In the spin and charge striped-ordered cuprate La$_{1.875}$Ba$_{0.125}$CuO$_4$, the bulk superconducting $T_c$ is strongly suppressed to about 4K. Nevertheless, recent experiments revealed unusual superconducting fluctuations far above $T_c$. In particular, these experiments show evidence for 2D superconductivity in this 3D (albeit anisotropic) system, which is unprecedented. We propose an explanation of these results in terms of a new phase, the “striped superconductor”, in which the superconducting order parameter is modulated periodically in space and averages to zero. Such a state can naturally explain the apparent vanishing of the inter-layer Josephson coupling in La$_{1.875}$Ba$_{0.125}$CuO$_4$. We discuss several phenomenological features of this phase, including a unique sensitivity to disorder which can lead to an xy “gauge glass” phase that breaks time reversal symmetry spontaneously. Possible microscopic mechanisms leading to striped superconductivity will be briefly discussed.