We have performed a series of optical-optical double resonance experiments with one or two cw Ti:sapphire lasers, to excite the $2^1\Pi_g$ state of Rb$_2$, recording infrared fluorescence from $2^1\Pi_g$ on a Fourier transform spectrometer. Fluorescence from the lower vibrational levels of $2^1\Pi_g$ ($T_e = 22069.56$ cm$^{-1}$) is dominated by transitions to the $B^1\Pi_u$ state studied by Amiot and Vergès$^a$. Vibrational and rotational relaxation from laser-pumped levels $v' < 15$ now give a rather complete description around the potential minimum of the $2^1\Pi_g$ state, completing the observations for $6 \leq v \leq 50$ reported by Han et al$^b$ last year. Fluorescence from $v' > 35$, occurs also to the $0^+$ components of the $A^1\Sigma^+_u \sim b^3\Pi_u$ complex. Fitting all available $2^1\Pi_g \rightarrow B^1\Pi_u$ data for $^{85}$Rb$_2$ and $^{85}$Rb$^{87}$Rb (several thousand transitions) has also given an improved description of the bottom of the $B^1\Pi_u$ state potential well. The $2^1\Pi_g$ state correlates at long-range with Rb 5s + Rb 4d $^2D_{5/2}$ atoms$^c$, giving a dissociation energy of 1279.6 cm$^{-1}$. Most new data lie below $v = 45$, 250 cm$^{-1}$ below this dissociation threshold.