The term “auroral arc” is used variously to describe quasi-static structures resulting from inverted-V precipitation, more dynamic structures occurring at substorm breakup, and even structure within the diffuse aurora. In general, however, arcs are structured regions of enhanced energy exchange between the magnetosphere and upper atmosphere, typically transferring between 1-100 kW per square km of sky in the form of accelerated electron flux and Joule dissipation. Ground-based optical observations provide a wealth of information on fundamental arc properties including shapes, sizes, orientations, lifetimes, characteristic frequencies of oscillation (if any), multiplicity, and more. Yet the literature contains surprisingly few statistical studies of these basic parameters, leaving candidate arc theories largely unconstrained. This talk summarizes observational constraints taken from both ground-based and in-situ measurements and compares with candidate arc theories including those based on dispersive Alfven waves, ionospheric feedback, and distant “generators” consisting of electric field discontinuities. The conclusion of this comparison is that no existing theory satisfies all constraints, indicating that an additional mechanism or mechanisms must be found.