H$_3^+$, the cornerstone molecule of interstellar chemistry, was first detected in interstellar space in 1996\textsuperscript{b} in the dense molecular clouds GL2136 and W33A. We have now extended this ion’s diagnostic powers to the diffuse interstellar medium with the detection of H$_3^+$ along the line of sight to the visible star Cygnus OB2 No. 12\textsuperscript{c}. Three rovibrational transitions in the 3.7 \textmu m region were observed using the CGS4 infrared spectrometer at the United Kingdom Infrared Telescope and the high-resolution Phoenix spectrometer at the Kitt Peak National Observatory.

We have developed a simple chemical model of interstellar chemistry which describes the abundance of H$_3^+$ in both diffuse and dense clouds. The application of this model to Cygnus OB2 No. 12 shows that this line of sight has H$_3^+$ number density $[\text{H}_3^+] \sim 4 \times 10^{-7}$ cm$^{-3}$, effective path length $L \sim 300$ pc, and hydrogen number density $[\text{H}] + 2[\text{H}_2] \sim 20$ cm$^{-3}$. The H$_3^+$ absorptions also provide an estimate of the effective kinetic temperature of the medium $T \sim 27$ K.

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