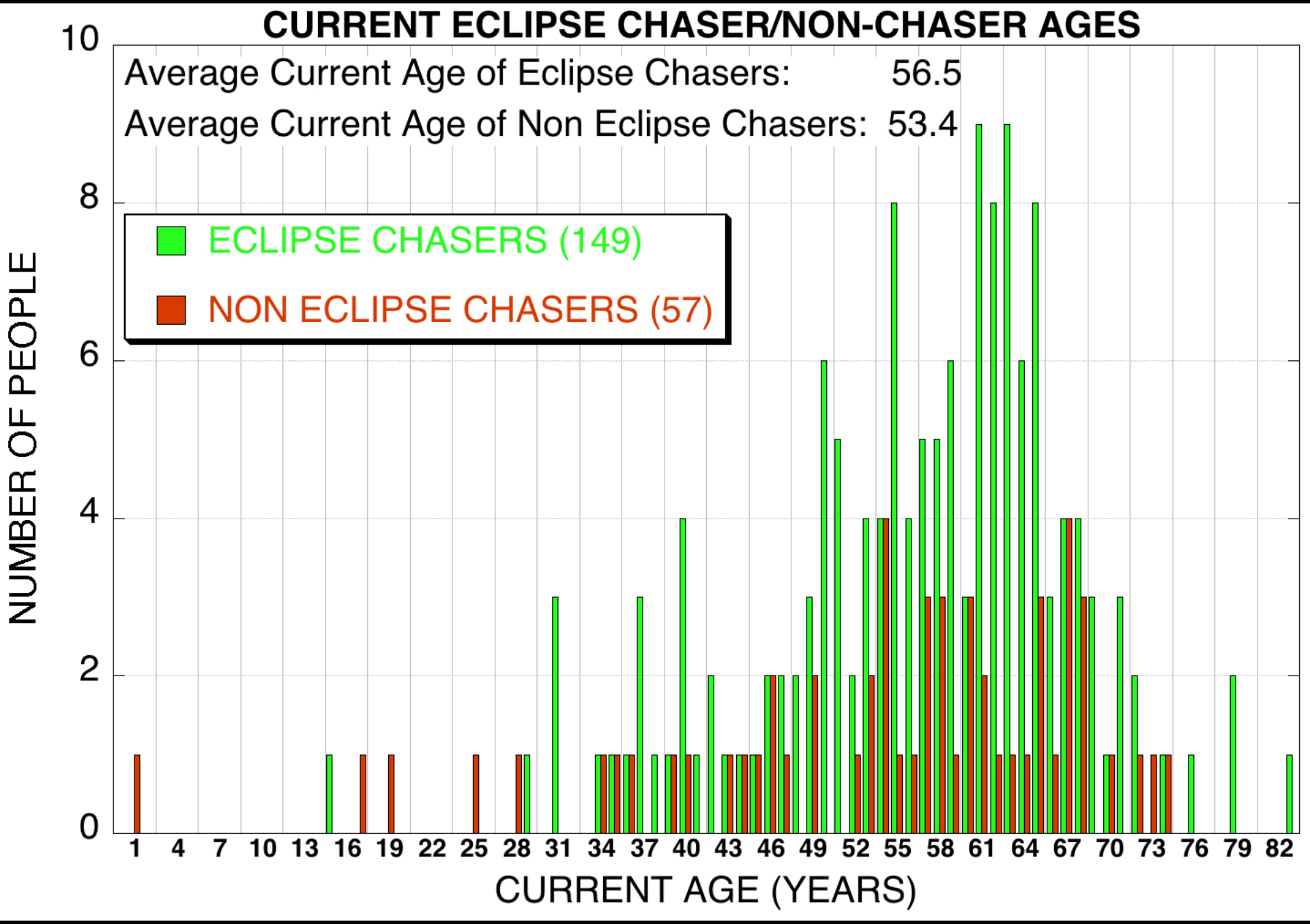
http://www.misterpoll.com/polls/596222/

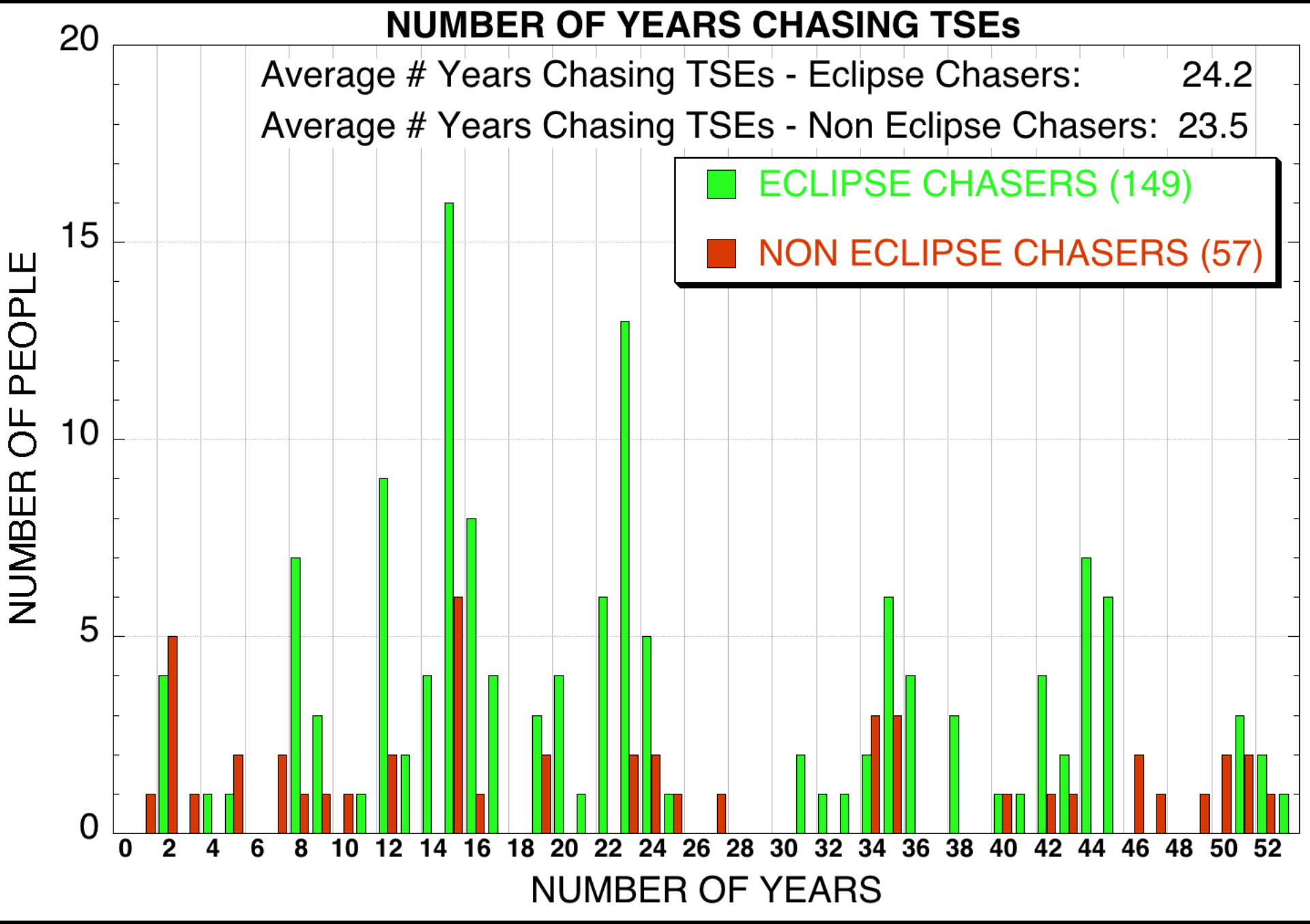
TOTALITY BY THE "NUMBERS":

- **# TSE's SEEN/ATTEMPTED**
- **AGE 1st TSE SEEN**
- **CURRENT AGE**
- **# YEARS CHASING ECLIPSES**

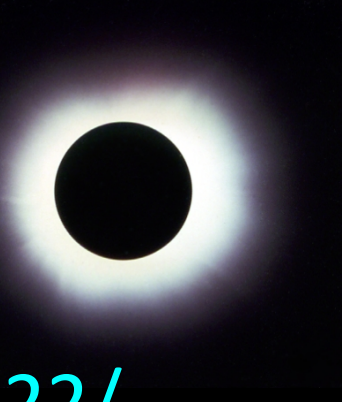

NUMBER OF TOTAL SOLAR ECLIPSES SEEN OR ATTEMPTED
Average # TSEs Seen/Attempted by Eclipse Chasers: 8.4
Average # TSEs Seen/Attempted by Non-Eclipse Chasers: 2.9
ECLIPSE CHASERS (149)
NON ECLIPSE CHASERS (57)
NUMBER OF PEOPLE
0
5
10
15
20
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
NUMBER OF TOTAL SOLAR ECLIPSES


AGE 1st TSE SEEN
Average Age 1st TSE Seen by Eclipse Chasers: 32.4
Average Age 1st TSE Seen by Non-Eclipse Chasers: 30.3
ECLIPSE CHASERS (149)
NON ECLIPSE CHASERS (57)
NUMBER OF PEOPLE
0 1 2 3 4 5 6 7 8
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66
AGE (YEARS)


CURRENT ECLIPSE CHASER/NON-CHASER AGES
Average Current Age of Eclipse Chasers: 56.5
Average Current Age of Non Eclipse Chasers: 53.4
ECLIPSE CHASERS (149)
NON ECLIPSE CHASERS (57)
NUMBER OF PEOPLE
0
2
4
6
8
10
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49 52 55 58 61 64 67 70 73 76 79 82
CURRENT AGE (YEARS)


NUMBER OF YEARS CHASING TSEs
Average # Years Chasing TSEs - Eclipse Chasers: 24.2
Average # Years Chasing TSEs - Non Eclipse Chasers: 23.5
ECLIPSE CHASERS (149)
NON ECLIPSE CHASERS (57)
NUMBER OF PEOPLE
NUMBER OF YEARS
0
5
10
15
20
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52

ECLIPSE-CHASER "EXPERIENCE"

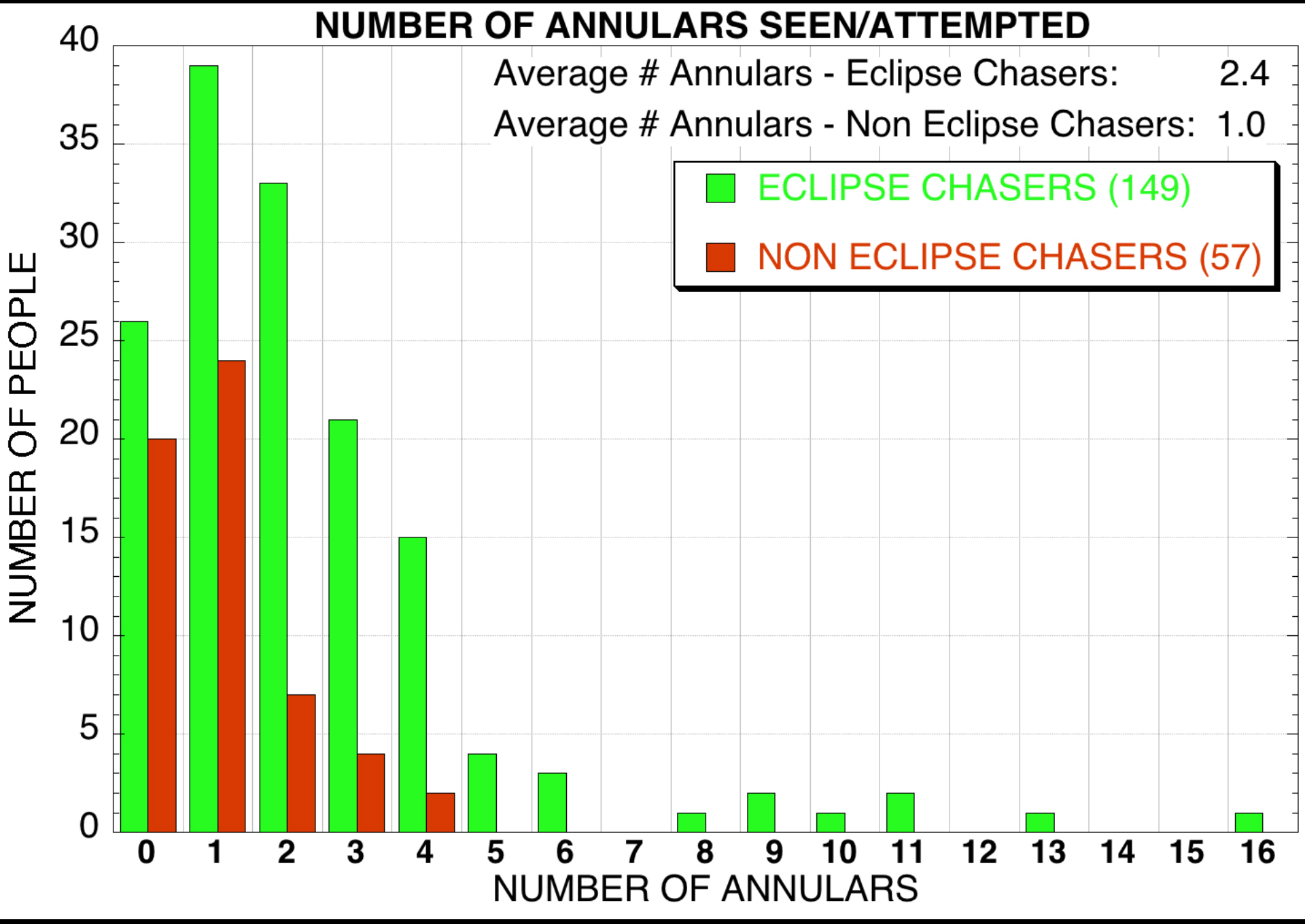


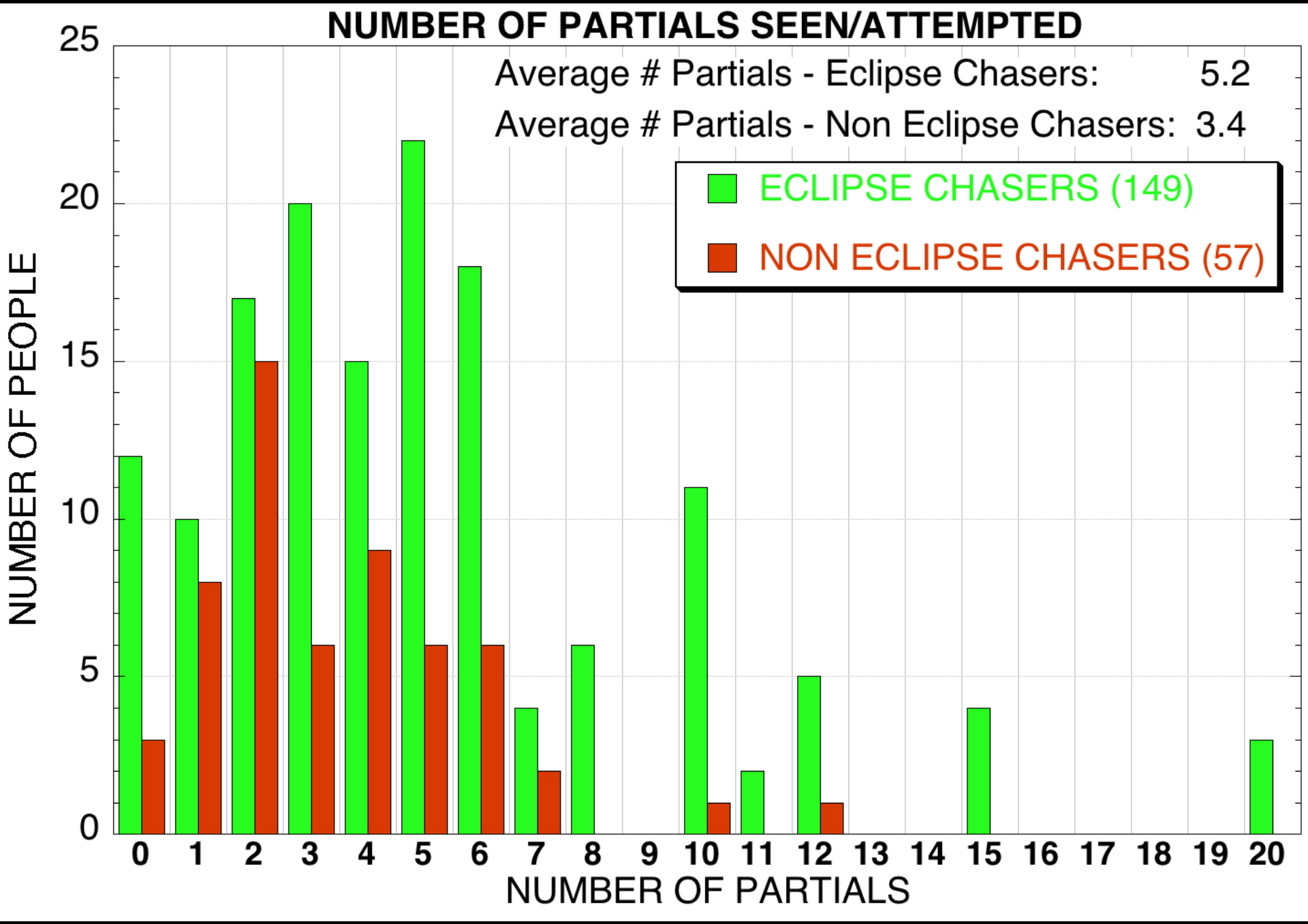
The Demographics of Umbraphillia

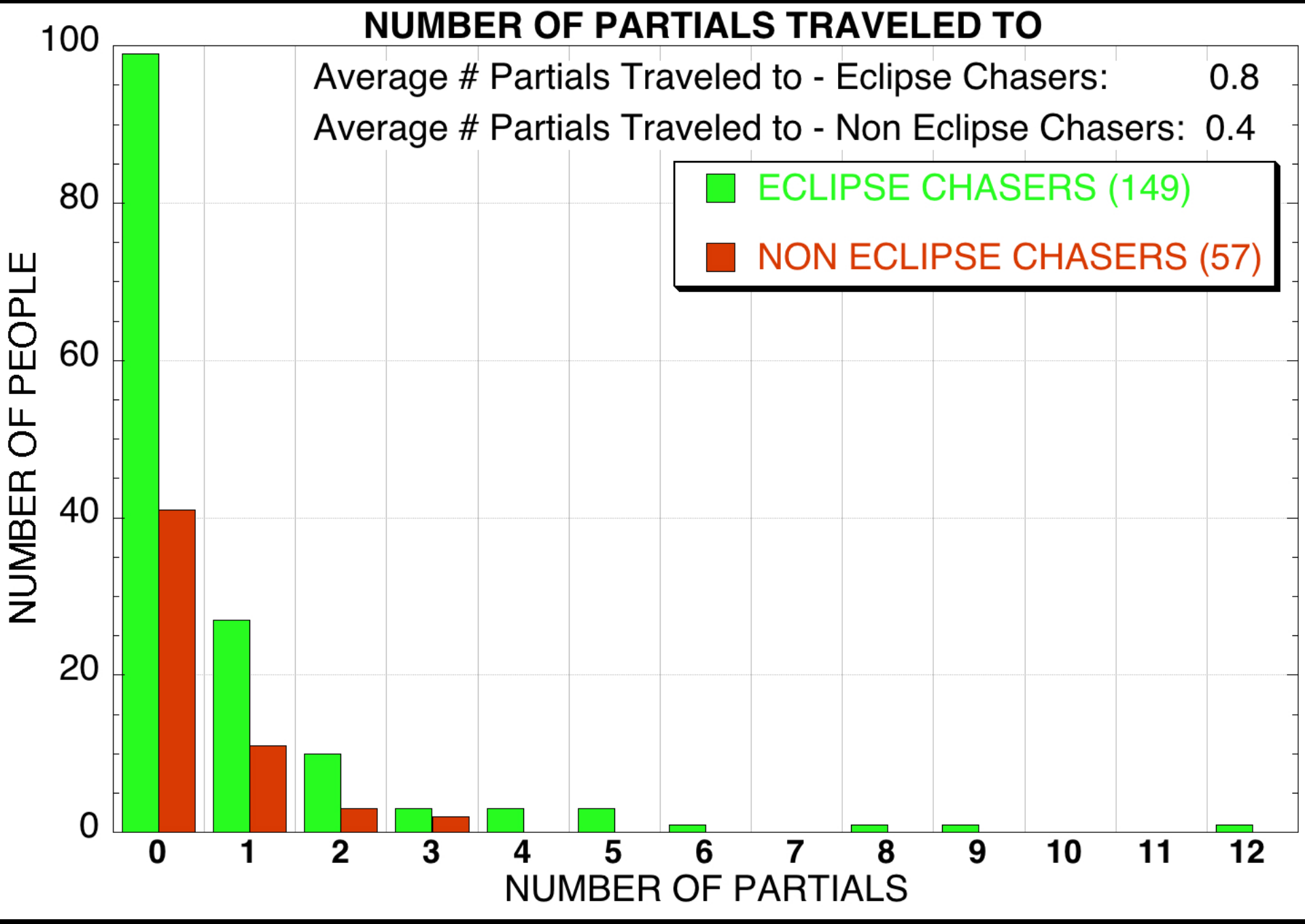
http://www.misterpoll.com/polls/596222/

CHASING OTHER SHADOWS BY THE "NUMBERS":

- **# ANTUMBRAL SHADOWS (ANNULARS)**
- **PENUMBRAL SHADOWS (PARTIALS)**


NUMBER OF ANNULARS SEEN/ATTEMPTED
Average # Annulars - Eclipse Chasers: 2.4
Average # Annulars - Non Eclipse Chasers: 1.0
ECLIPSE CHASERS (149)
NON ECLIPSE CHASERS (57)
NUMBER OF PEOPLE
0
5
10
15
20
25
30
35
40
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
NUMBER OF ANNULARS


NUMBER OF PARTIALS SEEN/ATTEMPTED
Average # Partials - Eclipse Chasers: 5.2
Average # Partials - Non Eclipse Chasers: 3.4
ECLIPSE CHASERS (149)
NON ECLIPSE CHASERS (57)
NUMBER OF PEOPLE
0
5
10
15
20
25
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
NUMBER OF PARTIALS


NUMBER OF PARTIALS TRAVELED TO
Average # Partials Traveled to - Eclipse Chasers: 0.8
Average # Partials Traveled to - Non Eclipse Chasers: 0.4
ECLIPSE CHASERS (149)
NON ECLIPSE CHASERS (57)
NUMBER OF PEOPLE
100
80
60
40
20
0
0
1
2
3
4
5
6
7
8
9
10
11
12
NUMBER OF PARTIALS

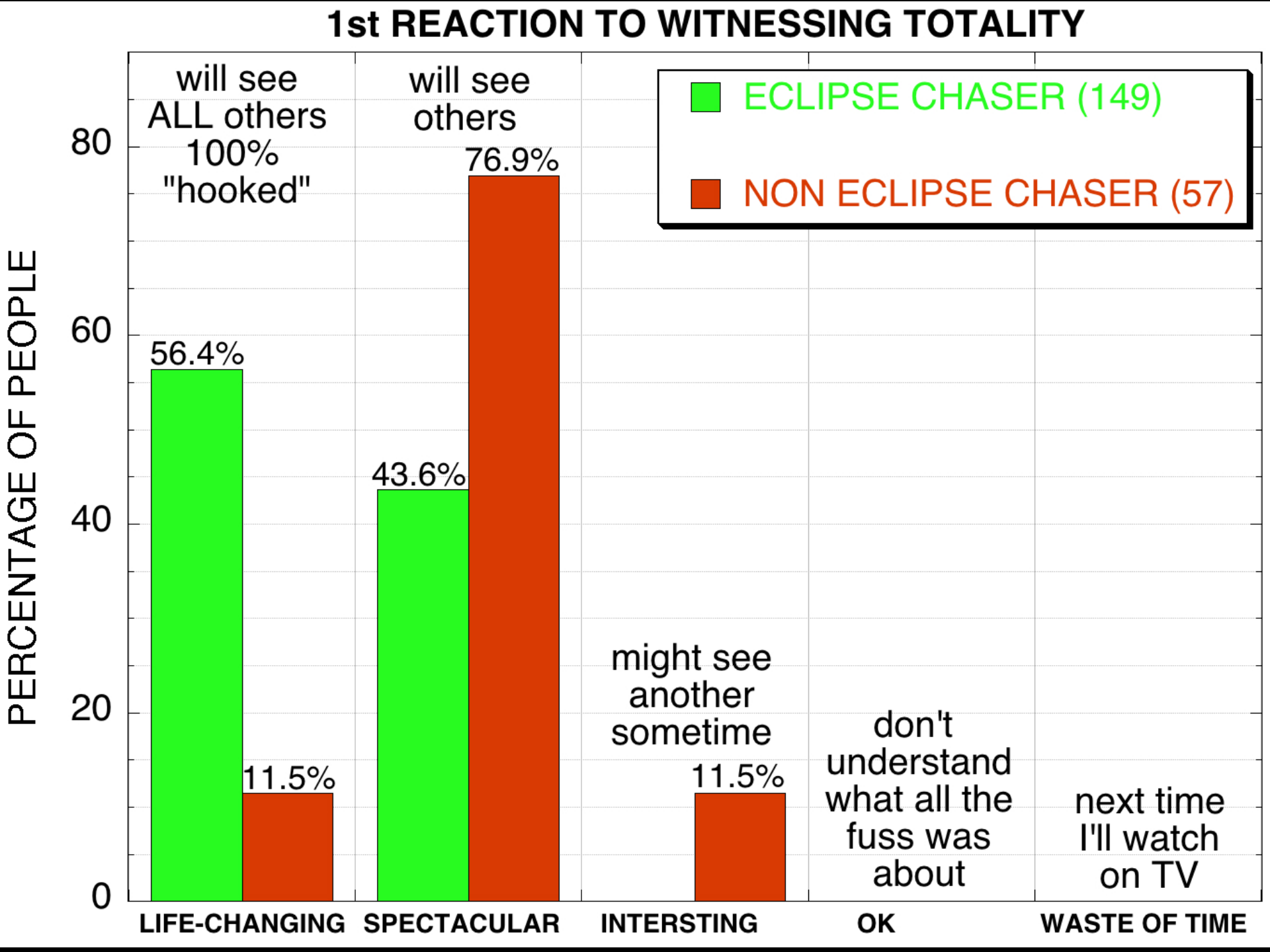
DEGREE OF "ADDICTION"

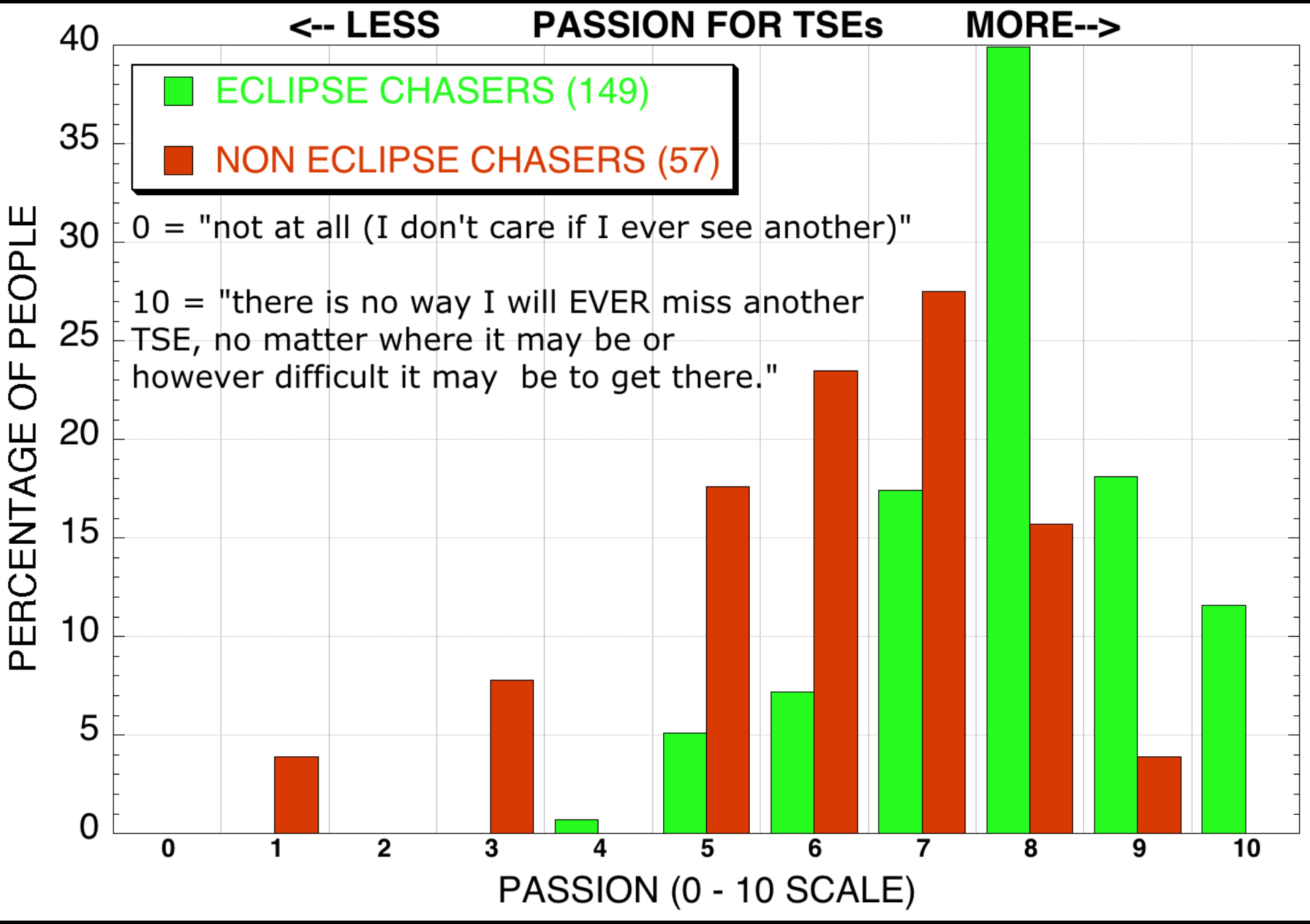
The Demographics of Umbraphillia

http://www.misterpoll.com/polls/596222/

TOTAL UMBRAL EMERSION

- **INITIAL REACTION (GETTING HOOKED)**
- **DEPTH OF COMMITMENT / PASSION**


1st REACTION TO WITNESSING TOTALITY
ECLIPSE CHASER (149)
NON ECLIPSE CHASER (57)
PERCENTAGE OF PEOPLE
0
20
40
60
80
will see ALL others 100% "hooked"
56.4%
11.5%
will see others
43.6%
76.9%
might see another sometime
11.5%
don't understand what all the fuss was about
next time I'll watch on TV
LIFE-CHANGING
SPECTACULAR
INTERSTING
OK
WASTE OF TIME


<-- LESS PASSION FOR TSEs MORE-->
ECLIPSE CHASERS (149)
NON ECLIPSE CHASERS (57)
0 = "not at all (I don't care if I ever see another)"
10 = "there is no way I will EVER miss another TSE, no matter where it may be or however difficult it may be to get there."
PERCENTAGE OF PEOPLE
PASSION (0 - 10 SCALE)
0
5
10
15
20
25
30
35
40
0
1
2
3
4
5
6
7
8
9
10

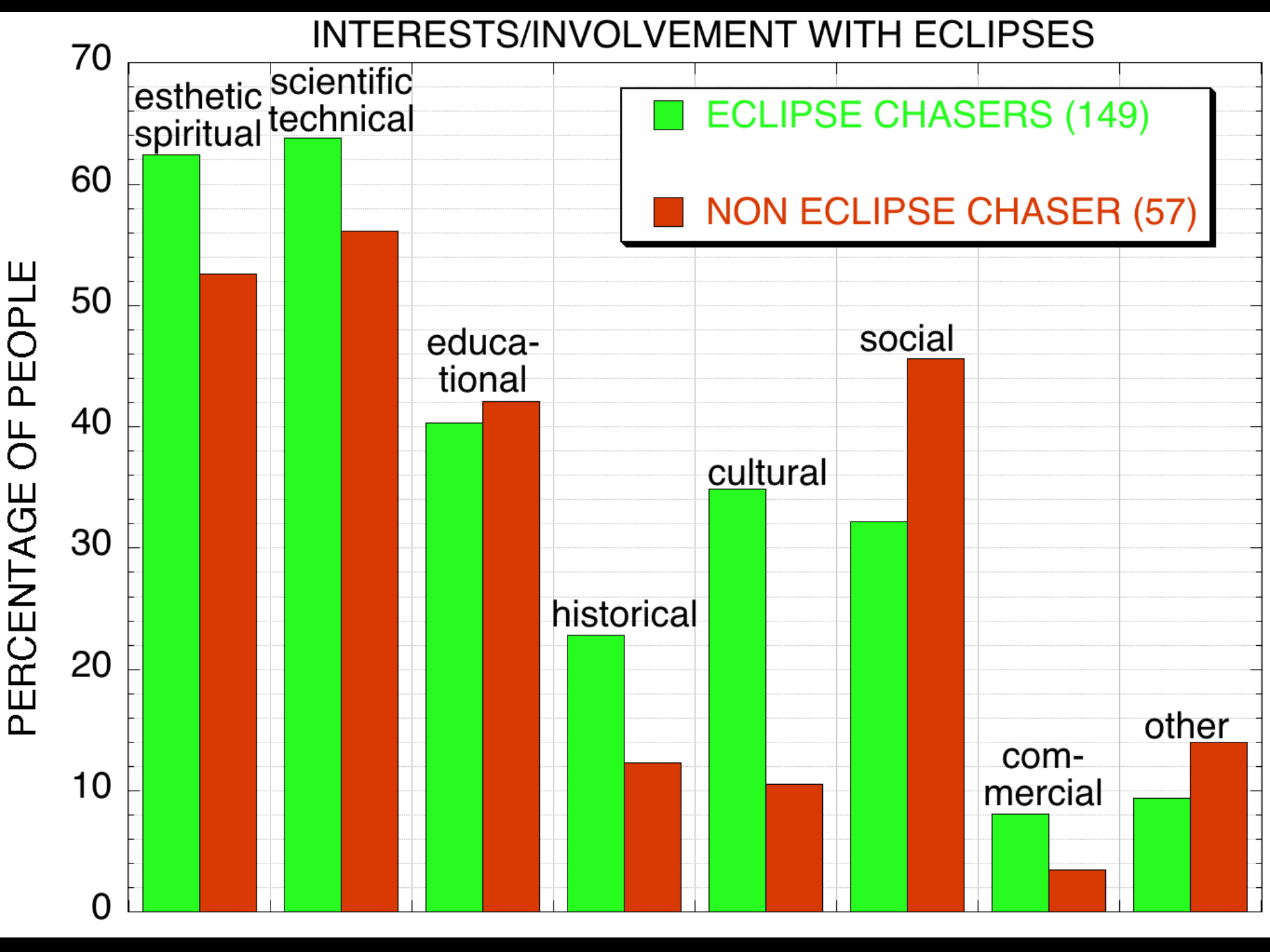
AREAS OF INTEREST

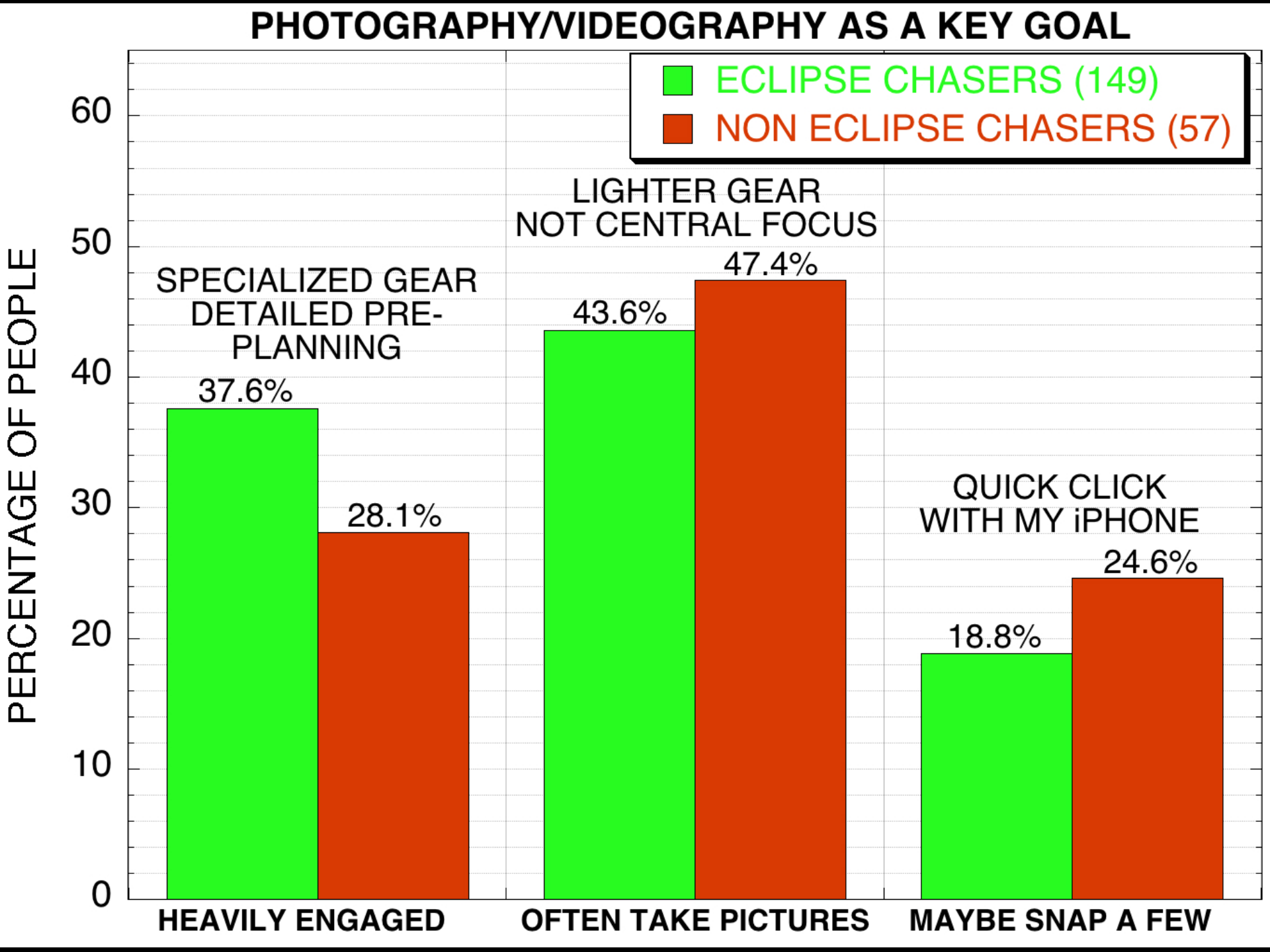
The Demographics of Umbraphillia

http://www.misterpoll.com/polls/596222/

THE MANY FACETS OF UMBRAPHILIA*

- **SOMETHING FOR EVERYONE…**
- **PHOTOGRAPHY/VIDEOGRAPHY**
- **PROFESSIONAL “vs.” RECREATIONAL**
- **PUBLICATION**


INTERESTS/INVOLVEMENT WITH ECLIPSES
PERCENTAGE OF PEOPLE
70
60
50
40
30
20
10
0
esthetic spiritual
scientific technical
educa-tional
historical
cultural
social
com-mercial
other
ECLIPSE CHASERS (149)
NON ECLIPSE CHASER (57)

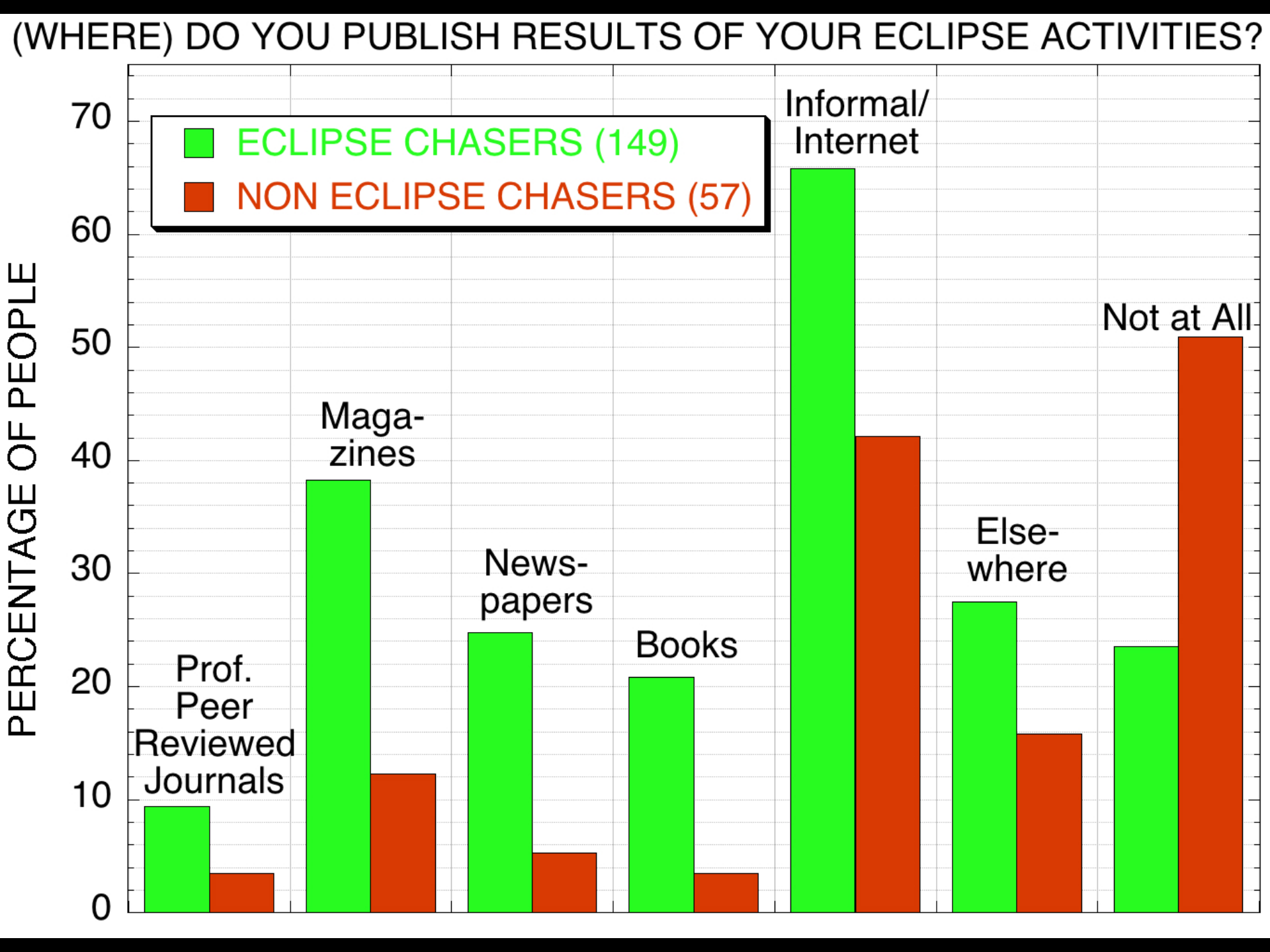

PHOTOGRAPHY/VIDEOGRAPHY AS A KEY GOAL
ECLIPSE CHASERS (149)
NON ECLIPSE CHASERS (57)
PERCENTAGE OF PEOPLE
60
50
40
30
20
10
0
SPECIALIZED GEAR DETAILED PRE-PLANNING
37.6%
28.1%
LIGHTER GEAR NOT CENTRAL FOCUS
43.6%
47.4%
QUICK CLICK WITH MY iPHONE
18.8%
24.6%
HEAVILY ENGAGED
OFTEN TAKE PICTURES
MAYBE SNAP A FEW

WORK/PROFESSION IS RELATED TO ECLIPSE INTERESTS:

ECLIPSE CHASERS: 28.2%
NON ECLIPSE CHASERS: 4.0%

PROFESSIONAL OR RECREATIONAL S.E. RELATED ACTIVITIES

% PERON INVOLVEMENTS	ECLIPSE CHASER			NON-ECL CHASER		
	PROF	RECR	NONE	PROF	RECR	NONE
IMAGING/DATA ANALYSIS	8.7	58.4	32.9	0.0	40.4	59.6
S.E. RELATED STUDIES	8.7	41.6	49.7	0.0	21.1	78.9
OBSERVATION PLANNING	10.1	53.0	36.9	0.0	36.8	63.2
TRAVEL ORGANIZING	8.1	25.5	66.4	1.8	15.8	82.5
EDU/PUB OUTREACH	12.8	41.6	45.6	3.5	35.1	61.4


(WHERE) DO YOU PUBLISH RESULTS OF YOUR ECLIPSE ACTIVITIES?
ECLIPSE CHASERS (149)
NON ECLIPSE CHASERS (57)
PERCENTAGE OF PEOPLE
0
10
20
30
40
50
60
70
Prof. Peer Reviewed Journals
Maga-zines
News-papers
Books
Informal/ Internet
Else-where
Not at All

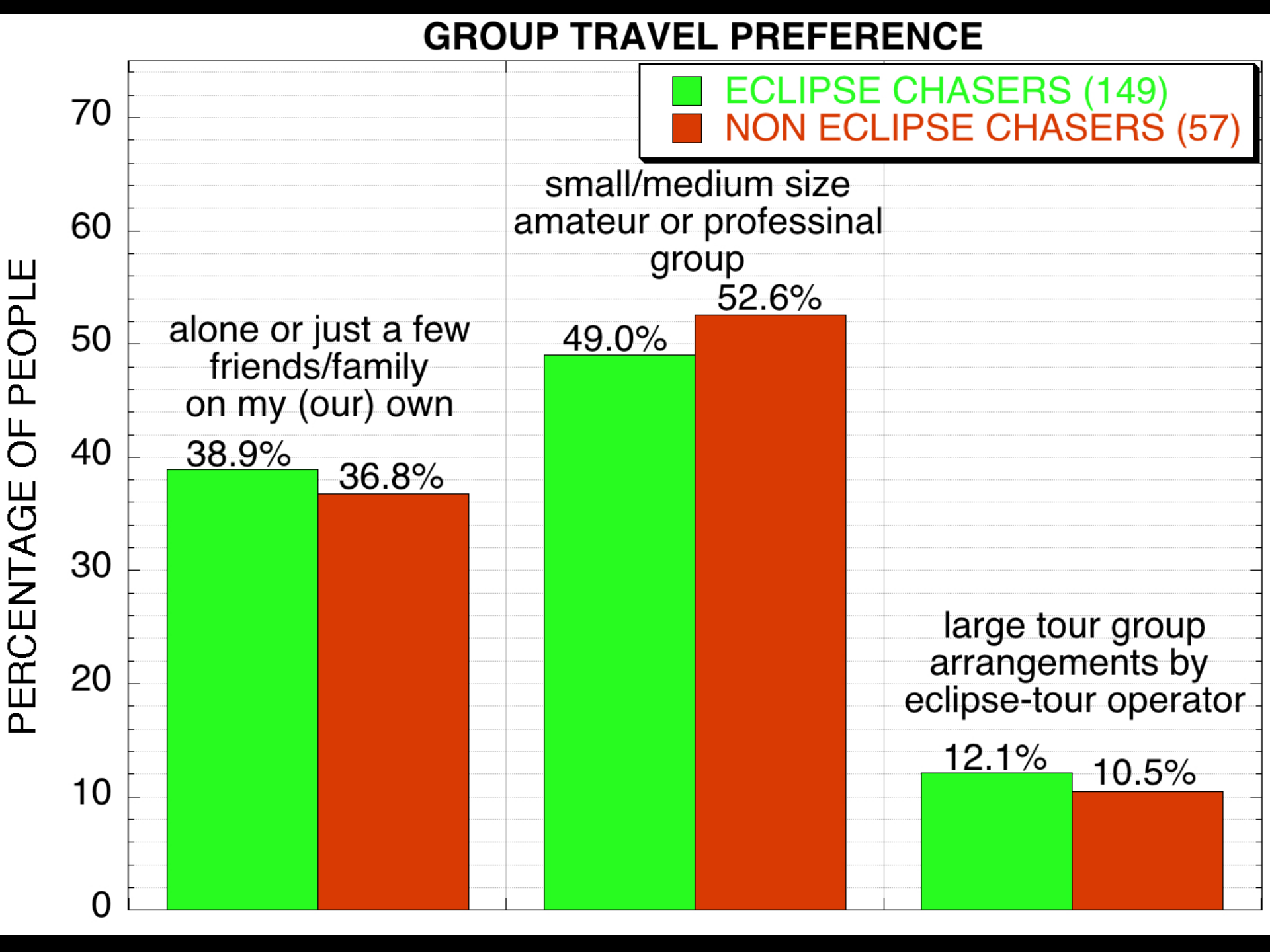
PERSONAL PREFERENCES

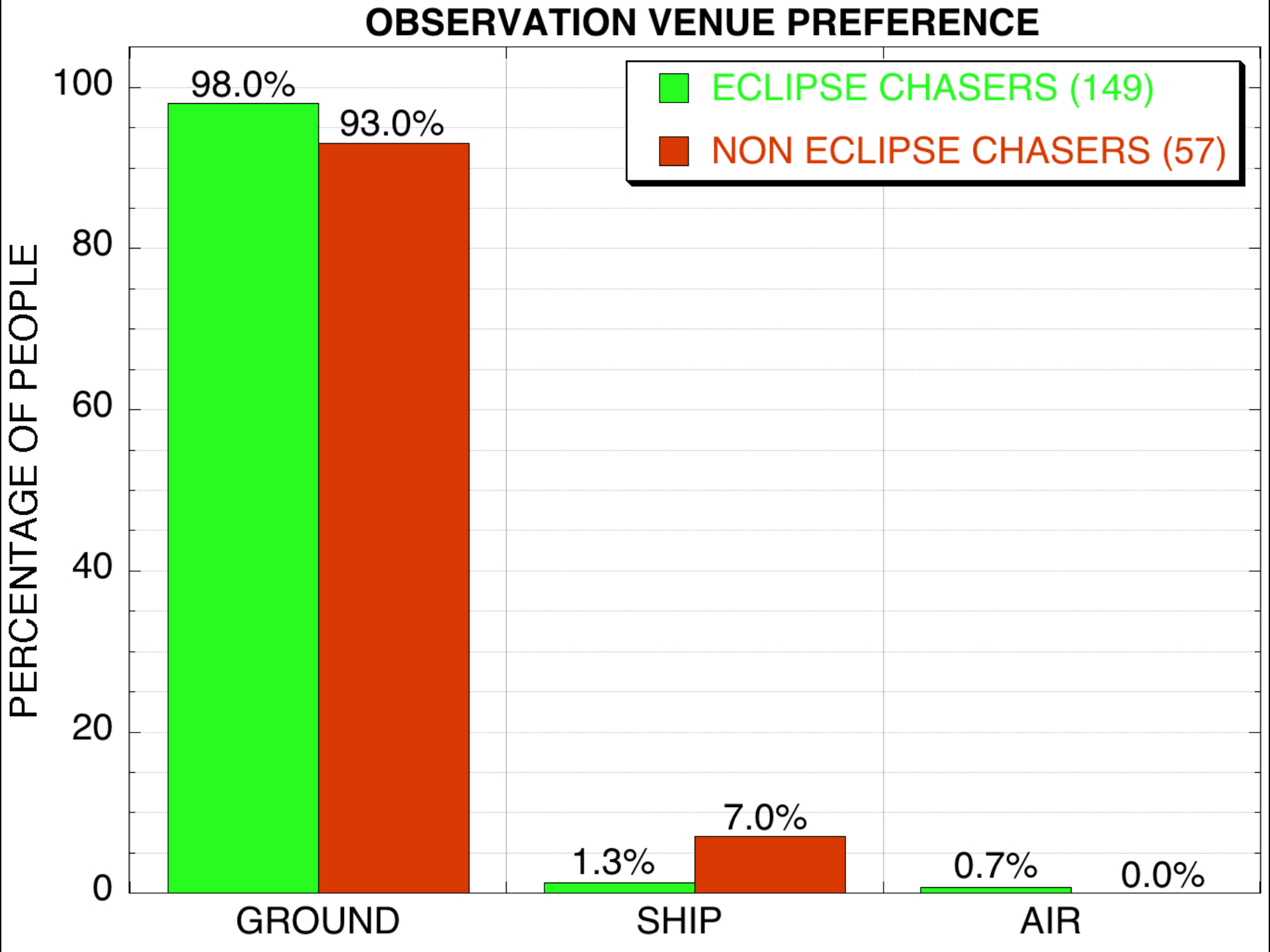
The Demographics of Umbraphillia

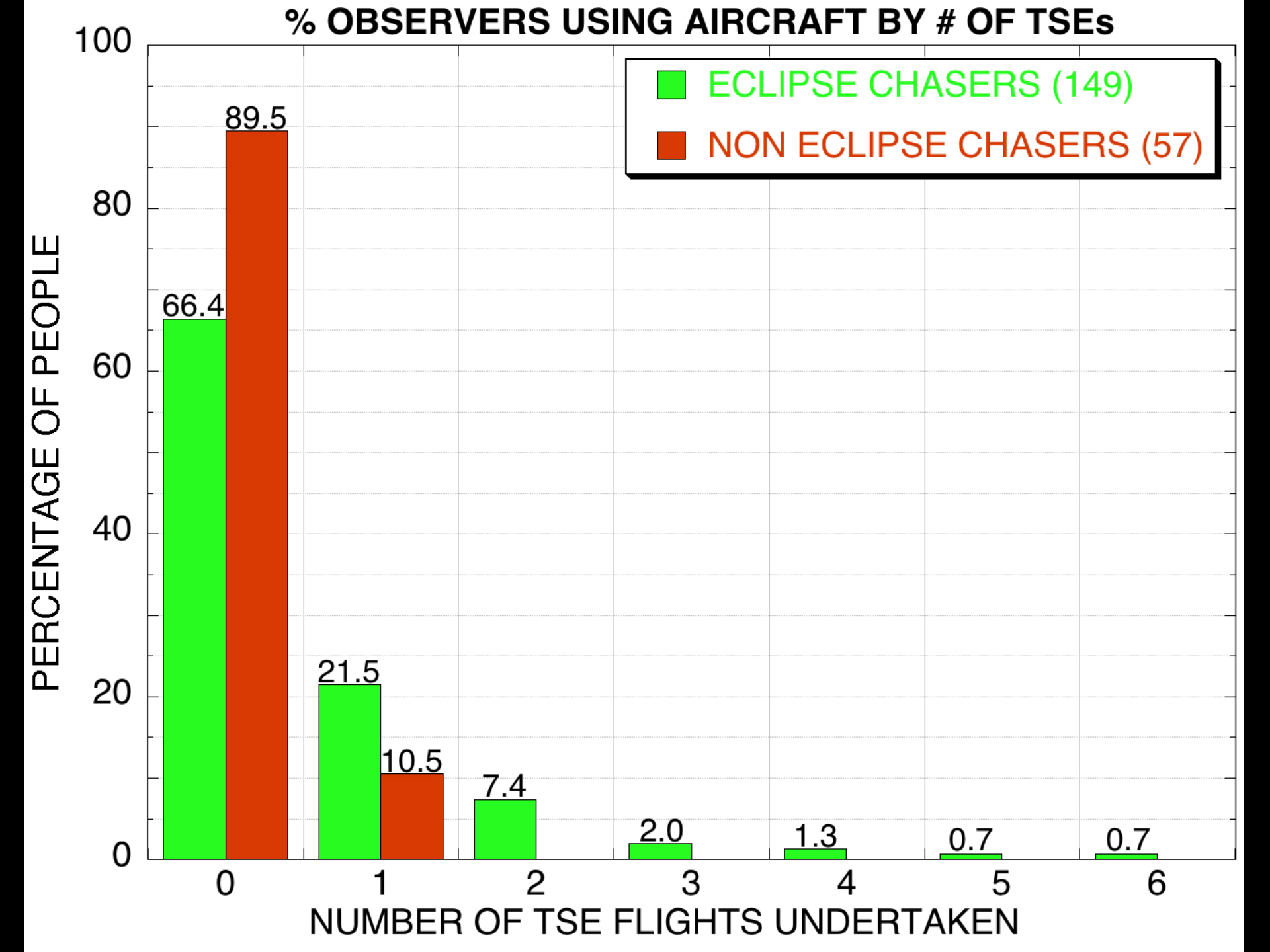
http://www.misterpoll.com/polls/596222/

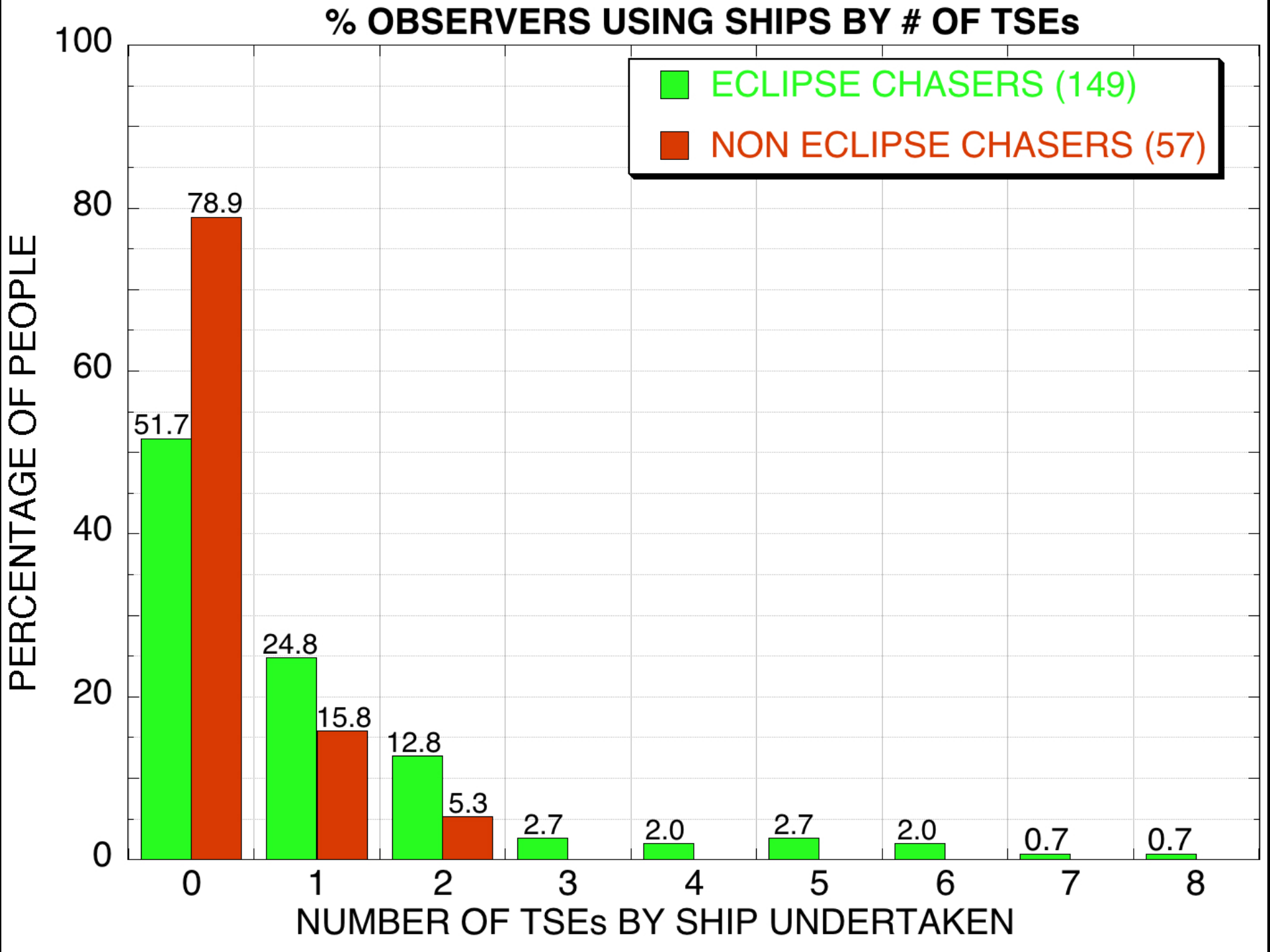
TSE OBSERVING:

- **SOLITUDE vs. A SOCIAL EVENT**
- **VENUE: LAND vs. SEA vs. AIR**


GROUP TRAVEL PREFERENCE
ECLIPSE CHASERS (149)
NON ECLIPSE CHASERS (57)
PERCENTAGE OF PEOPLE
70
60
50
40
30
20
10
0
alone or just a few friends/family on my (our) own
38.9%
36.8%
small/medium size amateur or professinal group
49.0%
52.6%
large tour group arrangements by eclipse-tour operator
12.1%
10.5%


OBSERVATION VENUE PREFERENCE
ECLIPSE CHASERS (149)
NON ECLIPSE CHASERS (57)
PERCENTAGE OF PEOPLE
100
80
60
40
20
0
98.0%
93.0%
1.3%
7.0%
0.7%
0.0%
GROUND
SHIP
AIR


% OBSERVERS USING AIRCRAFT BY # OF TSEs
ECLIPSE CHASERS (149)
NON ECLIPSE CHASERS (57)
PERCENTAGE OF PEOPLE
NUMBER OF TSE FLIGHTS UNDERTAKEN
100
80
60
40
20
0
0
1
2
3
4
5
6
66.4
89.5
21.5
10.5
7.4
2.0
1.3
0.7
0.7

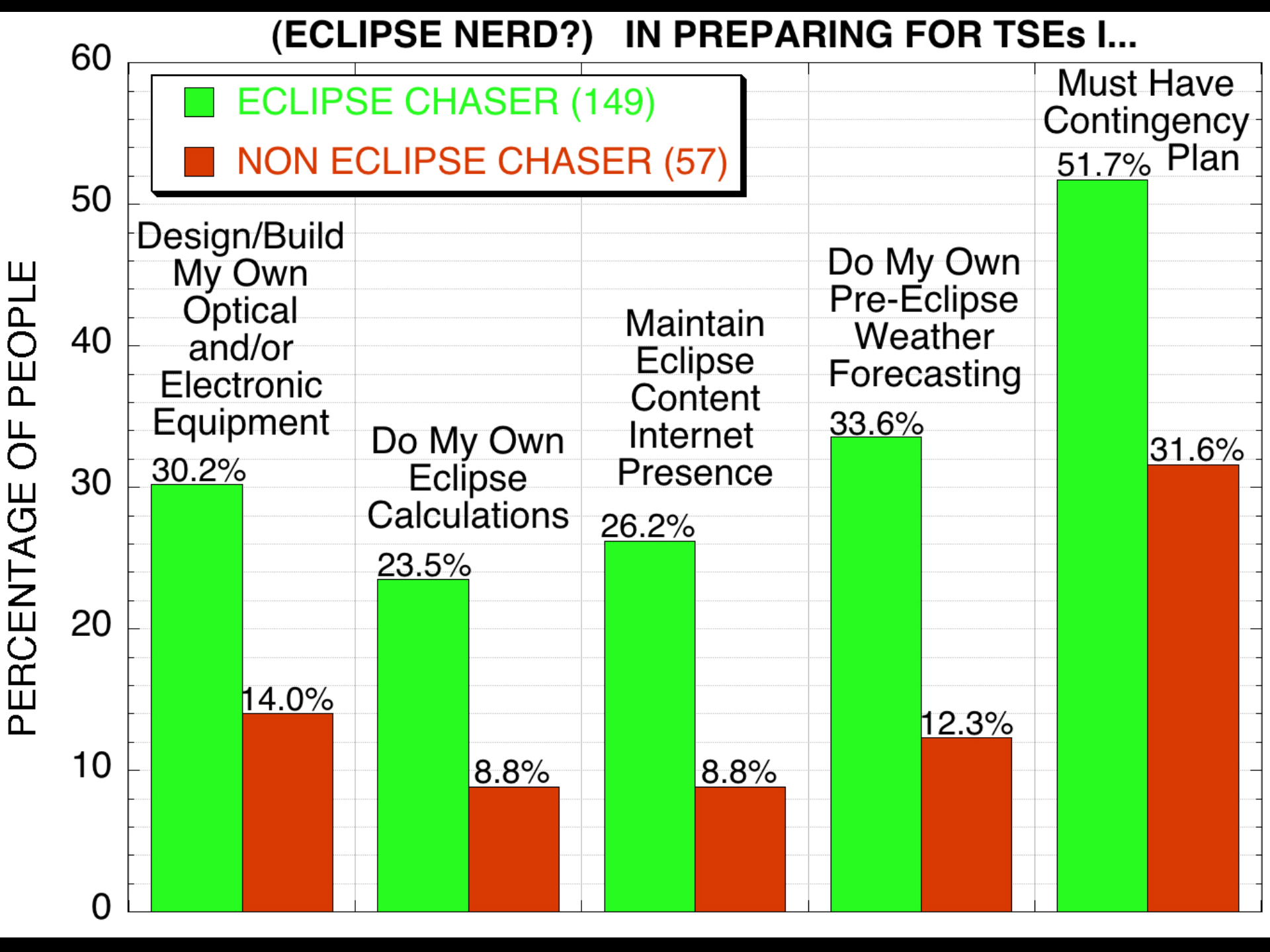

% OBSERVERS USING SHIPS BY # OF TSEs
ECLIPSE CHASERS (149)
NON ECLIPSE CHASERS (57)
PERCENTAGE OF PEOPLE
100
80
60
40
20
0
78.9
51.7
24.8
15.8
12.8
5.3
2.7
2.0
2.7
2.0
0.7
0.7
0
1
2
3
4
5
6
7
8
NUMBER OF TSEs BY SHIP UNDERTAKEN

PLANNING AND PREPATIONS

The Demographics of Umbraphillia

http://www.misterpoll.com/polls/596222/

- **ACTIVITIES INVOLVEMENT**
- **SITE SELECTION CRITERION**


(ECLIPSE NERD?) IN PREPARING FOR TSEs I...
ECLIPSE CHASER (149)
NON ECLIPSE CHASER (57)
PERCENTAGE OF PEOPLE
60
50
40
30
20
10
0
Design/Build My Own Optical and/or Electronic Equipment
30.2%
14.0%
Do My Own Eclipse Calculations
23.5%
8.8%
Maintain Eclipse Content Internet Presence
26.2%
8.8%
Do My Own Pre-Eclipse Weather Forecasting
33.6%
12.3%
Must Have Contingency Plan
51.7%
31.6%

PLANNING FACTOR IMPORTANCE (VALUE = 0-100)

ECLIPSE CHASER			NON ECLIPSE CHASER	
RANK	CRITERION	VALUE	CRITERION	VALUE
1	WEATHER	65.3	WEATHER	58.2
2	CONTINGENCY	44.3	DURATION	44.2
3	DURATION	42.3	BUDGET	42.1
4	SITESEEING	42.1	CONTINGENCY	39.8
5	BUDGET	37.8	GEOPOLITICS	34.8
6	GEOPOLITICS	37.4	SITESEEING	33.3

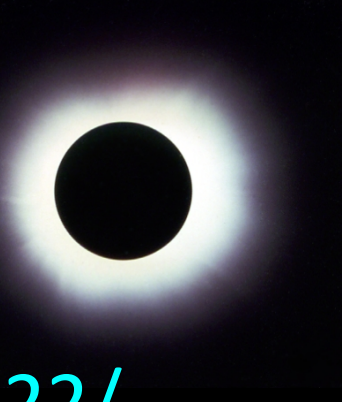
PERCENTAGE PASS ON SHORT DURATION

ECLIPSE CHASER: 24.2 %

NON ECLIPSE CHASER: 47.4 %

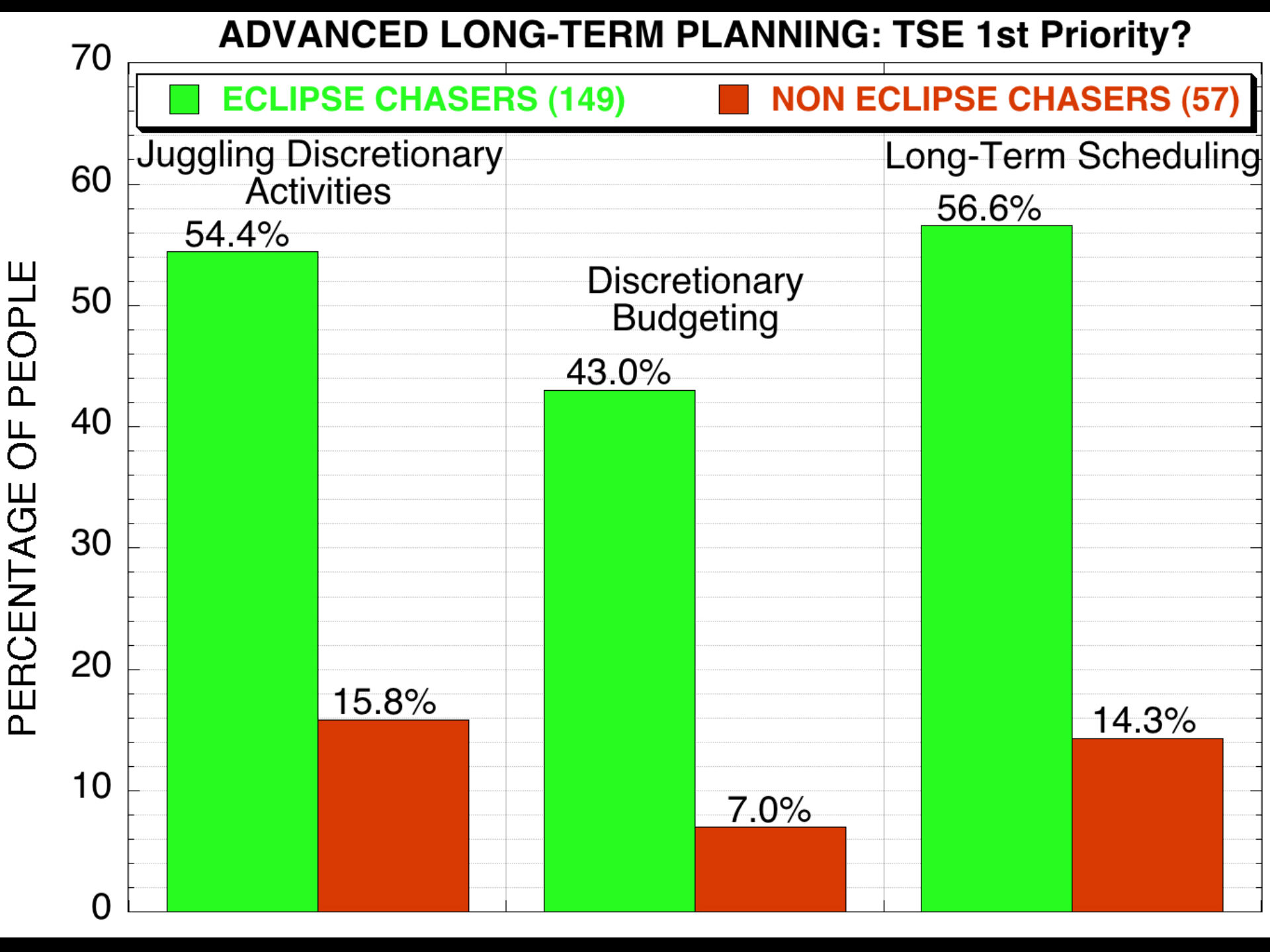
PLANNING AND PREPATIONS

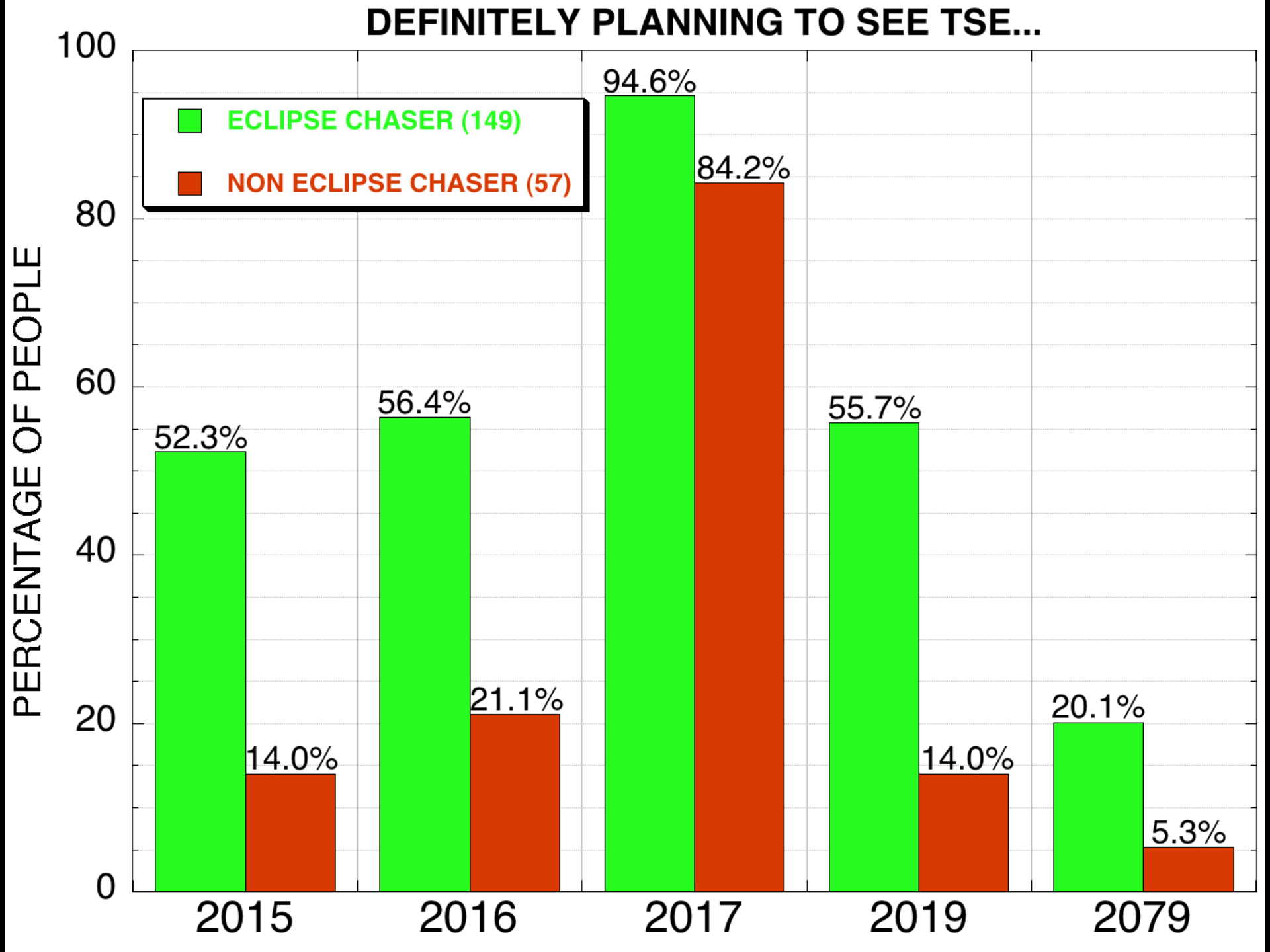
The Demographics of Umbraphillia

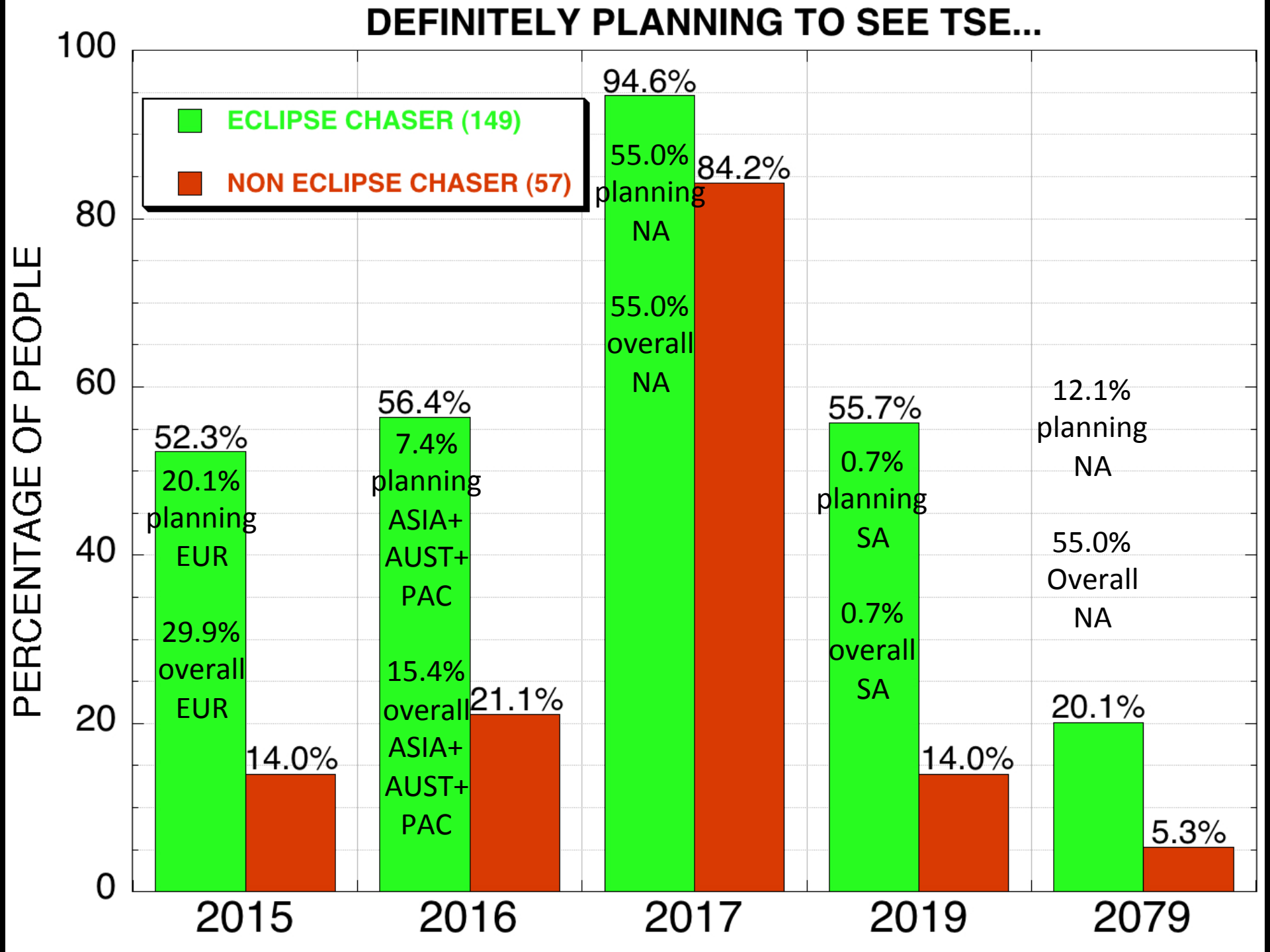


http://www.misterpoll.com/polls/596222/

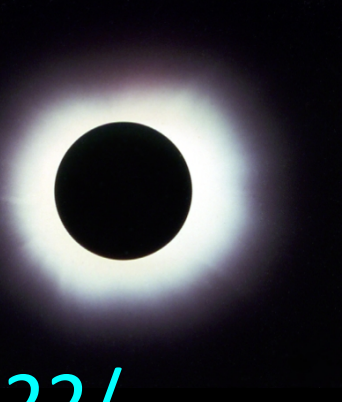
- **PLANNING FOR FUTURE ECLIPSES**


ADVANCED LONG-TERM PLANNING: TSE 1st Priority?
ECLIPSE CHASERS (149)
NON ECLIPSE CHASERS (57)
PERCENTAGE OF PEOPLE
70
60
50
40
30
20
10
0
Juggling Discretionary Activities
54.4%
15.8%
Discretionary Budgeting
43.0%
7.0%
Long-Term Scheduling
56.6%
14.3%


DEFINITELY PLANNING TO SEE TSE...
ECLIPSE CHASER (149)
NON ECLIPSE CHASER (57)
PERCENTAGE OF PEOPLE
100
80
60
40
20
0
52.3%
14.0%
56.4%
21.1%
94.6%
84.2%
55.7%
14.0%
20.1%
5.3%
2015
2016
2017
2019
2079


DEFINITELY PLANNING TO SEE TSE...
ECLIPSE CHASER (149)
NON ECLIPSE CHASER (57)
PERCENTAGE OF PEOPLE
100
80
60
40
20
0
52.3%
20.1% planning EUR
29.9% overall EUR
14.0%
56.4%
7.4% planning ASIA+ AUST+ PAC
15.4% overall ASIA+ AUST+ PAC
21.1%
94.6%
55.0% planning NA
55.0% overall NA
84.2%
55.7%
0.7% planning SA
0.7% overall SA
14.0%
12.1% planning NA
55.0% Overall NA
20.1%
5.3%
2015
2016
2017
2019
2079

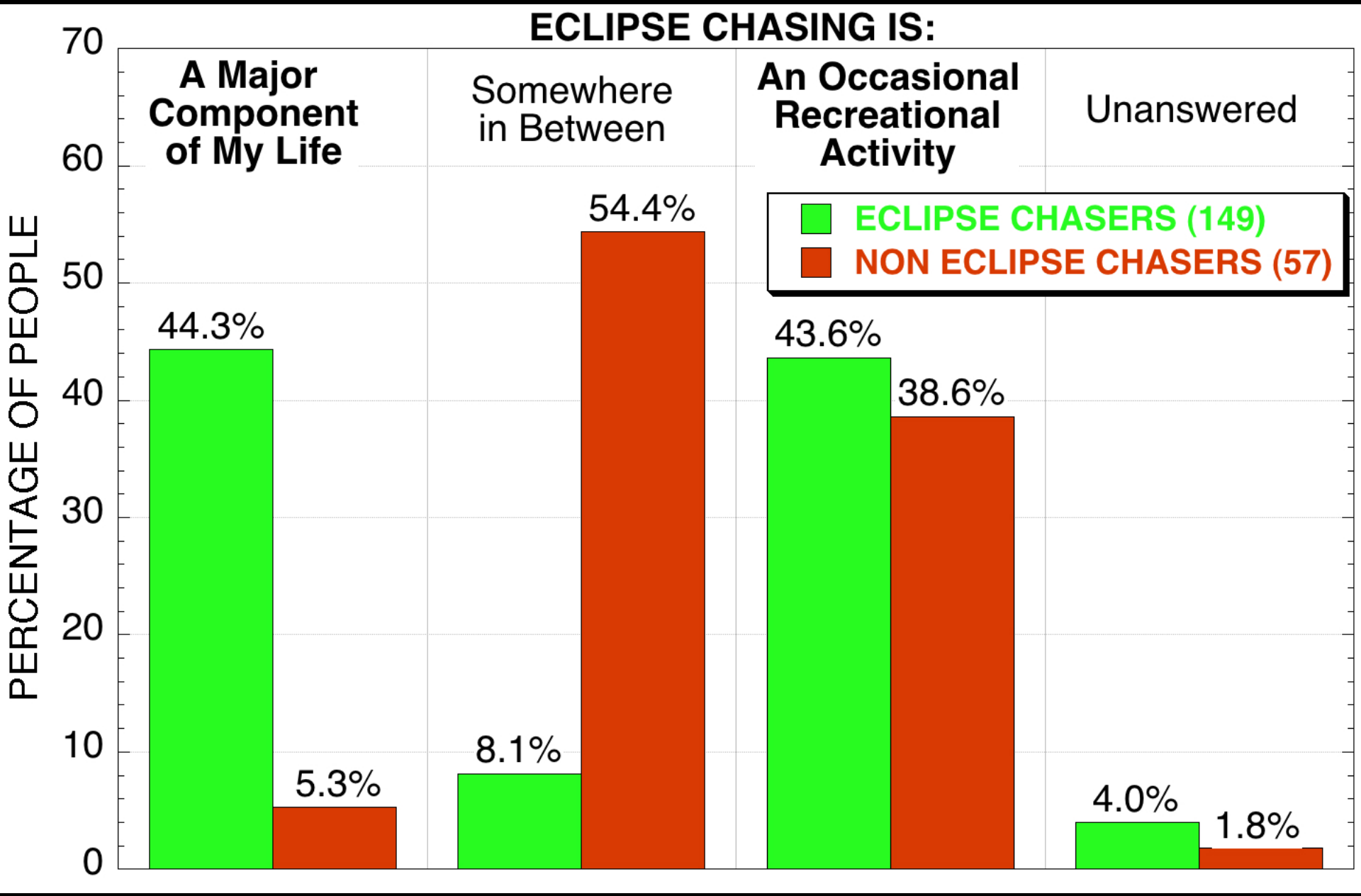
PLANNING AND PREPATIONS



The Demographics of Umbraphillia

http://www.misterpoll.com/polls/596222/

- **IN SUMMARY…**


ECLIPSE CHASING IS:
A Major Component of My Life
Somewhere in Between
An Occasional Recreational Activity
Unanswered
ECLIPSE CHASERS (149)
NON ECLIPSE CHASERS (57)
PERCENTAGE OF PEOPLE
70
60
50
40
30
20
10
0
44.3%
5.3%
8.1%
54.4%
43.6%
38.6%
4.0%
1.8%

COMMENTS BY UMBRAPHILES ON SOLAR ECLIPSE CHASING

"*It defies my understanding why a great many people who enjoy this activity seem to feel the need to adopt a label of being some kind of eccentric nut called an 'umbraphile' or some such.*"

UMBRAPHILE*: (n.) 1. shadow lover (2). one who is addicted to the glory and majesty of total solar eclipses.

Etymology: Latin *umbra* (shadow) + Greek *philos* (loving)

N.B.: The traverse of the lunar umbra heeds no national boundares, and neither do umbraphiles – hence the mixed etymological roots.

**Ref.*: Schneider, 2006, "There (70°S @ 10,177m) and Back Again: An Umbraphile's Tale" in *Astronomical Data and Software Systems XV*, ASP Conference Series, 351, 35

COMMENTS BY UMBRAPHILES ON SOLAR ECLIPSE CHASING

"It is the most spectacular sight one can witness on this planet "

– 9 TSEs, age 63, North America

COMMENTS BY UMBRAPHILES ON SOLAR ECLIPSE CHASING

"Most amazing natural phenomena I have experienced, and find it hard to believe that anything else would top it"

– 2 TSEs, age 63, Australia/Pacific

COMMENTARY ON SOLAR ECLIPSE CHASING

"I think eclipses are beautiful
things to experience.
This is a perfectly adequate and moderate
reason for chasing them."

– 8 TSEs, age 55, Europe

COMMENTS BY UMBRAPHILES ON SOLAR ECLIPSE CHASING

"Viewing a Total Solar Eclipse is not a matter of life and death, it is far more important than that."

– 11 TSEs, age 43, Europe

COMMENTS BY UMBRAPHILES ON SOLAR ECLIPSE CHASING

"I am not a spiritual/religious person,
but a TSE connects me with the
solar system/universe
in a way nothing else can."

– 3 TSEs, age 50, North America

COMMENTS BY UMBRAPHILES ON SOLAR ECLIPSE CHASING

"Eclipse viewing is a peak life experience
and truly addicting.
One visits exotic locations otherwise not seen.
Enjoy company and friendship
of other umbraphiles."

– 7 TSEs, age 58, North America

COMMENTS BY UMBRAPHILES ON SOLAR ECLIPSE CHASING

"Total eclipses are a gift to humanity. It would be an insult to the Will of Fate to refuse to partake in something which is, on all levels, so uniquely - and serendipitously - human. "

– 12 TSEs, age 51, North America

COMMENTS BY UMBRAPHILES ON SOLAR ECLIPSE CHASING

"Excellent combination of my interests: astronomy (focus on transient phenomena), photography, travel, computing, astronomy outreach."

– 13 TSEs, age 66, Australia/Pacific

COMMENTS BY UMBRAPHILES ON SOLAR ECLIPSE CHASING

"I love eclipses … both a 'once in a lifetime' and a 'bucket list' event. A total body experience. I have recommended to literally thousands of people … that they pursue and observe at least one TSE in their lifetimes."

- 1 TSEs, age 58, North America

COMMENTS BY UMBRAPHILES ON SOLAR ECLIPSE CHASING

"I don't consider myself religious, but {TSE2012} was one of the most incredible experiences of my life and I want to experience it some more. "

- 2 TSEs, age 26, Australia/Pacific

COMMENTS BY UMBRAPHILES ON SOLAR ECLIPSE CHASING

"The most spectacular event, natural or manmade, that a human could ever possibly hope to see.
No matter what we do or say, no one can ever change its happening or its phenomenae. …. special indeed!"

– 29 TSEs, age 67, North America

COMMENTS BY UMBRAPHILES ON SOLAR ECLIPSE CHASING

"Better than sex"

– 17 TSEs, age 65, North America