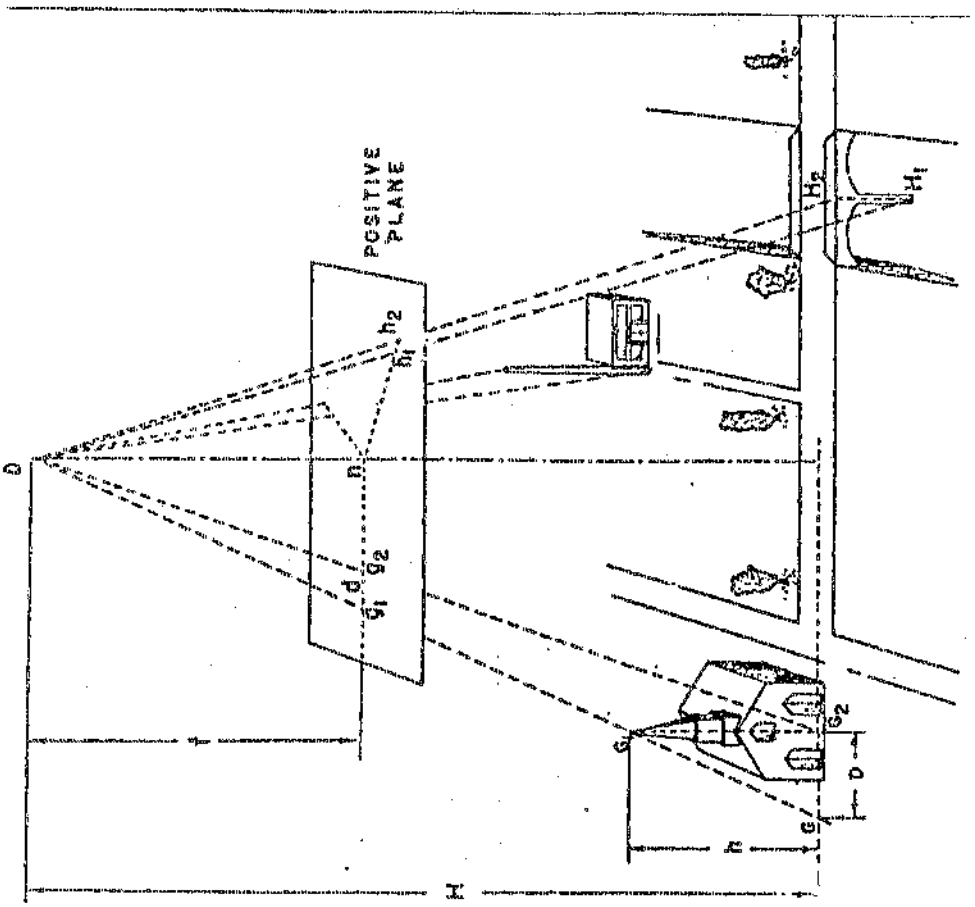


Figure 2-9.

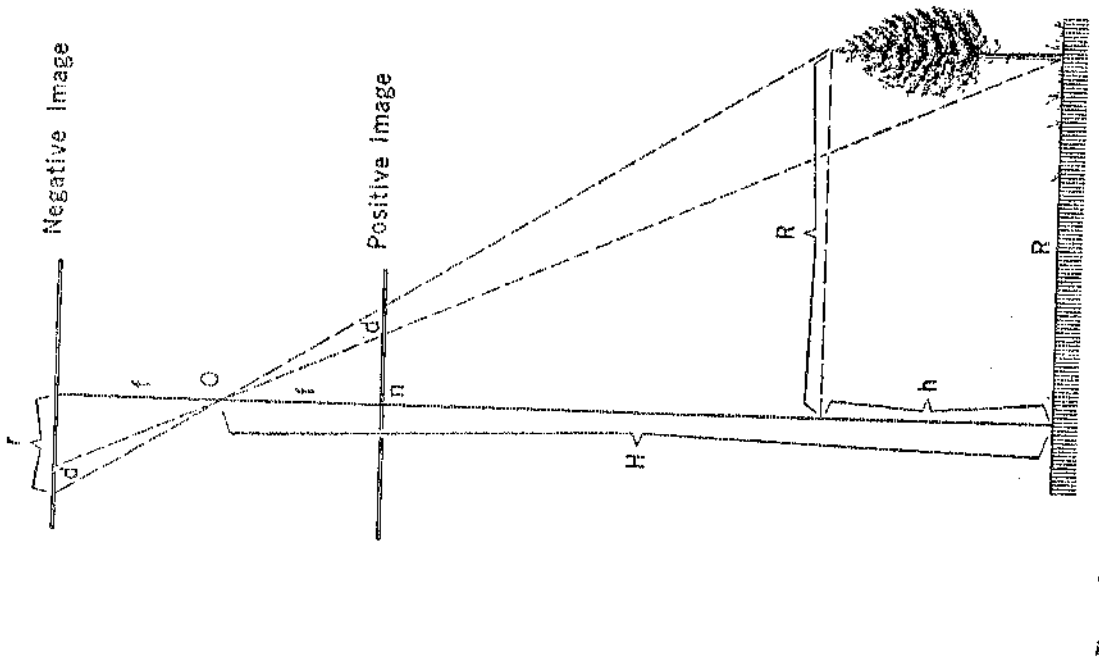


Figure 2-10 Displacement in single aerial photograph due to elevation.

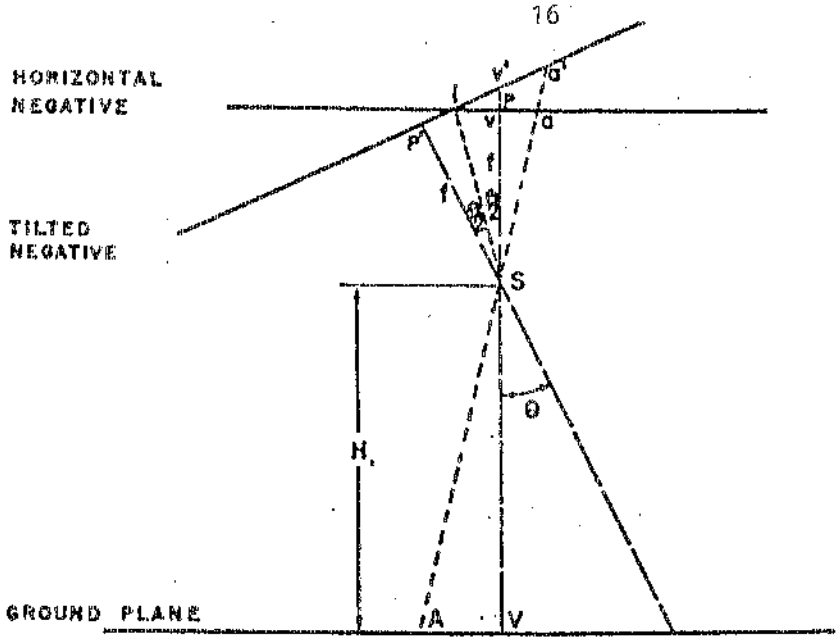


FIGURE 2-11.
DIAGRAM TO ILLUSTRATE TILT IN A PHOTOGRAPH

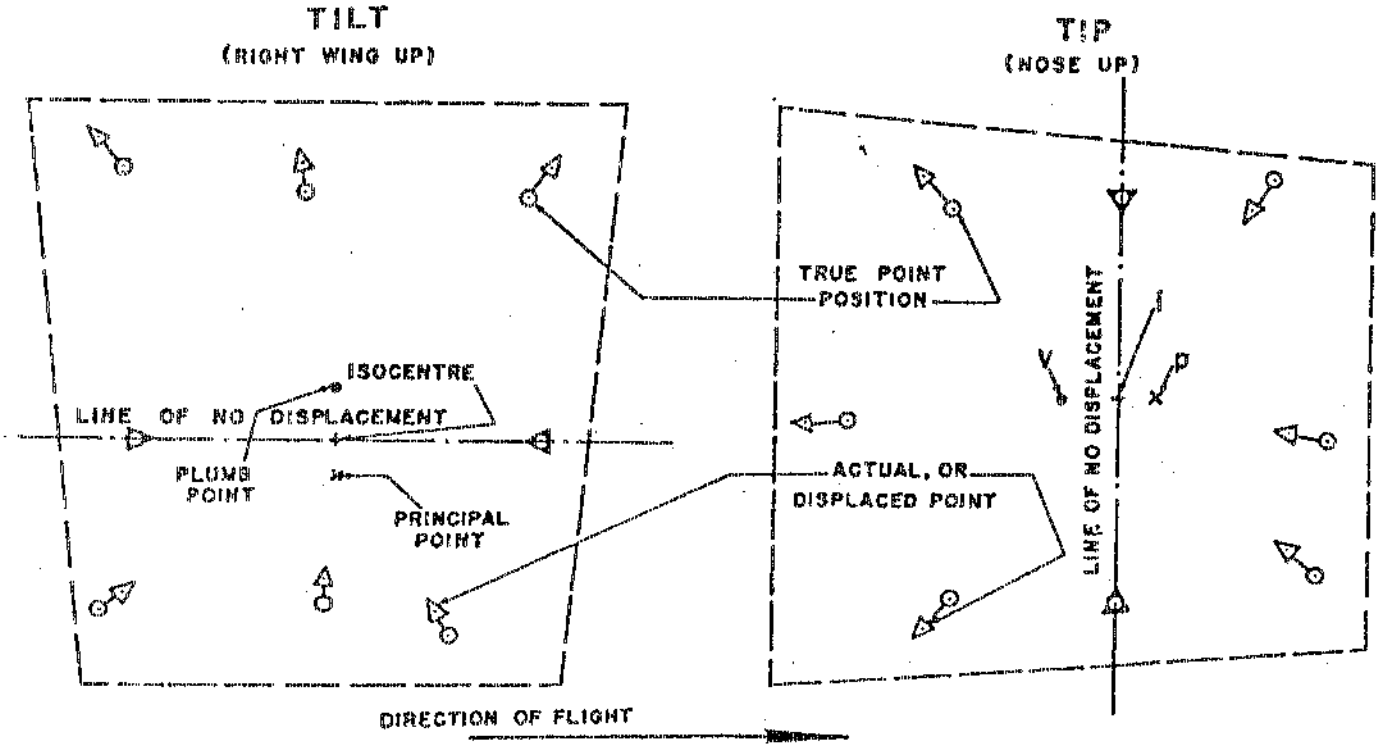


FIGURE 2-12.
DISPLACEMENT DUE TO TILT AND TIP
IN A PHOTOGRAPH
(POSITIVE PLANE)

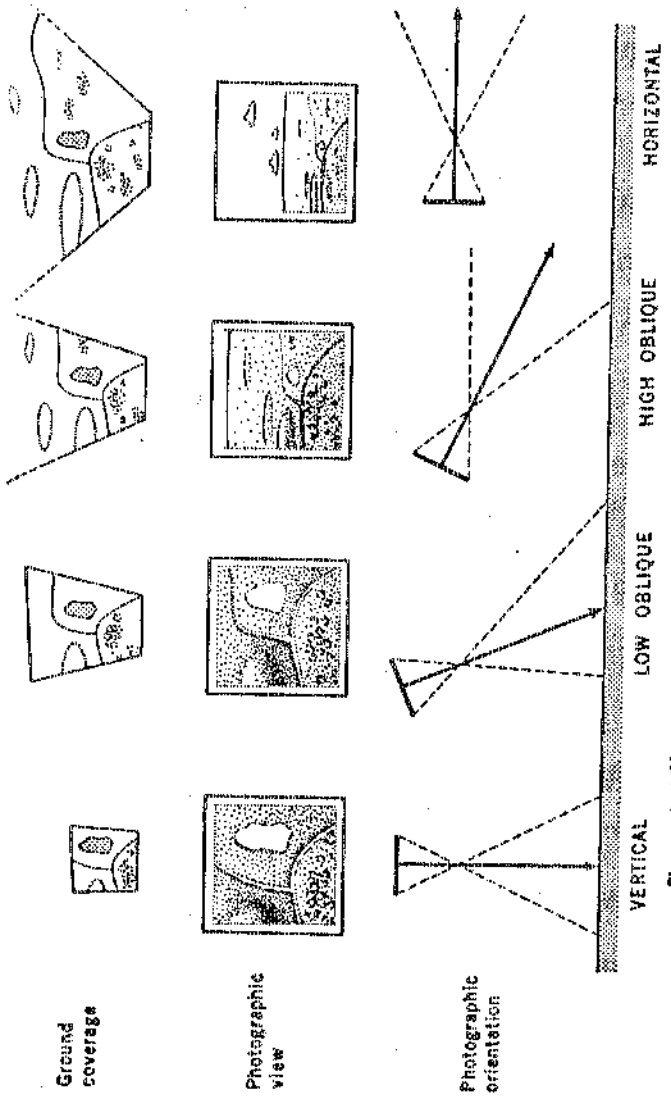


Figure 2-13 Characteristics of vertical and oblique photographs.

3. SINGLE IMAGE PHOTOGRAMMETRY

A photograph does not have the same geometric qualities as a map because of relief and tilt displacement. Thus a single photograph can only be regarded as a map substitute and may be used as such when the inherent errors can be neglected. On the other hand, photographs often show a more up-to-date record of the terrain than maps and are invaluable aids especially in the field of planning.

There are certain mehtods by which the inherent distortions of a photograph can be reduced or eliminated.

3.1 Rectification

Rectification is the process of transforming a tilted photograph into an equivalent truly vertical photo. A scale change can also be introduced. Instruments used for this process are called rectifiers. A rectified photo is free of tilt displacement but still contains image displacements due to relief. It remains a central projection.

Rectifiers operate on the principle of projection printing. The main components are: the illumination system, the negative holder, the projection lens and the ease or projection table (Figure 3-1). Rectification is performed in the following way:

Four control points are plotted at the scale desired for the rectified photo. Next the plot is placed on the easel and by manipulating the various controls of the instrument the projected images of the control points are made to coincide with the plotted points. The control sheet is then replaced by photographic paper and exposed.

The effect of tilt can also be reduced by the use of simple "reflection instruments". These instruments operate on the "camera Lucida" principle. The viewing system contains a semi-transparent mirror or prism whereby the photograph and a map or control sheet can be viewed simultaneously (Figure 3-2). With the help of various adjustment facilities such as tilting the photo holders, changing the viewing distance, shifting and rotating the map sheet, photo points can be matched up with the corresponding map points or plotted control points. Planimetric details can then be traced from the photo onto the map or a drawing sheet. Instruments based on this principle are the vertical sketchmaster, rectoplanograph, Zoom Transfer Scope, etc.

Such instruments can be used for updating existing maps or to transfer interpreted details from photograph to a map.

3.2 Differential Rectification

In the differential rectification process the rectified photo is exposed sequentially in small area elements and during this process the displacement due to relief is also eliminated (Figure 3-3). The instrument used for this purpose is the orthophotoscope and the product is called orthophoto. The orthophoto is an orthogonal projection with the appearance of a photograph (Figure 3-4).

3.3 Photo Maps and Mosaics

Two or more aerial photographs can be assembled to form a single continuous picture of an area. Such assembly is called aerial mosaic (Figure 3-5). Photos assembled into a map sheet format and cartographically enhanced form a photo map (Figure 3-6).

The geometric characteristics of the assembly depends on the geometric characteristics of the individual photographs and on the method used for the assembly. One can distinguish between:

- Uncontrolled mosaics which are prepared by simply matching the image details of adjacent photographs.
- Semicontrolled mosaics when some ground control points are available to reduce the propagation of errors in joining the photos and/or the mosaic is scaled.
- Controlled mosaics are prepared from rectified photos of uniform scale and are assembled onto a network of horizontal control points.
- Rectified photo map is a controlled mosaic arranged in a map sheet format and annotated.
- Orthophoto map consists of orthophotos joined together to form an annotated map sheet.

Note that orthophotos and orthophoto maps have the same geometric characteristics as a line map (orthogonal projection) but contain all the information that appears on the original aerial photo.

Mosaics and photomaps have distinct advantages over line drawn maps. They arre invaluable in land-use planning and in planning for large engineering projects. A line map is an edited representation of the terrain; only certain features are transferred from the photograph. Photomaps show the study area comprehensively and critical featurees which would affect the project such as drainage patterns, geologic features, land-use, vegetation cover can be more accurately assessed. These products are also useful to inventory natural resources. Laypersons can relate much easier to photomaps than to line maps.

A disadvantage of photomaps is that topographic information and annotations are more difficult to add and may saturate the content. Some people also object to the fact that it is difficult to make notations or design drawings on them. It is also difficult to update photomaps.

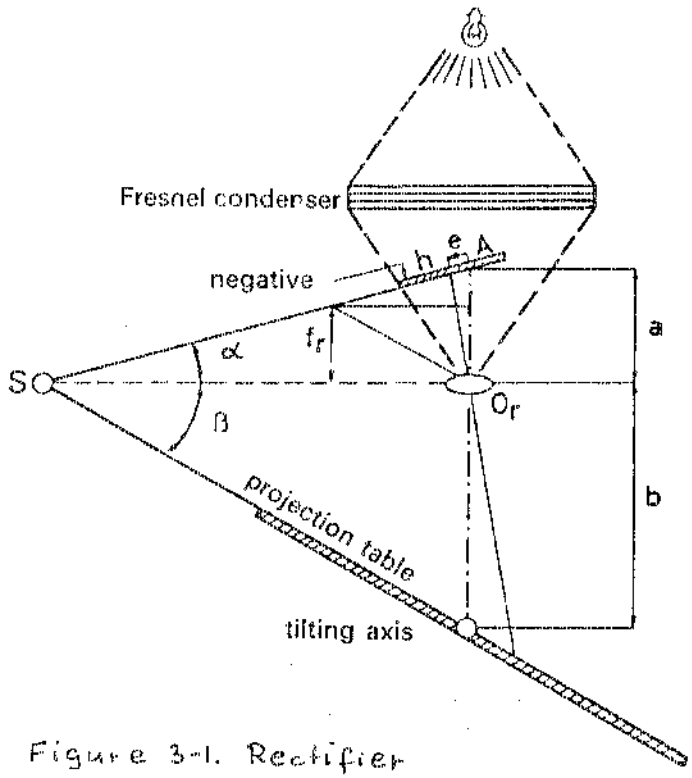


Figure 3-1. Rectifier

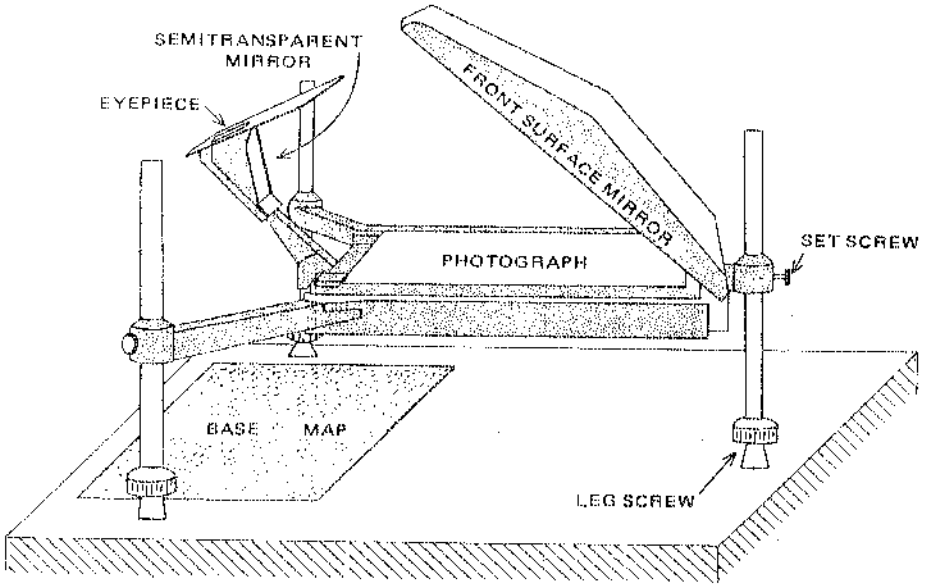
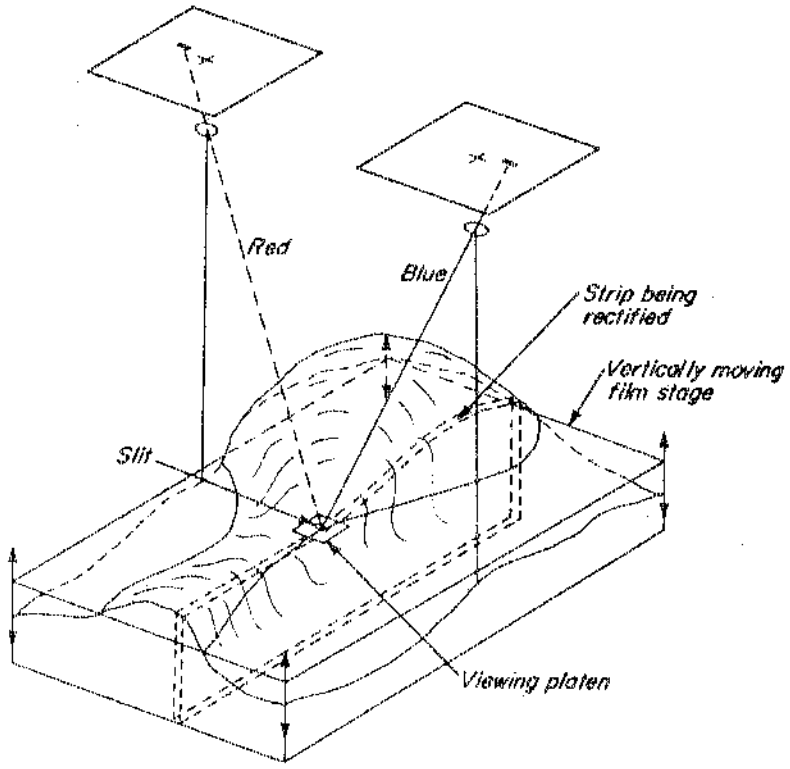
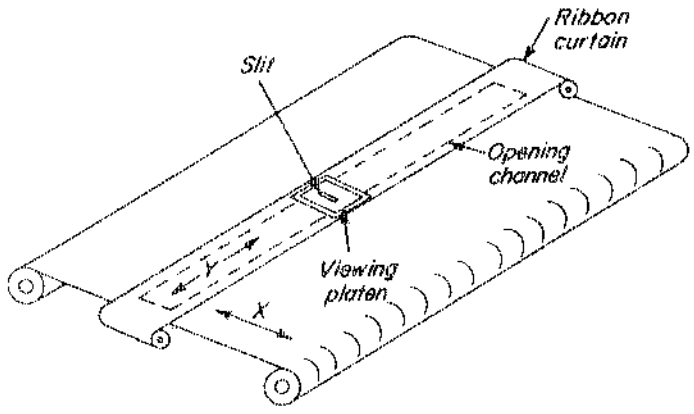


Figure 3-2 Schematic diagram of a vertical sketchmaster. A semi-silvered eyepiece mirror enables the operator to view photograph and map simultaneously.

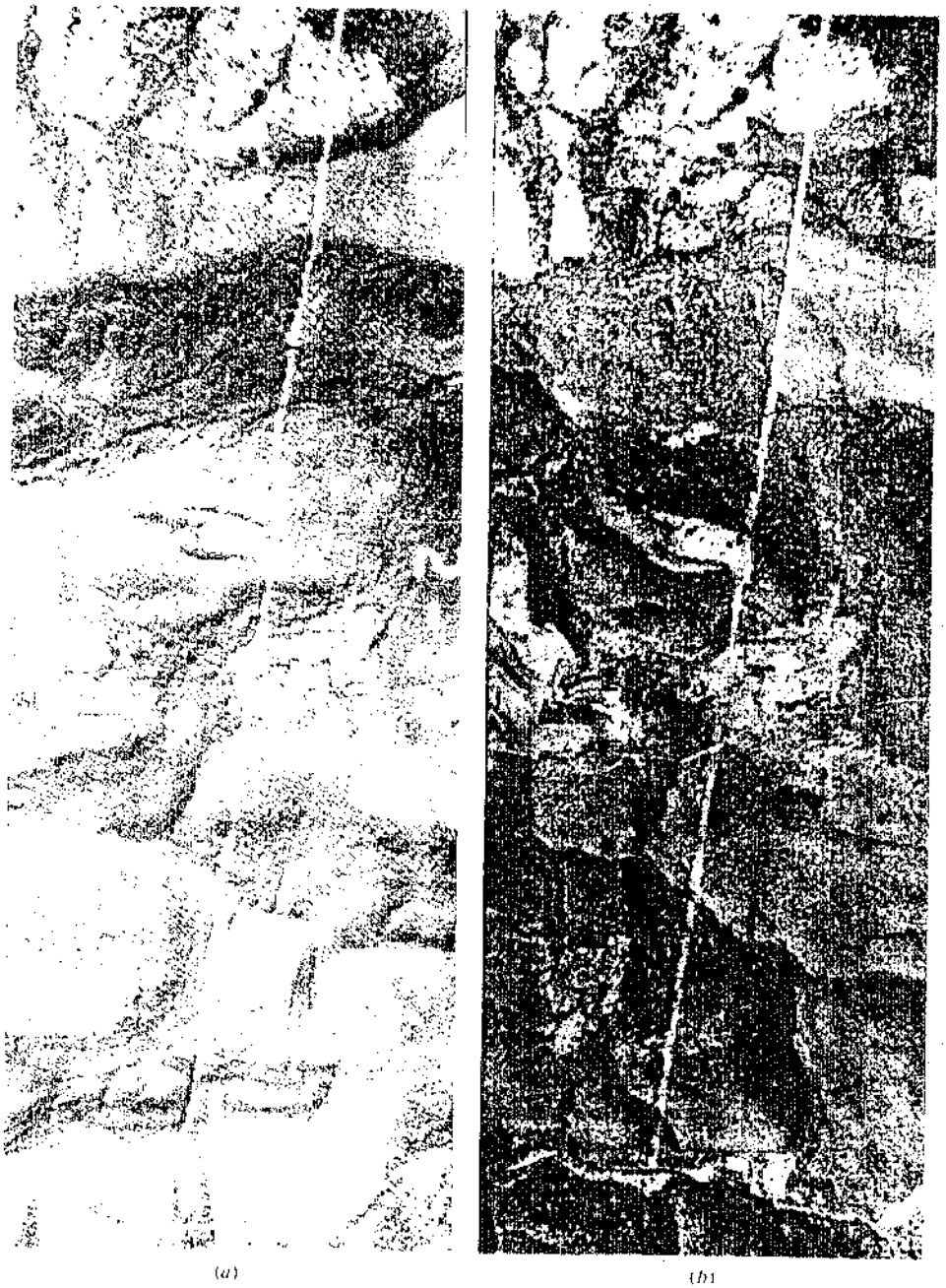


Fixed line element rectification.



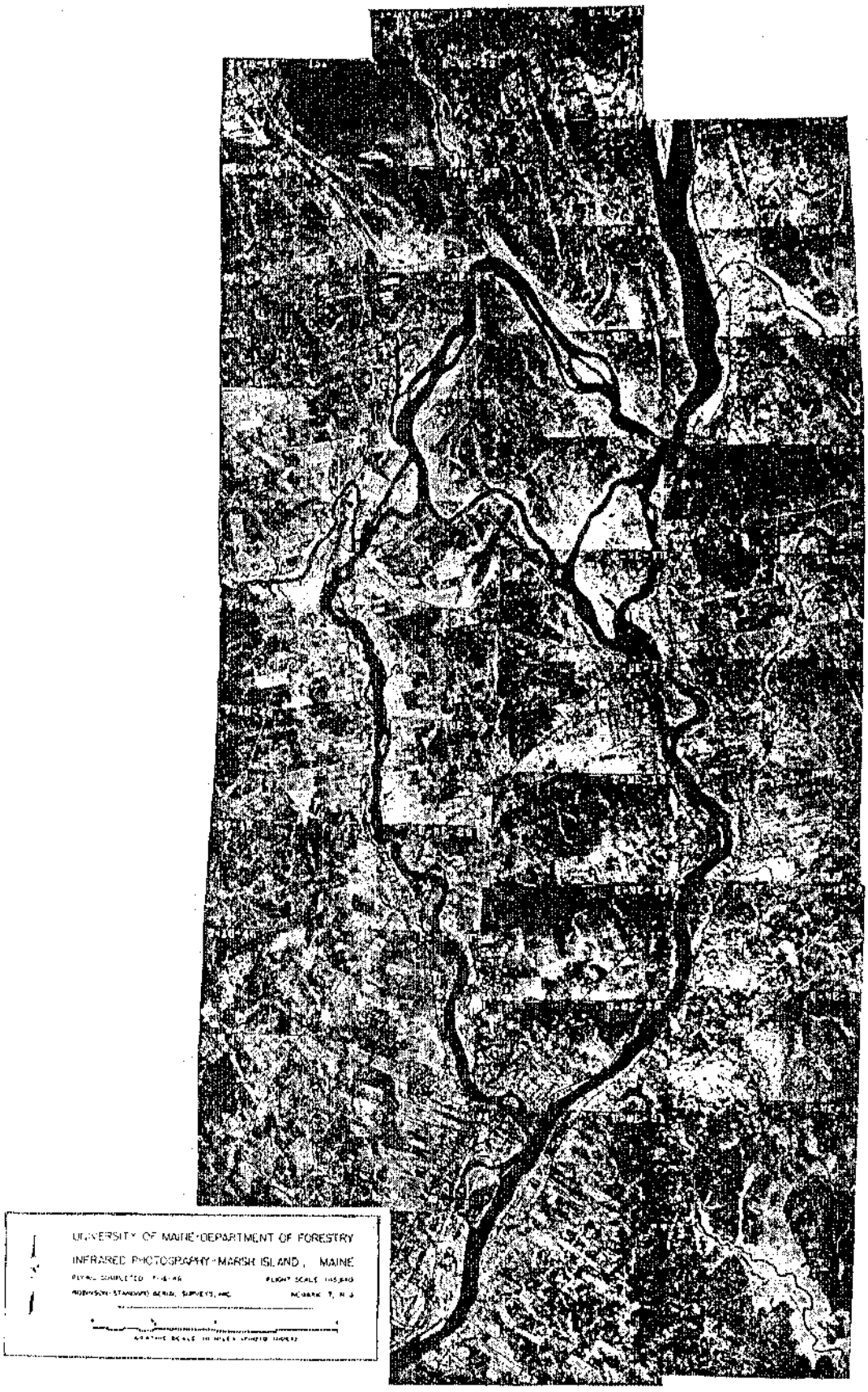
Curtain used to cover film exposure in line element rectification.

Figure 3-3 Differential rectification



(*a*) (*b*)

FIGURE 3-4.
(*a*) Portion of a perspective photo taken in Oklahoma. (Note the apparent crookedness of the power line caused by relief displacement.) (*b*) Orthophoto of some portion of perspective photo shown in (*a*). (Note straightness of the power line after relief displacement is eliminated.) (*Courtesy U.S. Geological Survey*)



Robinson-Standard Aerial Surveys, Inc.

Figure 3-5. Index mosaic. Orono and Old Town, Maine.

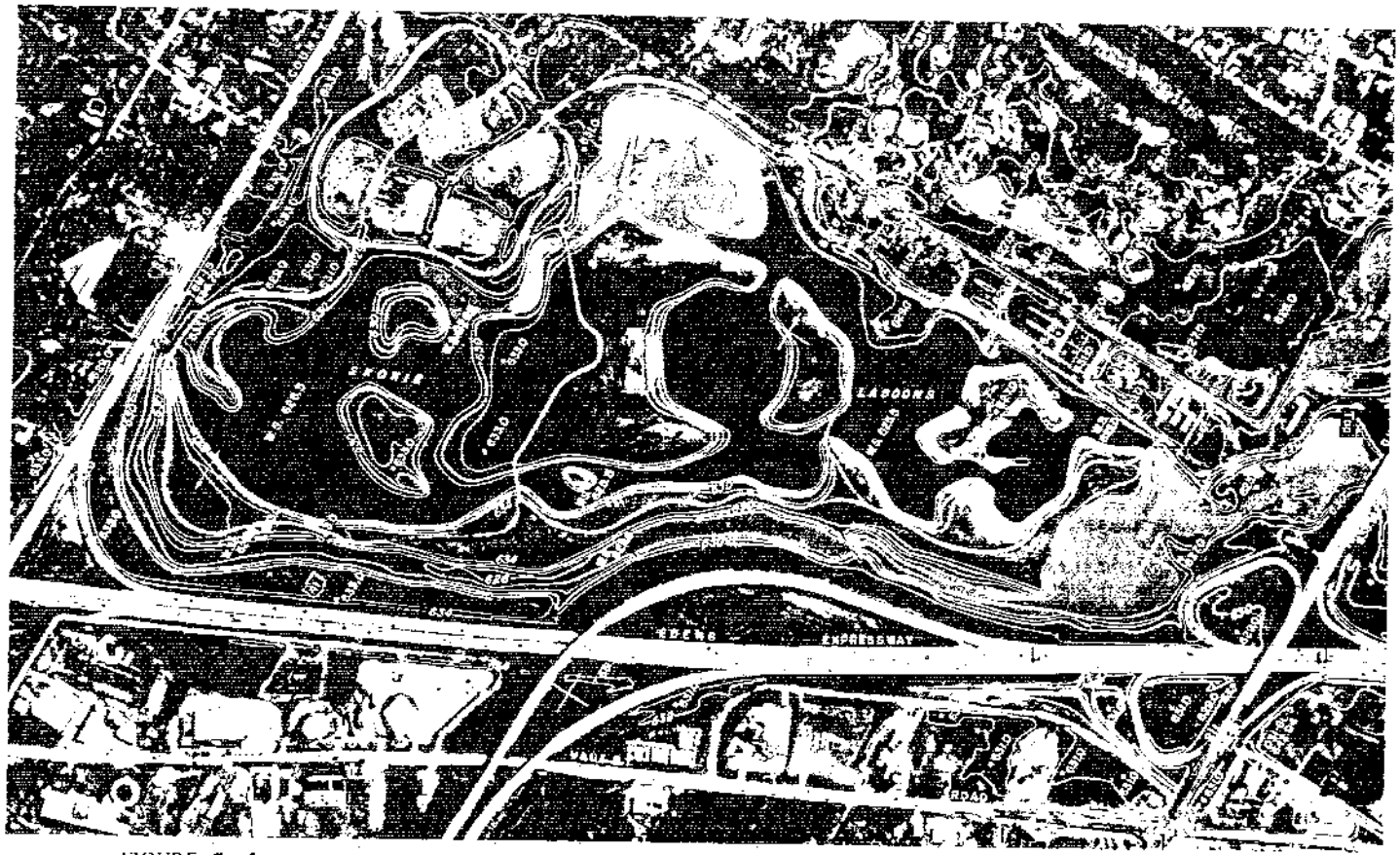


FIGURE 3-6.
A portion of an orthophotomap with elevation contours superimposed.
(Courtesy USDA Soil Conservation Service)