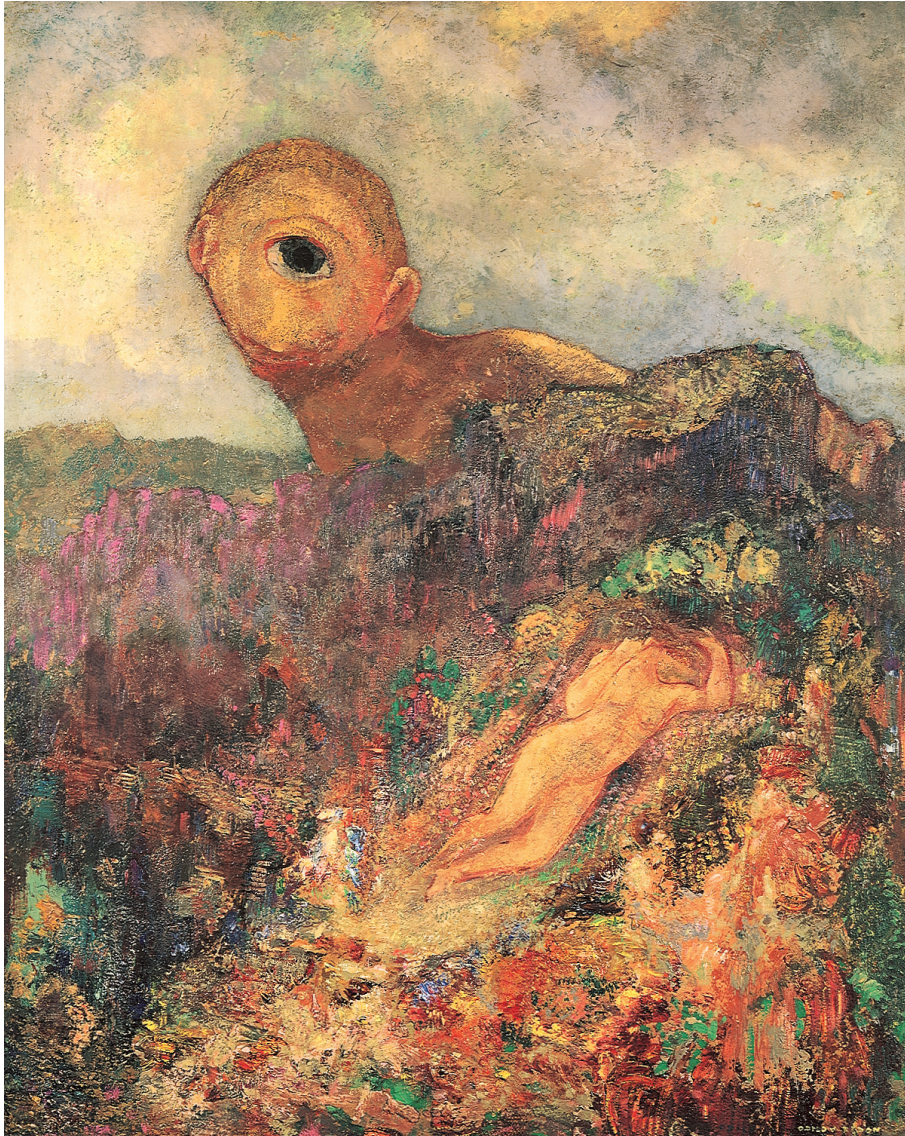


Part I

Camera Geometry and Single View Geometry



The Cyclops, c. 1914 (oil on canvas) by Odilon Redon (1840-1916)
Rijksmuseum Kroller-Muller, Otterlo, Netherlands /Bridgeman Art Library

Outline

This part of the book concentrates on the geometry of a single perspective camera. It contains three chapters.

Chapter 6 describes the projection of 3D scene space onto a 2D image plane. The camera mapping is represented by a matrix, and in the case of mapping points it is a 3×4 matrix P which maps from homogeneous coordinates of a world point in 3-space to homogeneous coordinates of the imaged point on the image plane. This matrix has in general 11 degrees of freedom, and the properties of the camera, such as its centre and focal length, may be extracted from it. In particular the internal camera parameters, such as the focal length and aspect ratio, are packaged in a 3×3 matrix K which is obtained from P by a simple decomposition. There are two particularly important classes of camera matrix: finite cameras, and cameras with their centre at infinity such as the *affine camera* which represents parallel projection.

Chapter 7 describes the estimation of the camera matrix P , given the coordinates of a set of corresponding world and image points. The chapter also describes how constraints on the camera may be efficiently incorporated into the estimation, and a method of correcting for radial lens distortion.

Chapter 8 has three main topics. First, it covers the action of a camera on geometric objects other than finite points. These include lines, conics, quadrics and points at infinity. The image of points/lines at infinity are vanishing points/lines. The second topic is camera calibration, in which the internal parameters K of the camera matrix are computed, without computing the entire matrix P . In particular the relation of the internal parameters to the image of the absolute conic is described, and the calibration of a camera from vanishing points and vanishing lines. The final topic is the *calibrating conic*. This is a simple geometric device for visualizing camera calibration.