

A black and white engraving depicting a landscape scene. In the foreground, two figures are visible: one standing and looking up at the sky, and another sitting on a rock. The middle ground shows a small town or village with a church spire, nestled in a valley. The background features rolling hills under a dark sky. A large, bright comet with a long, triangular tail is the central focus of the sky. The overall style is that of a 19th-century engraving.

*Giuseppe Piazzi and the Great
Comet of the Year 1811*



LOOKING AT THE COMET TILL YOU



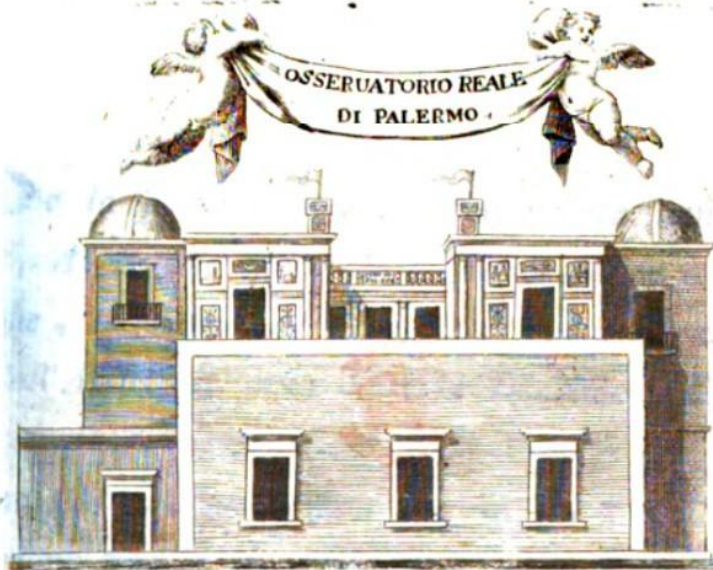
DELLA COMETA

DEL 1811.

OSSERVATA

NELLA SPECOLA DI PALERMO

Dai 9. Settembre ai 11. Gennaio 1812.



PALERMO

DALLA REALE STAMPERIA

"What grounds have we for judging the true mass of comets? What certainty have we that they are solid bodies rather than gaseous ones?"

"Ether has always been regarded as a substance of infinite lightness and as offering scarcely any resistance; how, then, are we to explain the ascent of cometary particles? Should we suppose the ether to become denser than they are?"



IOANNIS KEPLERI,
Mathematici Cæsarei
hanc Imaginem,
ARGENTORATENSIS BIBLIOTHECÆ
Consecr.

DE COMETIS LIBELLI TRES.

- I. *ASTRONOMICVS*, Theoremata continens de motu Cometarum, ubi Demonstratio Apparentiarum & altitudinis Cometarum qui Annis 1607. & 1618. conspecti sunt, noua & ἀξίολογ.
- II. *PHYSICVS*, continens Physiologiam Cometarum nouam & ἀξίολογ.
- III. *ASTROLOGICVS*, de significationibus Cometarum Annorum 1607. & 1618.

AVTORE
IOHANNE KEPLERO,
SAC. CÆS. MAIEST. MATHEMATICO,

Seneca Nat. Quæst. lib. 6. cap. 26.

Erit qui demonstret aliquando, in quibus Cometa partibus errent, cur tam seducti à ceteris eant, quanti qualesq; sint. Contenti sumus inuentis: aliquid veritati & posteris conferant.

Cum Priuilegio Sac. Cæsareæ Maiest.
ad Annos XV.



AVGVSTÆ VINDELICORVM,
Typis Andreae Apergeri, Sumptibus Sebastiani Mylii Bibliopola
Augustani, M. DC. XI K.

Johannes Kepler, *De cometis libelli tres*,
Augustæ Vindelicorum, 1619

Anonymous, Johannes Kepler, 1620
(Chapitre de Saint-Thomas, Strasbourg).

JOHANNES KEPLER

De Cometis libelli tres, Augustæ Vindelicorum, 1619

Ignoscant igitur Philosophi, antiqua dogmata tuentes, nova fabricanti dogmata, seu potius vetera illa Anaxagoræ et Democriti revocanti: quodque huc usque in scholis negatum fuit, in cælo generationes et corruptiones inesse, non minus atque in hac terrestri et rapida aura; id ex professo statuenti.

Et si vero Cometæ in ipso æthereo oriuntur, non tamen ideo circularibus motibus præditos existimo, ut Planetæ; sed rectilineos, ut Bolidas, seu ignes artificiales. (Pag. 100)

Let the philosophers, then, who uphold the ancient doctrines, forgive one who fashions new doctrines—or rather, one who calls back to life those old doctrines of Anaxagoras and Democritus—and who openly maintains that **generation and corruption are present in the heavens no less than in this terrestrial and ever-changing atmosphere. And even if comets do arise in the ether itself, I do not therefore suppose that they are endowed with circular motions, like the planets, but rather with rectilinear motions, like bolides or fireworks.**

Nec minus ætherem Cometis refertum esse puto, quam Oceanum piscibus. Quod autem rari apparent nobis, ingens ætheris vastitas in causa est. [...] Sæpe etiam prius videri quam esse desinunt. Nec minus ætherem Cometis refertum esse puto, quam Oceanum piscibus. Quod autem rari apparent nobis, ingens ætheris vastitas in causa est. [...] Sæpe etiam prius videri quam esse desinunt. Cum enim præterita semel tellure, iam porro in profundum ætheris feruntur, a tellure discedentes; paulatim minori cernuntur angulo, & tandem evanescunt. Ut plurimum etiam conduntur sub sole radiosi, atque deficiunt modis incognitis; incertumque tunc, utrum extinguantur, dissiliant, dissipentur, an deflagrent cinisque fiant. (Ibid.)

Nor do I think the ether any less filled with comets than the Ocean is with fish. The reason why they appear so rare to us is the immense vastness of the ether. [...] They often become visible before they cease to exist. For once they have passed beyond the Earth, they are carried ever farther into the depths of the ether, receding from the Earth; gradually they are seen at a smaller and smaller angle, and eventually disappear. For the most part, moreover, they are concealed beneath the Sun's radiant light, and vanish by means unknown to us; and it is then uncertain whether they are extinguished, broken apart, dispersed, or consumed by fire and reduced to ashes.

Coacta materia in orbem, ex natura omnium rerum, quae uniuntur, & sole rectis radiis pellucidum hunc globum ferientibus atque penetrantibus, existimo sequi aliquid de intima Cometa materia, exireque viam eandem, quàm prerrumpunt Solis radii: atque hoc pacto corpus Cometæ perlui, colorari, & denique annullari, & sicut Bombices filo fundendo, sic Cometas Cauda expiranda consumi & denique mori. Sic penes nos hic in terris, Sole & linteis, omne genus colorum extinguit & delet, materiam, in qua color habet, disiciens: usque adeo plane candidissima fiant. (*Ibid.*)

When the matter has been gathered into a spherical form, in accordance with the nature of all things that coalesce, and as the Sun strikes and penetrates this transparent globe with its direct rays, I suppose that some portion of the comet's innermost matter follows [the same course] and makes its way out along the same path through which the Sun's rays force their passage; and that in this manner the body of the comet is permeated by the rays, takes on colour, and is finally annihilated; and that, just as silkworms consume themselves in producing their thread, so **comets consume themselves in expelling their tails and finally perish**. Thus here on Earth the Sun, acting upon linen, extinguishes and effaces every kind of color by breaking down the matter in which the color resides, until the linen becomes perfectly white.



PHILOSOPHIÆ
NATURALIS
PRINCIPIA
MATHEMATICA.

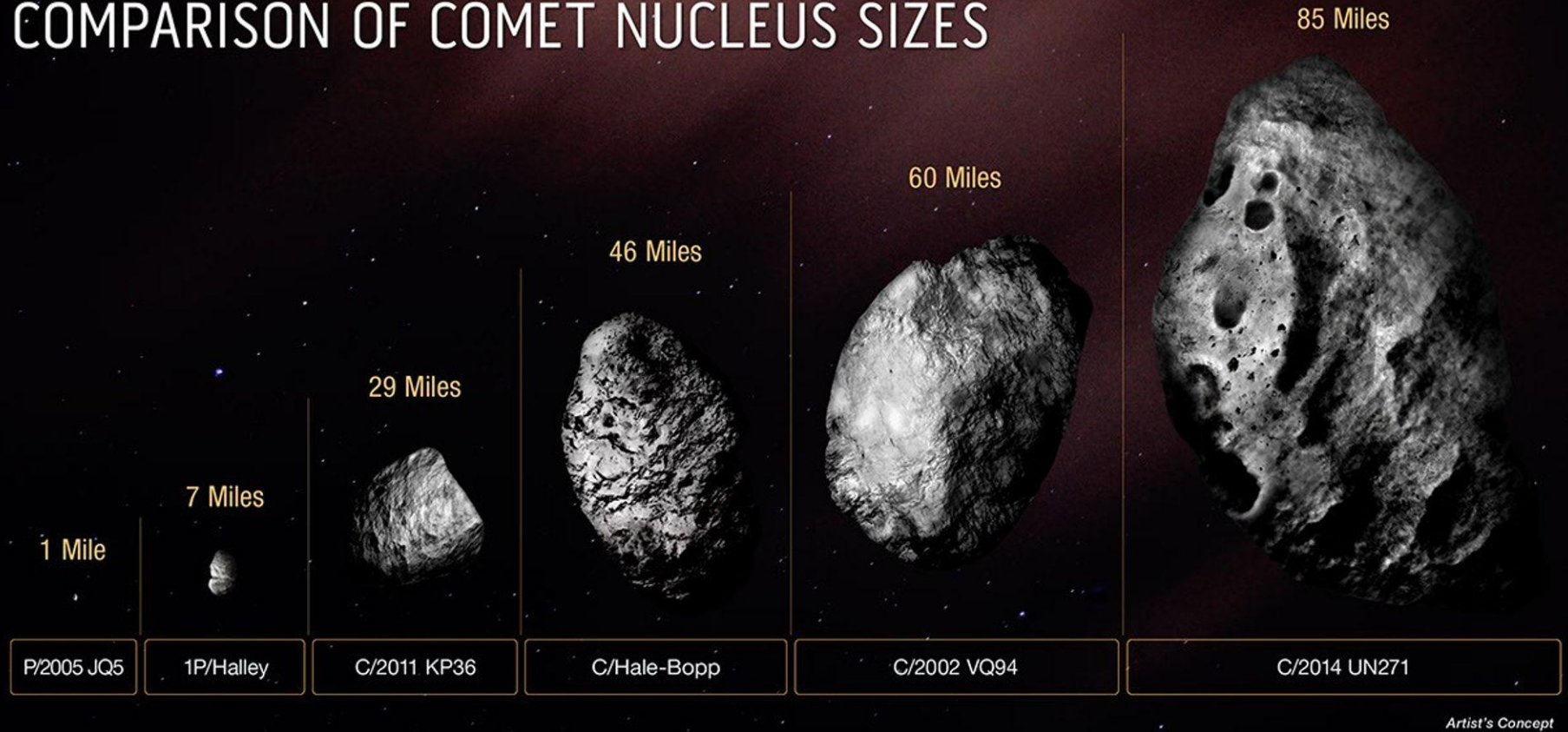
Autore ^{aut} J. S. NEWTON ^{Scripte Lincol.} Trin. Coll. Cantab. Soc. Matheseos
Professore ^{et Societatis Regiæ Sodali} Lucasiano, & Societatis Regiæ Sodali.

IMPRIMATUR.
S. PEPYS S, Reg. Soc. PRÆSES.
Julii 5. 1686.

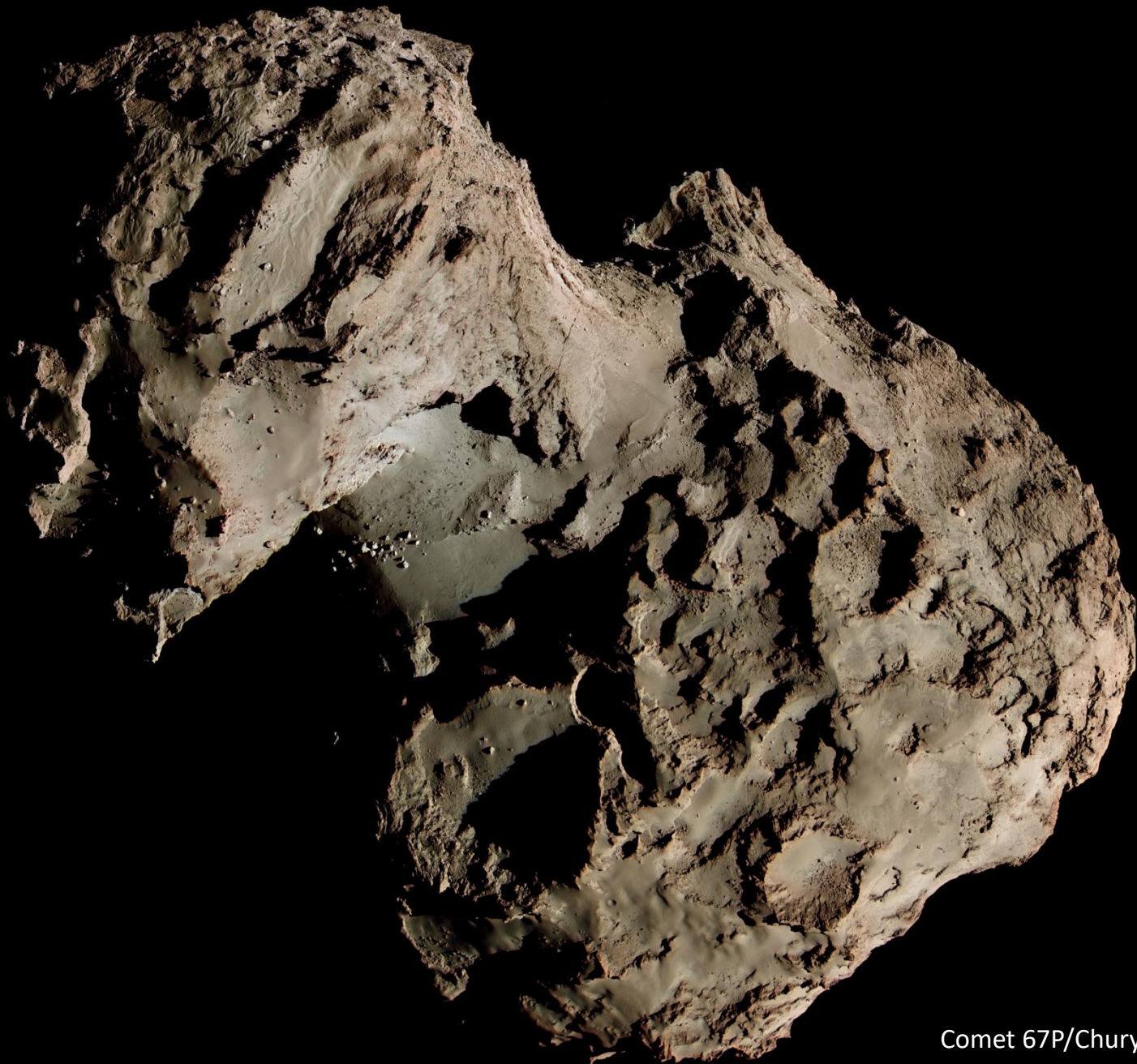
LONDINI,

Jussu Societatis Regiæ ac Typis Josephi Streater. Prostat apud
plures Bibliopolas. Anno MDCLXXXVII.

COMPARISON OF COMET NUCLEUS SIZES



Comet C/2014 UN271 (Bernardinelli-Bernstein) is currently the record-holder for big comets (85 miles). Credit: NASA, ESA, Zena Levy (STScI)



Comet 67P/Churyumov-Gerasimenko
on 3 August 2014 from a distance of 285 km



JOHANNES FLAMSTEEDIUS *Derbiensis*
Astronomiae Professor Regius. Anno Aetatis 74 Obijt
Decem. 31 1719

The Great Comet of 1680

$$\left(\frac{1000}{6}\right)^2 = \frac{1000000}{36} \sim 28000$$

$$\frac{28000}{3} \cdot \frac{1}{4} > 2000$$

For the Sun's rays do not act any way upon the mediums which they pervade, but by reflection and refraction. And those reflecting particles heated by this action, heat the matter of the Ether which is involved with them. That matter is rarefied by the heat which it acquires, and because by this rarefaction the specifick gravity, with which it tended towards the Sun before, is diminished, it will ascend therefrom like a stream, and carry along with it the reflecting particles of which the tail of the comet is composed; the impulse of the Sun's light [...] promoting the ascent. (Isaac Newton, A Treatise of the System of the World, London, 1728, pag. 124)

Will: Whiston
A. M.



A NEW
T H E O R Y
OF THE
E A R T H,

From its ORIGINAL, to the
CONSUMMATION of all Things.

WHEREIN
The CREATION of the World in Six Days,
The Universal DELUGE,
And the General CONFLAGRATION,
As laid down in the Holy Scriptures,
Are shewn to be perfectly agreeable to
REASON and PHILOSOPHY.

With a large Introductory Discourse concerning the Genuine Nature, Stile, and Extent of the *Mosaic* History of the CREATION.

By WILLIAM WHISTON, M. A.
Chaplain to the Right Reverend Father in God,
JOHN Lord Bishop of NORWICH, and
Fellow of *Clare-Hall* in Cambridge.

L O N D O N:

Printed by R. Roberts, for Benj. Tooke at the
Middle-Temple-Gate in *Fleet-street*. MDCXCVI.

V. *Observations of a Comet, with Remarks on the Construction of its different Parts.* By William Herschel, LL.D. F.R.S.

Read December 19, 1811.

THE comet which has lately visited the solar system has moved in an orbit very favourably situated for astronomical observations. I have availed myself of this circumstance, and have examined all the parts of it with a scrutinizing attention, by telescopes of every degree of requisite light, distinctness, and power.

The observations I have made have been so numerous, and so often repeated, that I shall only give a selection of such as were made under the most favourable circumstances, and which will serve to ascertain the most interesting particulars relating to the construction of the comet.

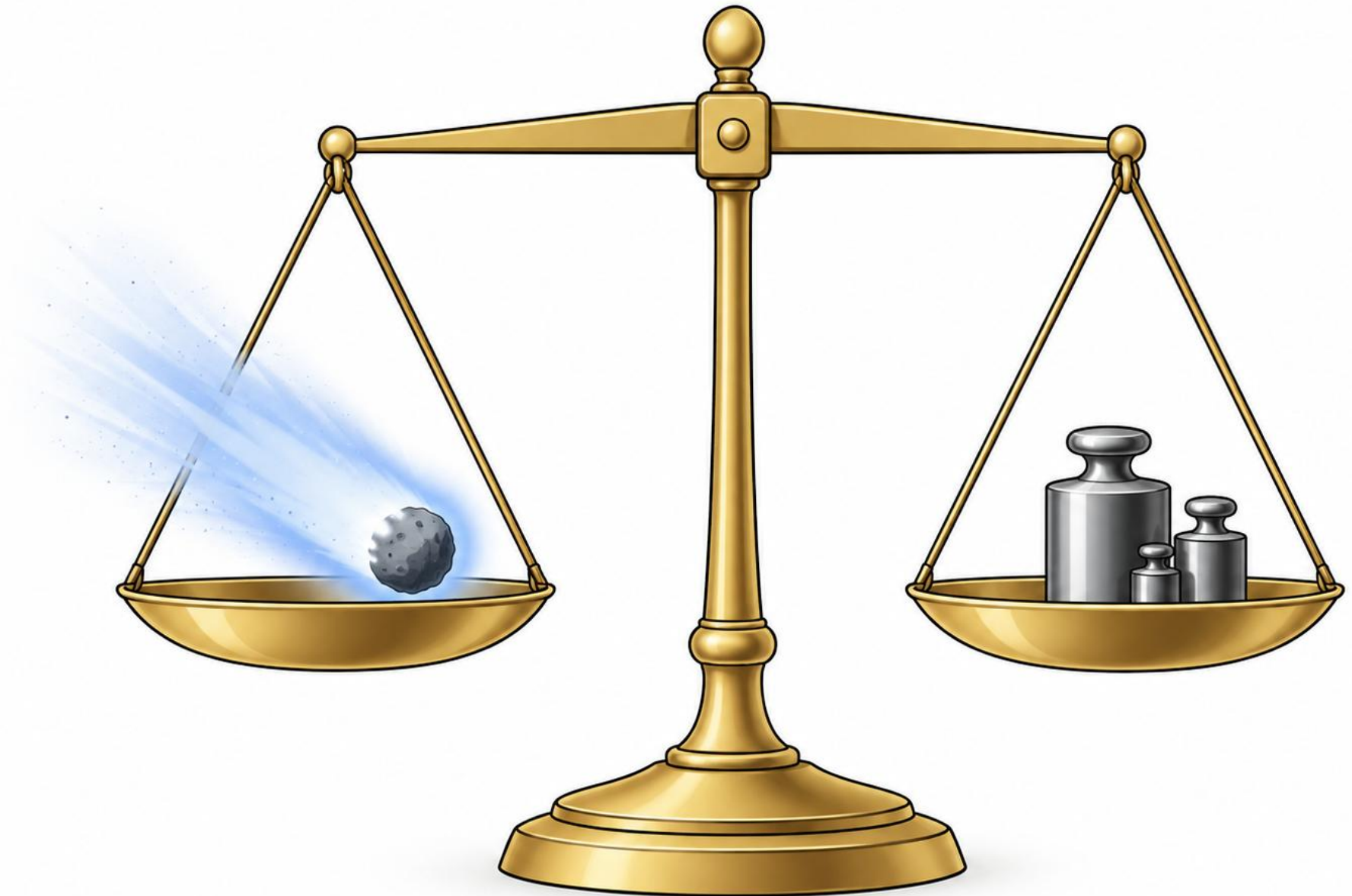
As my attention in these observations were every night directed to as many particulars as could be investigated, it will be most convenient to assort together those which belong to the same object; and in the following arrangement I shall begin with the principal part, which is

The planetary Body in the Head of the Comet.

By directing a telescope to that part of the head where with the naked eye I saw a luminous appearance not unlike a star; I found that this spot, which perhaps some astronomers may call a nucleus, was only the head of the comet; but that within

Prego!

How much does a comet *weigh*?



Pierre-Simon Laplace (1749 –1827)

Gravitation perturbation method (1805)

228 MÉCANIQUE CÉLESTE,

En supposant, comme dans le livre VI,

$$m' = \frac{1}{329630};$$

et faisant $T = 2042^j,682$, on trouve

$$\delta T = -2^j,046,$$

c'est la quantité dont l'action de la terre a diminué la durée de la révolution de la comète.

230 . MÉCANIQUE CÉLESTE,

Si l'on suppose la masse m de la comète, égale à la masse m' de la terre, on trouve pour l'augmentation $\delta T'$ de l'année sydérale,

$$\delta T' = 0^j,11612.$$

Nous sommes bien certains par toutes les observations, et surtout par les nombreuses comparaisons des observations de Maskeline, que Delambre vient de faire pour construire ses tables du soleil, que la comète de 1770 n'a pas altéré de $2^j,8$, l'année sydérale; ainsi nous pouvons être sûrs que sa masse n'est pas $\frac{1}{5000}$ de celle de la terre.

Il résulte des calculs du chapitre précédent, que cette comète a traversé le système entier des satellites de Jupiter; et cependant elle ne paraît pas y avoir causé la plus légère altération.

Optical (photometric) method (1857)

$$6\,000\,000\,000\,000\,000\,000\,000\,kg \cdot \frac{1}{194\,000\,000\,000\,000\,000} \approx 30\,000\,kg$$

Actual estimated mass $\approx 6 \cdot 10^{13}$ kg

Édouard Albert Roche (1820–1883)

Extent of cometary atmospheres method (c. 1860)

Mass of Donati's Comet

$$\frac{M_c}{M_e} = 0.000047$$

$$5.7 \cdot 10^{21} t \cdot 0.000047 = 268 \text{ billion } t$$

Mass of Encke's Comet

$$\frac{M_c}{M_e} = \frac{1}{1,000} = 5.7 \text{ trillion } t$$

Édouard Albert Roche (1820–1883)

As compared with the mass of the earth the mass of Donati's comet would be equal to 0.000047; that is to say, to about the twenty-thousandth part of the former, or about fifty-three times the mass of the terrestrial atmosphere. It would be equal in weight to a sphere of water of 250 miles radius, or to about 268,000 billions of tons—a very different estimate indeed to the pounds of M. Babinet! As regards the density, M. Roche deduces it from the diameters of the nucleus and the nebulosity, which in October 1858 were nearly 4" and 50", or 990 miles and 12,400 miles respectively. Assuming that the mass remained unchanged from June, the date of the first determination, to the month of October, and that the mass of the nebulosity was the 1,000th part of the total mass, the density of the nucleus would be almost an eighth of that of water, and the density of the nebulosity about the 154,000th part of that of atmospheric air.

Encyclopædia Britannica

The COMETS are solid opaque bodies, with long transparent trains or tails, issuing from that side which is turned away from the sun. They move about the sun in very excentric ellipses; and are of a much greater density than the earth; for some of them are heated in every period to such a degree, as would vitrify or dissipate any substance known to us. Sir Isaac Newton computed the heat of the comet which appeared in the year 1680, when nearest the sun, to be 2000 times hotter than red-hot iron; and that, being thus heated, it must retain its heat until it comes round again, although its period should be more than twenty thousand years; and it is computed to be only 575.