Penetration of electromagnetic fields into enclosures or cavities through apertures in the cavity walls has been of interest for many years, yet there are aspects of this important subject which apparently are not widely understood. And there are several fundamentally different methods which researchers have employed over the years to determine interior fields when an aperture-perforated structure is illuminated by radiation from a known exterior source, though the advantages and disadvantages of available methods are rarely delineated. For the simple structure of a perfectly conducting, vanishingly thin shell which possesses an aperture and which encloses a volume region filled with homogeneous material, computation of the interior field caused by a known exterior source can be quite problematic: some methods yield highly inaccurate interior fields, especially when the penetration is weak, and some methods which might otherwise lead to accurate data fail at cavity “resonances” even though the interior is not completely enclosed by the cavity walls – there is an aperture present. In this paper, “problems with aperture theory” are addressed. Several methods for solving aperture problems are outlined in general and the solution accuracies that one might expect from them are discussed. Why some methods are more accurate than others is explained. It is pointed out why some methods fail at cavity “resonances,” though there is no physical basis for this failure when the cavity shell is perforated by an aperture. Moreover, it is demonstrated by means of simple examples that the interior fields can be determined and expressed in forms free of the singularities inherent in the expressions for these fields arrived at by means of “aperture theory.” For the most part, difficulties that one might encounter in aperture theory and how they can be circumvented are illustrated by solutions of simple aperture problems for which closed-form expressions for interior fields can be found.