Comet Section

Denning's lost comet has been found

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Director

Figure 1. William Frederick Denning, first Director of the BAA Comet Section and discoverer of D/1894 F1 (2007 HE4).

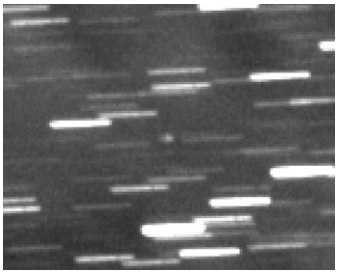

Figure 2. 2007 HE4. This is a crop from a stack of 51×30 s exposures, mid-time 2007 Apr 18.875 UTC. The field is 5.0×4.0 arcmin, with north up, and a pixel size of 2.14 arcsec. 0.40-m Schmidt–Cassegrain plus CCD. *(Peter Birtwhistle)*

The first Director of the Comet Section, William Frederick Denning (Figure 1), discovered his fifth and final comet from Bristol on the evening of 1894 Mar 26. At the time, the comet was in northern Leo but it was already quite faint at around 12th magnitude, having passed through perihelion around six weeks earlier. It was initially designated 1894a. A very preliminary orbit indicated that the comet was probably periodic.[1] Further astrometry was collected through April, May, and June, with orbit calculations showing that the comet had a period of around 7.5 years and a perihelion distance of around 1.1 au.[2] The last astrometry of the comet was obtained on 1894 Jun 5.91 and it was not seen at subsequent returns. It was eventually designated D/1894 F1 (Denning).

In 1977, Richard Buckley published a paper on lost comets in the *Journal*.[3] This paper reviewed 11 lost periodic comets, including D/1894 F1 (at that time called 1894 I). Buckley recomputed the orbit from the 1894 observations, obtaining a period of 7.39 years. He rated the chance of recovery of the comet as 'fair', although it had not been seen at any of the 10 returns since its discovery. We now know that the actual period in 1894 was 7.43 years. Buckley's paper also included Denning's other lost comet, 1881 T1, his first discovery, which was recovered in 1978 and is now known as 72P/Denning–Fujikawa.

On 2007 Apr 17, an apparently asteroidal object was discovered by the Lincoln Near-Earth Asteroid Research (LINEAR) survey and designated 2007 HE4. Peter Birtwhistle imaged this object on that night (Figure 2) and reported it as magnitude 19.1. The object was observed until May 18, and the short arc allowed computation of its orbit. 2007 HE4 was in an elliptical orbit with perihelion distance q = 1.6 au and a period of around 9.3 years.

On 2024 Jul 25, Peter Van Wylen posted on the **comets-ml** mailing list that his analysis demonstrated that 2007 HE4 had shown cometary activity in 2007.[4] Two days later, Maik Meyer responded that he had managed to link the two objects. Peter Birtwhistle then checked his images from 2007 and confirmed that the object was extended to the east. 2007 HE4 had been the first observed return of D/1894 F1 since the original discovery, but nobody had realised this at the time!

Comet orbits can be subject to significant perturbations due to the gravitational effects of the planets, mainly Jupiter, and so the orbital elements change with time. This explains the different periods of D/1894 F1 and 2007 HE4. Meyer provided the following orbital elements for D/1894 F1 for epoch 2025 Dec 1.0 TT on the Comet Section mailing list:[5]

Perihelion	2025 Dec 4.06727 TT = 1:36:52 (JD 2461013.56727)
A1 -3.83×10^{-9}	*A2* 3.58×10^{-10} au/day^2
Epoch	2025 Dec 1.0 TT = JDT 2461010.5
M 359.67526526	*Ma* 0.0222
n 0.10587093	*Peri.* 109.41912
a 4.42538997	*Node* 20.62196
e 0.6471858	*Incl.* 4.02545 (J2000 ecliptic)

P 9.31 H 15.0 *G* 0.15 *q* 1.5613 *Q* 7.2894

242 of 312 observations 1894 Mar. 27 – 2007 May 18; mean residual 3.28″

I have used these elements to integrate the orbit back to 1890, showing how the period has changed over time (Figure 3). Using the reported magnitudes of 2007 HE4 and adjusting for the very inaccurate magnitudes reported in 1894, I get a magnitude formula of:

$$m1 = 14 + 15 \log10(r) + 5 \log10(d)$$

Using the integrated orbit, the magnitude of the object can be estimated. It was at its brightest for the return of 1894 and only reached magnitude 18 in 2007. Sam Deen has investigated the circumstances of various returns and in most cases the geometry is very poor.[6] So far, no images of the comet have been found at any of the other returns.

The next perihelion is in 2025 Dec, when the comet might reach 18th magnitude again with an approach to the Earth of less than 1 au in 2026 Mar. This will hopefully provide an opportunity to image the comet again, 131 years after its original discovery.

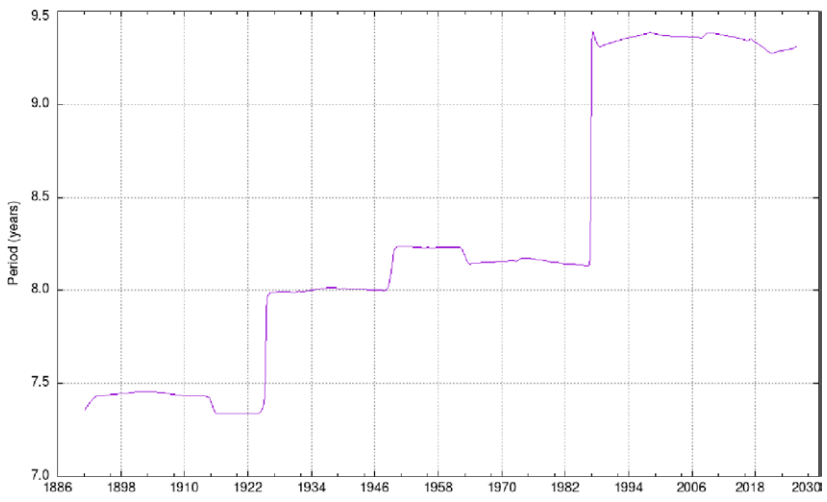

Figure 3. The orbital period of the comet has evolved over time, mainly due to encounters with Jupiter.

1 *J. Br. Astron. Assoc.*, **4**(5), pp. 18–19 (1894)
2 Kronk G. W., *Cometography: Volume 2*, 1800–1899, Cambridge University Press, 2003, pp. 715–717
3 *J. Br. Astron. Assoc.*, **87**(3), pp. 226–239 (1977)
4 **bit.ly/3XMgBvw**
5 **bit.ly/3zovUB4**
6 *Central Bureau Electronic Telegram*, 5425, 2024 Aug 2