The Mavericks
Comets and Asteroids over the Ages

Robert Dick
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Bruce Peninsula, Dark-Sky Preserve

Comet Variety
- perspective
- tail morphology
- gas/dust content

Map of Impacts
Perhaps a 5-km diam. asteroid

Chelyabinsk, February 2015
20-meter meteoroid
Cost to City greater than cost to environment

Evolution of Human Culture
Fire light - 200,000 years (dark night)
Electric light - 150 years (perpetual twilight)
Creativity, Contemplation
Vacant Streets

Culture and Science in Art
Fire and the Fading Twilight
Creative Mind Before Sleep
Human Record
Perceptive limits
Cultural norms
Social context
Europe Bayeux Tapestry, Circ. 1070s
Scene 32 and 33, Comet Halley and Harold

Great Comet of 1680
Neighbours view comet
Some take measures
over Rotterdam
Lieve Verschuier
Dutch painter
1627-1686

Comets - Early Depictions
Han Dynasty
206 BC–220 AD
Differences in the comet “tails”
Record of Observations
Cataloguing

Change in the Sky
OMENS in the SKY
-Bridged GAP between “Mysteries of their World” and their “Reality”

Celestial change → Earth-bound change

SCIENTIFIC and ARTISTIC RECORDS
say as much about the SOCIETY as about the WORLD

Comet Records
European Bias

Asteroids / Minor Planets
1801 (Piazzi) – Ceres
1802 (Olbers) – Pallas
1807 (Olbers) – Vesta
Spherical limit ~ 500 km
Ida and Eros

- Ida: 60 x 19 km
- Eros: 34 x 11 km

Ida’s "moon" Dactyl: 1.5 km diam.

Battered Rubble
Dusty Surface

**Inference**

- Ice: 0.9 g/cc
- Water: 1 g/cc
- Rock: ~2.5 g/cc
- "Metals": 2.7 – 8.9 Al to Ni (Fe=7.9)

Asteroids – Ice-Rock-Metal or porous (rubble piles)

Surface temperature: -73°C to -143°C
→ lots of ice and porous rock

**Asteroids / Minor Planets**

- 1801 (Piazzi) – Ceres: 952 km diam.
  - Abs. Mag. 3.3
  - Density 2.1 g/cc
- 1802 (Olbers) – Pallas: 524 km diam.
  - Abs. Mag. 4.13
  - Density 3.0 g/cc
- 1807 (Olbers) – Vesta: 512 km diam.
  - Abs. Mag. 3.2
  - Density 3.4

Different composition / structure

**Friend or Foe**

Different orbital “families” and compositions

- Stoney and Metallic → mineral resource
  - or “Shooting Gallery”

**Origins**

- Ice and rock
  - Sublimation of ice
  - Preservation of ice

- Asteroids
  - Inner Solar System

- Comets
  - Outer Solar System

**Composition**

- Water ice + CO₂ + methane + ammonia

- Ices nucleate onto fluffy dust
  - many voids, density < 1 (delicate)
Can Statistics Help?

Distant objects move slowly
Passage by Sun is fast and brief
Most time spent in “deep freeze”
Brief solar passage – vaporization – Comet “turns-on” –

Comet Orbits

Two Extremes
1. short period (<200 years – inside Pluto’s orbit)
   - faint = “old” (many near Sun encounters)
   - “dusty” tail
   - near plane of solar system [affected by planets]
2. long period (>> 200 yrs – > realm of planets)
   - bright = “young”
   - “gaseous” tail
   - rounds the Sun very quickly
   - high “inclination” [immune to planetary gravity]

Asteroids vs Comets

Asteroids
[once discovered]
Orbits → Predictable
Long-term study
Many → Statistics
Orbital and compositional “families”

Comets
[discovery is patient sport]
Rare returns
No two are the same
Patterns are “coarse”
Romantic Spectacle [even for astronomers]

Thank you for coming.
Look up when the sky is clear.

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Apprehension about Change

Impact cratering → regional / planetary disruption
“Biological memory” or “innate fear” of change?

Other Sources
Scot Manley – Russian Meteor
https://www.youtube.com/watch?v=u_faNY70L78