We first consider the scattering of time harmonic plane waves by a perfectly conducting infinite cylinder of cross section $D$. We observe that the Dirichlet eigenvalues for the Laplacian in $D$ can be determined from the far field pattern of the scattered wave and hence from the Faber-Krahn inequality we can obtain a lower bound for the area of $D$. We then consider the corresponding problem for a dielectric cylinder. Here we observe that a relatively new type of spectra called transmission eigenvalues can be determined from the far field pattern of the scattered wave and show that infinitely many transmission eigenvalues exist and form a discrete set. We then obtain a Faber-Krahn type inequality for transmission eigenvalues which, if $D$ is known, provide a lower bound on the index of refraction $n(x)$. Of special interest is the case when cavities may be present, i.e. regions where $n(x)=1$. We consider both isotropic and anisotropic materials. (Received August 20, 2009)