On the Evolved Nature of CK Vul

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CK Vul is classified as, amongst others, the slowest known nova, a hibernating nova, or a very late thermal pulse object. Following its eruption in AD 1670, the star remained visible for 2 years. A 15-arcsec nebula was discovered in the 1980's, but the star itself has not been detected since the eruption. We here present radio images which reveal an 0.1-arcsec radio source with a flux of 1.5 mJy at 5 GHz. Deep Hα images show a bipolar nebula with a longest extension of 70 arcsec, with the previously known compact nebula at its waist. The emission-line ratios show that the gas is shock-ionized, at velocities $> 100\,\mathrm{km\,s^{-1}}$. Dust emission yields an envelope mass of $\sim 5\times10^{-2}\,\mathrm{M_\odot}$. Echelle spectra indicate outflow velocities up to $360\,\mathrm{km\,s^{-1}}$. From a comparison of images obtained in 1991 and 2004 we find evidence for expansion of the nebula, consistent with an origin in the 1670 explosion; the measured expansion is centred on the radio source. No optical or infrared counterpart is found at the position of the radio source. The radio emission is interpreted as thermal free-free emission from gas with $T_\mathrm{e} \sim 10^4\,\mathrm{K}$. The radio source may be due to a remnant circumbinary disk, similar to those seen in some binary post-AGB stars. We discuss possible classifications of this unique outburst, including that of a sub-Chandrasekhar mass supernova, a nova eruption on a cool, low-mass white dwarf, or a thermal pulse induced by accretion from a circumbinary disk.