Remote sensing as a technology can be said to have started with the appearance of the first photographs. The so-called aerial photo - emerged in the 1840s with pictures taken from balloons. By the First World War, cameras mounted on airplanes provided aerial views of fairly large surface areas that proved invaluable in military reconnaissance. From then until the early 1960s, the aerial photograph remained the single standard tool for depicting the earth surface.
The mission to the Moon needed maps of the lunar surface, especially of the proposed landing sites. These were prepared using remote sensing techniques.

The first multispectral photography done from space was on the famous 1968 Apollo 9 manned mission. Four Hasselblad cameras were mounted in a holder such that they all aimed at the same target point when their shutters were triggered simultaneously.

Images from the Apollo 9 multispectral four-lens camera were digitized and used to develop techniques for processing Landsat data, which, in 1969, was still four years away.

APOLLO PROGRAM

- The Lens
- The Shutter
- The Film Magazine
- The Lens Cone
- The Drive Mechanism

ELEMENTS OF AERIAL CAMERAS
SCHEMATIC DIAGRAM OF AN AERIAL CAMERA

CROSS-SECTIONAL VIEW OF AN IMAGE FORMED BY A SIMPLE LENS
Relative Aperture \( f \) = Focal length/aperture size

CHROMATIC ABERRATION
Complex lenses are corrected for this effect.

APERTURE STOP

Relative Aperture \( f \) = Focal length/aperture size

bright \[\text{dim}\]

aperture

\begin{tabular}{ccccccc}
\text{f stop} & f 2 & f 2.8 & f 4 & f 5.6 & f 8 & f 16 & f 22 & f 32 \\
relative brightness & 100\% & 50\% & 25\% & 12\% & 6\% & 3\% & 1.5\% & 0.7\% \\
\end{tabular}
AERIAL CAMERAS

1. Metric Cameras
   (cartographic cameras)
2. Reconnaissance Cameras
3. Strip Cameras
4. Panoramic Cameras

Strip Camera

Panoramic Camera
AERIAL FILMS

1. Black and White
2. Color Reversal (like Slides)
3. Normal Color
4. Color Infrared

FIGURE 3.10. Spectral sensitivities of two photographic films. (a) Black-and-white panchromatic film (Kodak TRI-X Aerographic Film 2403). (b) Black-and-white infrared film (Kodak Infrared Aerographic Film 2424). Copyright Eastman Kodak Company. Permission has been granted to reproduce this material from KODAK Data for Aerial Photography (Code: M-29), courtesy of Silver Pixel Press, official licensee and publisher of Kodak books.
Aerial photographs can be classified according to the orientation of the camera in relation to the ground at the time of exposure.

1. High Oblique
2. Low Oblique
3. Vertical
FIGURE 3.21. Oblique and vertical aerial photographs.
CALCULATING THE SCALE OF A VERTICAL AERIAL PHOTOGRAPH

- Scale defines the relationship between linear distance on a vertical photograph and the corresponding actual distance on the ground.
- Scale is expressed as a representative fraction (RF) between linear measurements on the photo and corresponding distances on the ground.

\[ \text{RF} = \frac{f}{H} \]

- For area measurements in the photo:
  1) Planimeter
  2) Weight
  3) Counting Points

FIGURE 3.5. Schematic representation of terms to describe geometry of vertical aerial photographs.
INTRODUCED ERRORS BY PLANE MOVEMENTS
Pilots normally acquire vertical photographs by flying a series of parallel flight lines that together build up complete coverage of a specific region.

Each flight line consists of individual frames, usually numbered in sequence.

**MOSAICS**

A series of vertical aerial photographs.
The displacement of an object caused by a change in the point of observation is called parallax.

Stereoscopic parallax is caused by taking photographs of the same object but from different points of observation.
ORTHOPHOTOS

Stereoscopic photographs can be used to generate a corrected form of an aerial photograph known as an orthophoto that shows photographic detail without the errors caused by tilt and relief displacement.

What is the difference between an aerial photograph and an orthophoto?

1. A conventional perspective aerial photograph contains image displacements caused by the tilting of the camera and terrain relief (topography). It does not have a uniform scale. You cannot measure distances on an aerial photograph like you can on a map. It is not a map.
2. The effects of tilt and relief are removed from the aerial photograph by the rectification process to create an orthophoto.
3. An orthophoto is a uniform-scale photograph. It is a photographic map.
4. Since an orthophoto has a uniform scale, it is possible to measure directly on it like other maps.
5. An orthophoto may serve as a base map onto which other map information may be overlaid.

FROM PHOTOGRAPHS TO DIGITAL DATA

In late July 1972 NASA launched the first Earth Resources Technology Satellite (ERTS-1). The multispectral data provided by the on-board sensors led to an improved understanding of crops, minerals, soils, urban growth, and many other Earth features and processes. The name of the satellite, and those that followed, was soon changed to Landsat. Landsat has provided more data about the Earth than can ever be analyzed.

1) Return Beam Vidicon camera (RBV)  Bands 1, 2, and 3
2) Multispectral Scanner (MSS)  Bands 4, 5, 6, 7
3) Thematic Mapper (TM)  Bands 1, 2, 3, 4, 5, 6, and 7
1. Read Chapter 3 and answer the review questions 1, 2, and 6 (at the end of the chapter).