above the datum.

At an elevation of 50 m, the scale is

$$S_{50} = \frac{0.152 \text{ m}}{(500 - 50)\text{m}} = \frac{1}{2960}$$

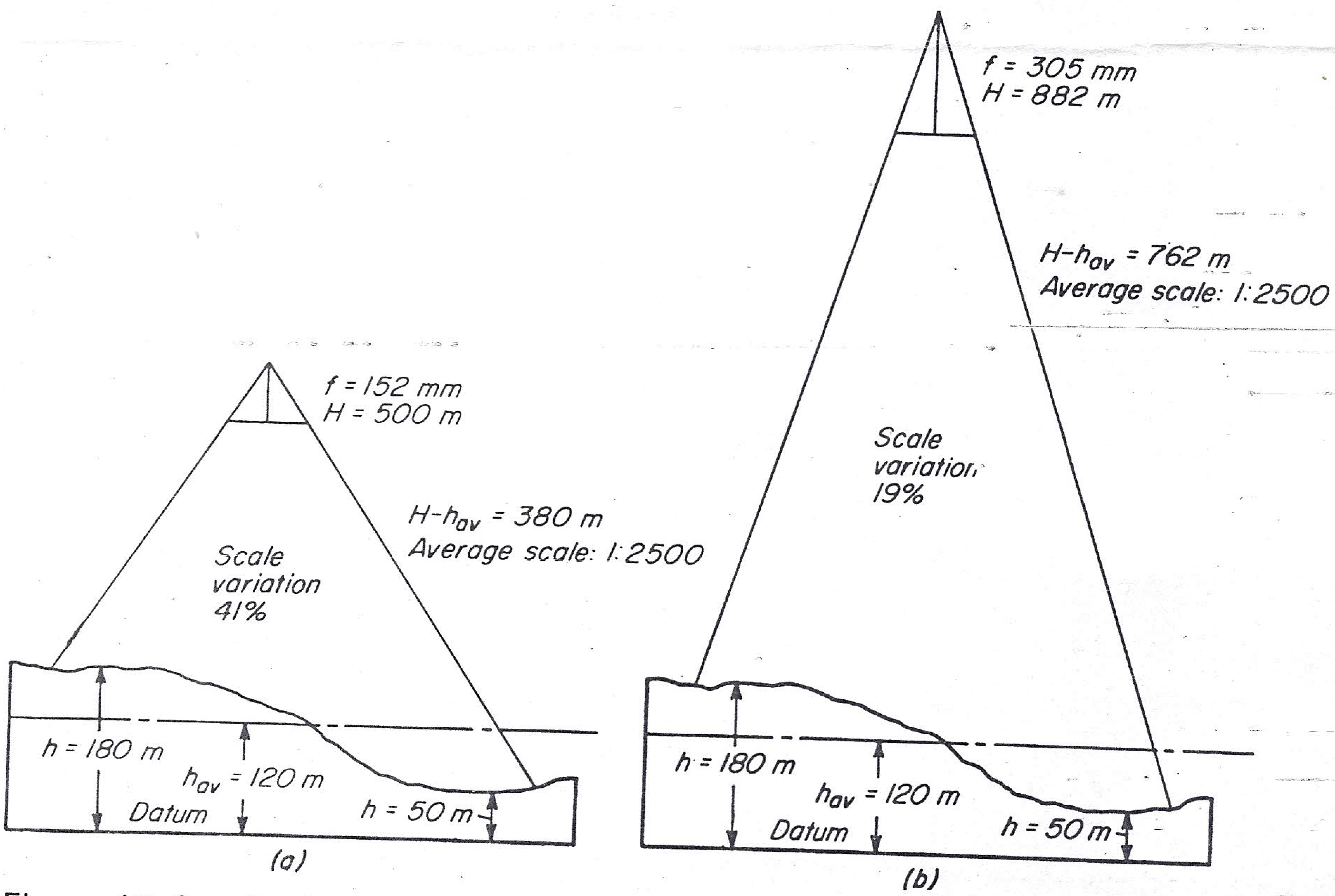


Figure 15-2. Scale variation.

flying height is determined as 500m.

$\frac{1}{2500} = \frac{152}{H-120}$; $H = (\cdot152 \times 2500) + 120 = 498 / - 500m.$

At an elevation of 50m, scale is $S_{50} = \frac{0.152m}{(500-50)\,m}$
$= 1/2960$

At an elevation of 180m, the scale is

$S_{180} = \frac{0.152\,m}{(500-180)\,m} = \frac{1}{2105}$.

SCALE VARIATION is about 41%.

However by using the 305mm focal length, the scale variation is reduced to 19%. This may produce allowable scale variation and the interpretation becomes easy and useful.

4) Relief Displacement:

Relief displacement generally affects the construction of mosaics. Relief displacement ~~tends to ma, be is~~ will decrease with increasing flying height. In addition, increased focal length also ~~fac~~ facilitates to maintain a certain scale at a higher elevation. As the ~~a~~ relief displacement cannot be removed ~~even~~ even by rectification, suitable higher flying height and focal length are sought.

PTO

5) TILT OF THE PHOTOGRAPHS: 4/7

The tilt is resolved into two components. One is in the direction of ~~tilt~~ flight and the other is normal to the flight direction. The first is called y-tilt or angle ϕ. The second is called x-tilt or angle ω. In the first, result is the overlap on one side is greater than desire amount of overlap, and the overlap on the opposite side ~~will~~ is smaller than the desired amount. This may cause gaps or breaks. This can be looked after by using the viewfinder to control the overlap during flight.

In the second, it will cause side lap to increase one side and decrease on the other side, the effect will be decrease in the photographed area. This is solved by decreasing the computed ~~distance~~ spacing between of flight lines.

6) CRAB and TAIL [FIG.]

Moffit p. 90 Fig 4:17

Whenever an air craft head into a cross wind, it is deviated and makes an angle with the flight line. This angle is called "CRAB". The focal plane of the camera is square parallel to the flight line when there is no crab. With crab angle, camera focal plane makes ~~crab~~ crab angle resulting in reduction in the coverege width and gaps in the photography.

PTO

Reflights are generally considered.
Drift is caused by the failure of the aircraft to stay on the predetermined flight line.
For example, with an average scale being 1:10,000, and the aircraft drift 200ft on one side. The drift amounts to 1/4" at the photography scale. This results in the loss of about 30% in the side lap on the opposite side of the ~~dr~~ direction of drift. Drift is due to poor flight-line map. This will require reflights.

7, With desired overlap & side laps, ~~xx~~ scale, and the prevailing relief an tilt displacement, suitable flying height is determined. This will produce the photos of desired requirement.

8) COMPUTATION OF FLIGHT PLAN

The data required to compute the flight plan are (i) Focal length (ii) Flying Height (iii) Photo size (iv) Area size (v) Flight line position (vi) overlap (vii) side lap (viii) scale of flight map (ix) ground spee.

~~This~~ These are illustrated in the following example.

PTO

Example 6/9 Fig Moffit pp. ~~15~~ 492 & 493
Fig 15.4 Fig 15-5

The following data are given:

Area – 15 miles x 8.5 miles. focal length : 12 inches

Purpose: construction of a mosaic

Photo format = 9" x 9" average scale 1 : 12 000

average ~~elevation~~ elevation above sea level 700 feet.

overlap 60%. side lap 35%

Aircraft speed 150 mph. existing map scale 1 : 62500.

Determine the data for the flight plan.

(1) Flying height – required

~~$\frac{1 ft}{H ft} = \frac{1}{12000}$~~ ~~H = 12000' above 700 ft elevation~~
~~H = 12700 above sea level~~

$f = 12''$ or $1'$ $S_p = \frac{f}{H}$ $\frac{1}{12000} = \frac{f}{H}$

$\frac{1}{12000} = \frac{1}{H}$ $H = 12000$ ~~+700~~

Above mean sea level = 12000 + 700 = 12700'

(2) Flight line position

It is the ground distance between flight lines

side lap is 35% ∴ photo distance between

flight line = 100 − 35 = 65%

Photo size 9" x 9". – 65% of 9" = 5.85 inches

Width / ground spacing = $\frac{5.85}{12}$ x 12,000 (scale) = 5850 feet

(scale given 1 : 12000)

PTO

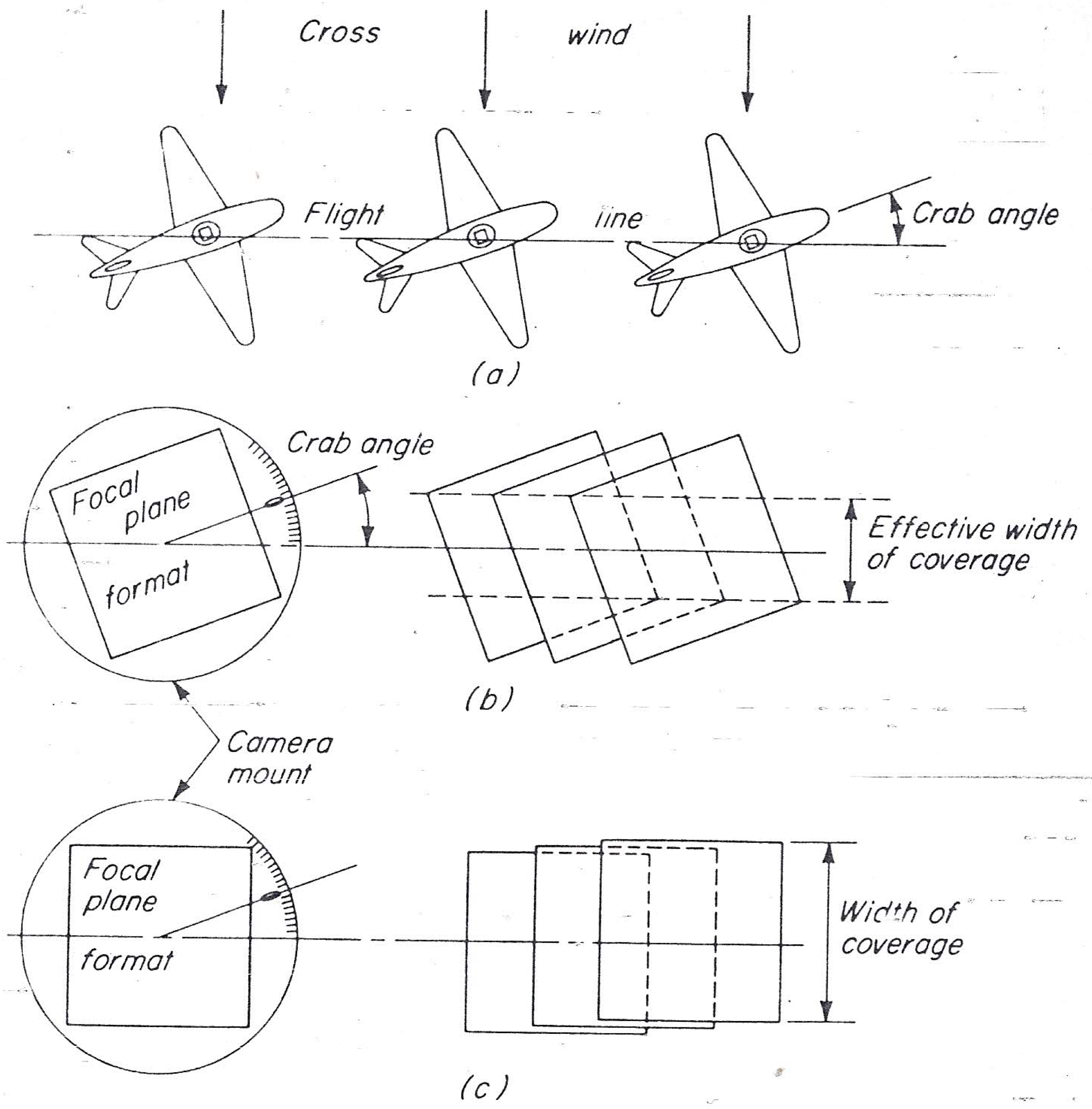


Figure 4-17. Crabbing of photographs.

7/9

3. Number of flight lines

Total width $= 8.5$ miles (given) $=$ ~~5280 feet~~ (1 mile $= 5280'$)

$= 8.5 \times 5280 = 44880$ feet.

spacing between flight lines 5580 feet (determined)

Number of flight lines $= \frac{\text{width}}{\text{flight line spacing}} = \frac{44880}{5580} + 1 = 8.41$

$= \underline{9}$ only

4. Adjusted ground distance between flight lines: WA $= \frac{44880}{9} = \underline{5610 \text{ feet}}$ and not $\underline{5580 \text{ feet}}$

5) Spacing of flight line on flight map:

The distance on the map corresponding to a ground distance of 5610 feet. Map scale 1:62500 ~~$1' = 62500'$~~

$W_M = \frac{5610' \times 12}{62500''} = \underline{1.08}$ inches

6. Ground distance between exposures:

Ground distance overlap 60% - net gain per photograph - 40% of the width of photograph or $0.40 \times 9'' = \underline{3.60}$ inches

The corresponding ground distance

Photo scale 1:12000 . $B = \frac{3.6 \times 12000}{12} =$ ~~12~~ $\underline{3600}$ feet

7. Exposure Interval Time

The time interval between exposures is usually integral number of seconds.

~~Aircraft speed is~~ 150 mph $= 150$ 1 mile $= 5280$ feet

$= \frac{150 \times 5280}{60 \times 60} = 220$ feet/second

PTO

Aircraft speed is 200 feet per second

Required exposure interval time:

$$= \frac{\text{Ground distance exposure}}{\text{speed}} = \frac{3600}{220} = 16.4 \text{ secons}$$

OR 16 seconds

ground distance exposure
is already determined as 3600 feet

Adjusted ground distance between exposures.

For the adjusted ground ~~distance~~ exposure
interval, namely 16 seconds, with the aircraft
speed of 220 ft/sec; adjusted ground distance is

$B_A = 220 \times 16 = 3520$ feet

Number of Photographs per flight line:

Length of flight line = 15 miles = (15 × 5280)
= 79200 feet (given)

Adjusted ground distance per exposure = 3520 feet
(determined)

No. of Photographs per flight line (plus 4)

$$= \frac{79200}{3520} + 4 = 26.5 = 27$$

No. of Flights = 9

Total no. of Photos: 27 × 9 = 243 Photos

PTO

- With proper planning the mission will be economical fulfilling the needs of the project

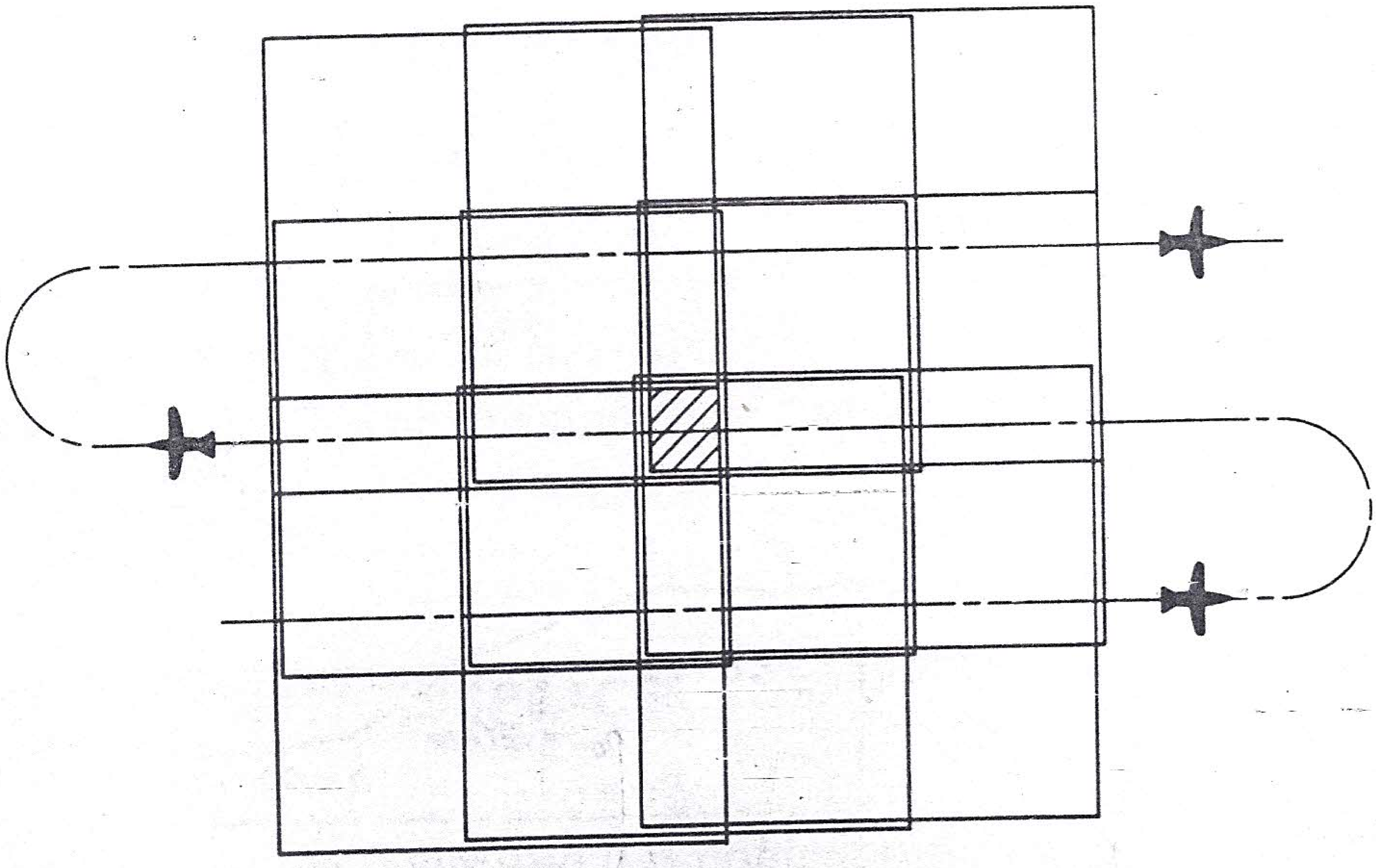


Figure 15-1. 60 % overlap in both directions for block triangulation.

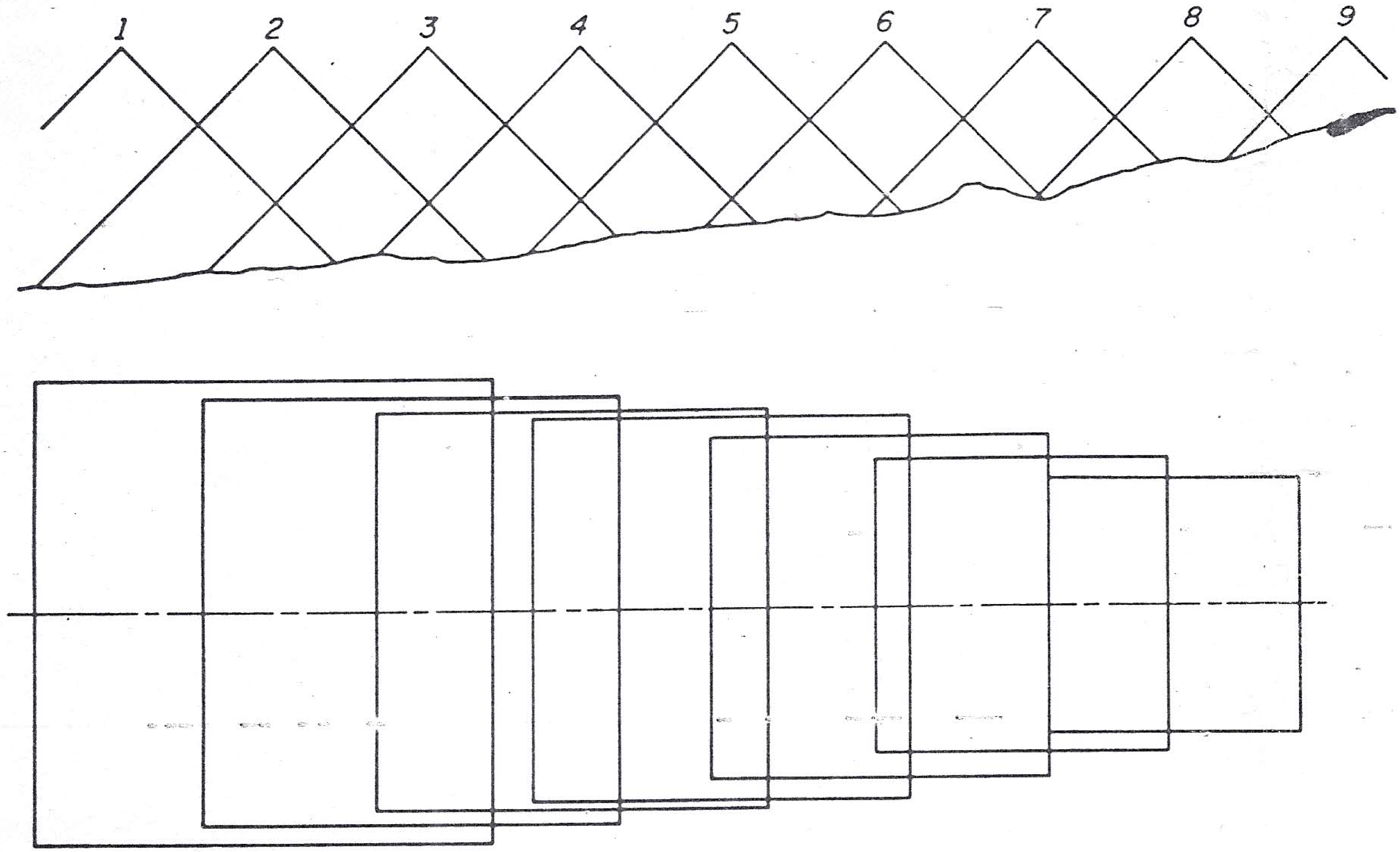


Figure 15-3. Scale variation from change in terrain elevation.

At an elevation of 180 m, the scale is

$$S_{180} = \frac{0.152\ \text{m}}{(500 - 180)\text{m}} = \frac{1}{2105}$$

This results in a scale variation of about 41%. However, when using the 305-mm focal length, the scale variation is reduced to about 19%.

Scale variation also affects photographic coverage because of a rising or falling of the terrain with respect to the flying height, and is an important factor to be considered when relatively low-altitude photography is taken for

$$W = \frac{5.85 \text{ in.} \times 12{,}000}{12 \text{ in./ft}} = 5850 \text{ ft}$$

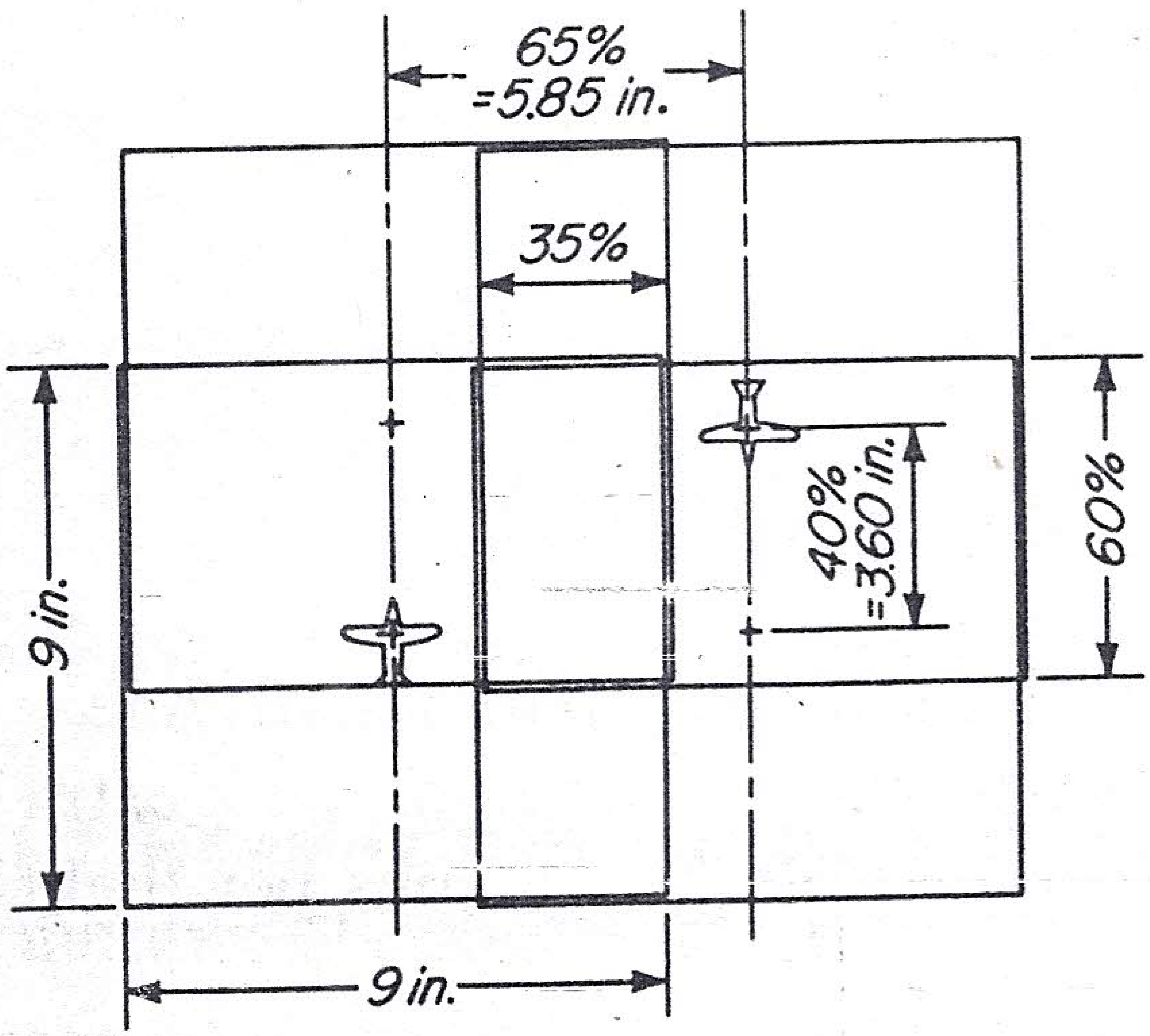


Figure 15-5. Distance between flight lines and between successive exposures.

stated datum, or photograph scale for a parti-
photograph; (4) size of area to be photographed
its shape must be taken into account in determini
flight lines); (5) position of the outer flight lines w
of the area; (6) overlap; (7) sidelap; (8) scale of flig
aircraft (if an intervalometer is to be used).

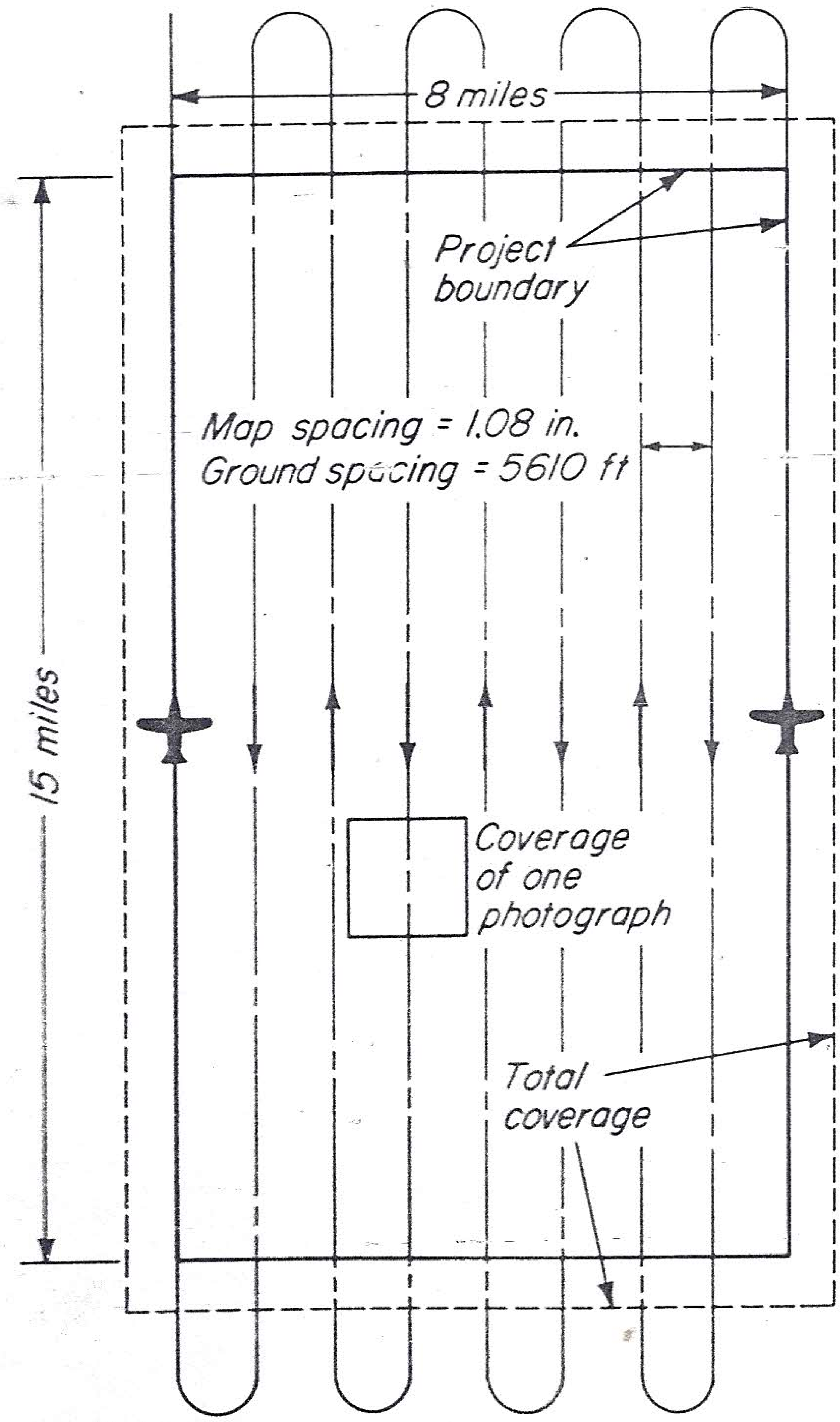


Figure 15-4. Calculation of flight plan.

(Total figures - 2) 1/2 Moffit Fig 5.7 - P-117

Types of Stereoscopes

For stereoscopic viewing aerial photographs, there are two basic types stereoscopes, namely i) Lens stereoscope ~~&~~ ii) Mirror stereoscope. ~~(Fig mof~~ (FIG)

1. Lens stereoscope: It consists of two simple magnifying lens mounted with a seperation equal to the average interpupillary distance of human eyes. However it can be adjusted to suit the individual user. Lenses are mounted ~~on a~~ in a frame and supported at a fixed ~~dist~~ distance above the table top.

If the distance ~~from~~ between the table top and the lenses, equals the focal length of the lenses, then the images of the points on the photograph will appear to come from infinity, as shown in figure (a); If the distance 'p' between the lenses and the table top is less than the focal length 'F' of the lenses, the images will appear to come from a finite distance 'q' as ~~shown~~ shown in the Fig - b. This satisfies the lens equation.

$1/p + 1/q = 1/F$. For a comfortable viewing photographs under the stereoscope may ~~be~~ be seperated, such that distance between corresponding points, namely "conjugate points" is approximately equal to or ~~les~~ less than interpupillary distance.

It presents ~~the~~ a magnified ~~imag~~ image to the viewer. If the height of the lenses above the table top equals the focal length, the magnification is 10 inches or 250 mm divided by the focal length. (e.b/f)

PTO

(1) Moffit p 117 ~~5-8~~ 5-9)

~~If~~ If the height $\frac{1}{2}$ is less than the focal length, the magnification is q/p. Most simple lens stereoscopes magnify about two times.

Mirror stereoscope (*) Fig -

The mirror stereoscope consists of a pair of reflecting prisms, m and ~~m~~ m', and a ~~w~~ pair of wing mirrors, M and M'. Each of these ~~are~~ is oriented 45° with the plane of the photographs. The total optical path distance, emMP or e'm'M'P' from the eyes to the plane of photograph varies from 8 to 18 inches (20 - 40 cm) depending on the kind of mirror stereoscope, for some types, a set of removable binoculars are placed at the position of the meniscus lenses. The binoculars produce an enlargement of a limited portion of the stereoscopic image for detailed study.

The advantage is that the photographs may be completely seperated for viewing, and the entire overlap area may be seen stereoscopically. In view of its size, it is not portable like ~~no~~ lens stereoscope.

+ .

to a certain extent when oriented under the lens stereoscope. Thus, a portion of the overlap area is obscured from view. One or the other photograph must then be rolled back in order to view the entire area stereoscopically. Or else, they must be flipped so that first one photograph overlaps the second in order to view, say, the left half of the stereoscopic image, and then the second overlaps the first in order to view the right half.

The mirror stereoscope, pictured in Fig. 5-8 and shown diagrammatically in Fig. 5-9 consists of a pair of reflecting prisms (or mirrors) m and m', and a pair of wing mirrors, M and M', each of which is oriented at 45° with the

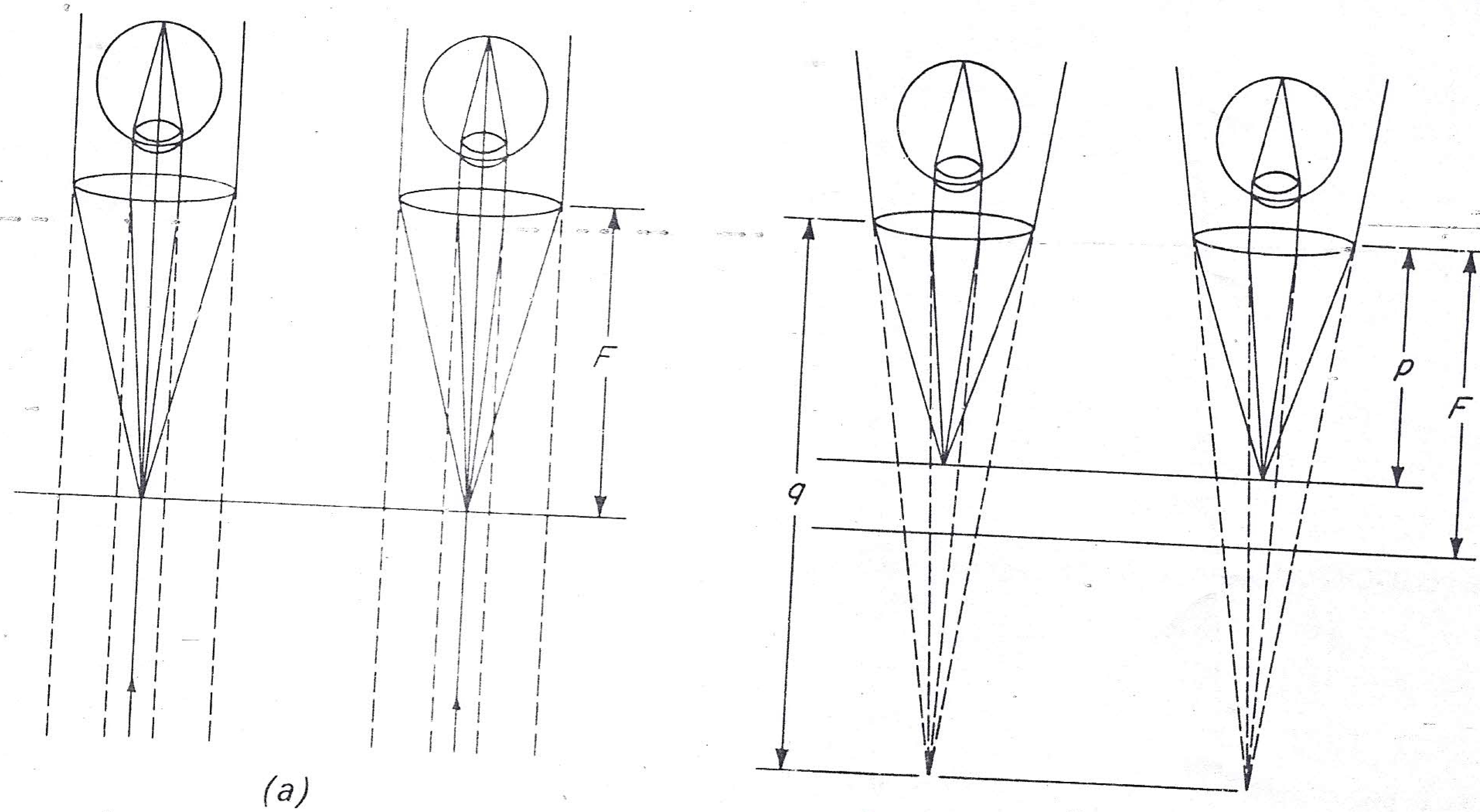


Figure 5-7. Optical principle of lens stereoscope.

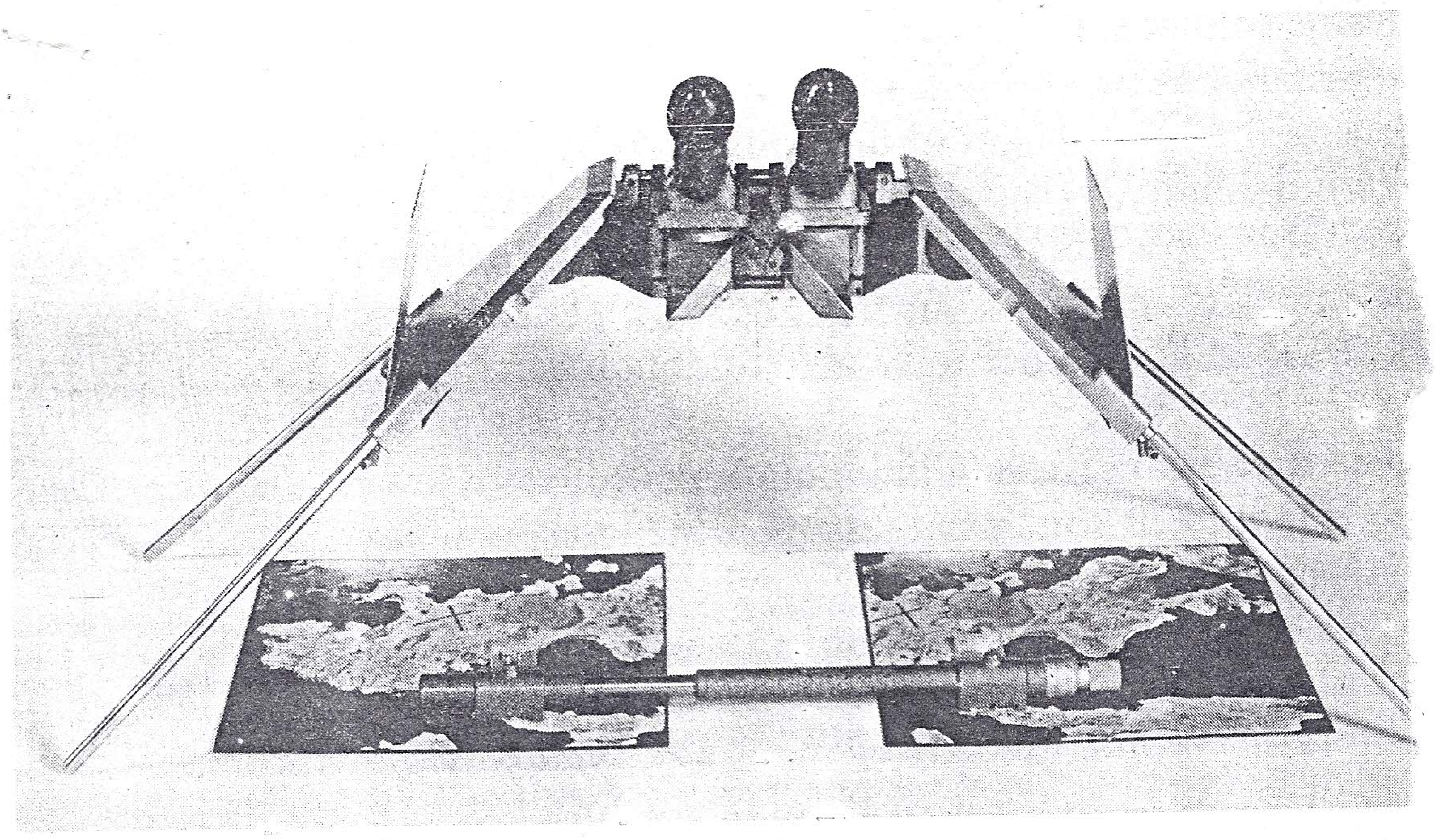
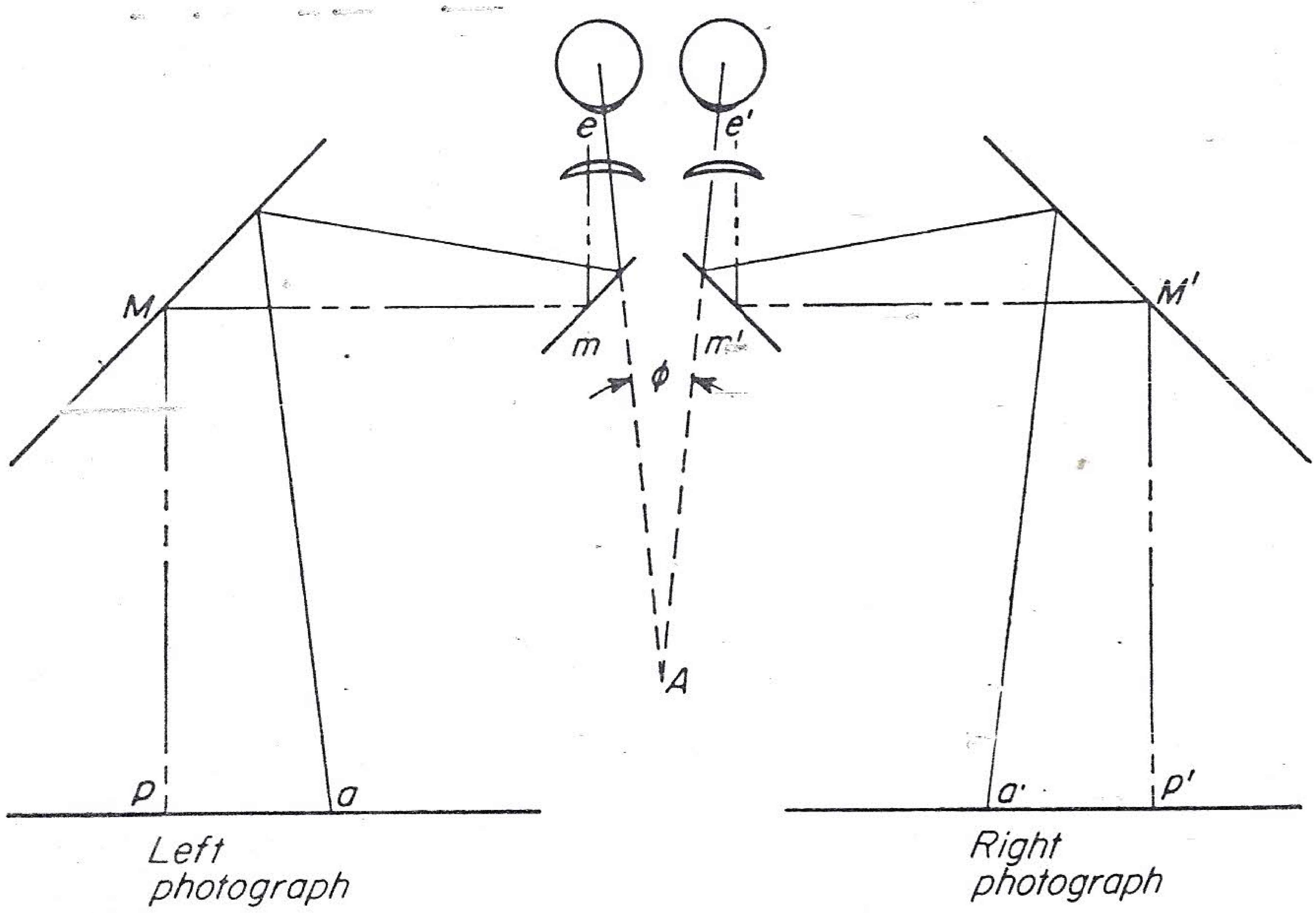


Figure 5-8. Mirror stereoscope. Courtesy of Wild Heerbrugg Instruments, Inc.



1-5— 5 pages I / ~~13~~ 13

Remote Sensing and Photogrammetry.

Remote sensing is the science and art of obtaining
information about an object, area or phenomenon
through the analysis of data. The data are
acquired by a device ~~or technic~~ that is not
in contact with the object, area or phenome-
-non under investigation. In earth science-
it is the method analysing the data of
earth's resources and features. In the
recent years this technology is of very
great application in the exploration
and analysis of earth's resources and
features. The remote collected ~~data~~ data
are of many forms. e.g. variations
in force distributions; acoustic
wave distributions; electromagnetic
energy distribution.

Photogrammetry is defined as the
means of measuring images on a photo-
-graph. It chiefly comprises (a) photograp-
-hing an object (b) measuring the image
of the object on the photographs (c) reducing
the measurements to useful form such as
a topographical map.

Modern photogrammetry acquire data
through radar imaging, radiant electro-
-magnetic detection and X-ray imaging.
It is also included under remote sensing

I/2

2/3

Photogrammetry is therefore a combination of measurement and interpretation. It is an art and science of acquisition, measurement, interpretation and evaluation of photographs, imageries and other remotely sensed data. Problems are solved with pure mathematical modeling using X and Y co-ordinates of image points. This method is also called analytical photogrammetry or computational photogrammetry

~~TYPES OF AERIAL PHOTOGRAMMETRY~~

TYPES OF PHOTOGRAMMETRY. Four types are recognised namely Aerial, Terrestrial, space and Close-range photogrammetry. Aerial photogrammetry is a branch wherein photographs of the terrain in an area are taken in an orderly sequence by a camera. The camera is mounted in an aircraft flying over the area. Here the platform is an ~~air~~ aircraft / helicopter.

In ~~terra~~ terrestrial photogrammetry, photographs are taken from fixed, known position on or near the ground. The camera axis is horizontal. ~~on~~

Space Photogrammetry embraces all aspects of extraterrestrial photography and imagery. The camera may be

fixed on earth / artificial satellite /,
positioned on the moon or a planet.
close-range photogrammetry implies
that the camera is relatively close to the
object and photographed. It is
used in the fields of architecture,
medicine, experimental engineering
laboratory investigations etc.

TYPES OF AERIAL PHOTOGRAPHS (+) [Fig I-1)

In majority of photogrammetry operations,
aerial photographs are used.
Aerial photographs are classified
according to camera orientation, format
size, angular coverege and type of
~~Fig~~
emulsion.
A. camera orientation - 3 types.
1. vertical photograph - Here the
photographs are taken with the optical
axis of the camera in a vertical
~~or very~~ or very nearly vertical position
2. High oblique - Photographs are taken
with the optical axis of the camera is
deliberated tilted far enough from the
vertical to show the earth's horizon.

Moffit Fig 1-10 - pp-9
(+) Fig I-1

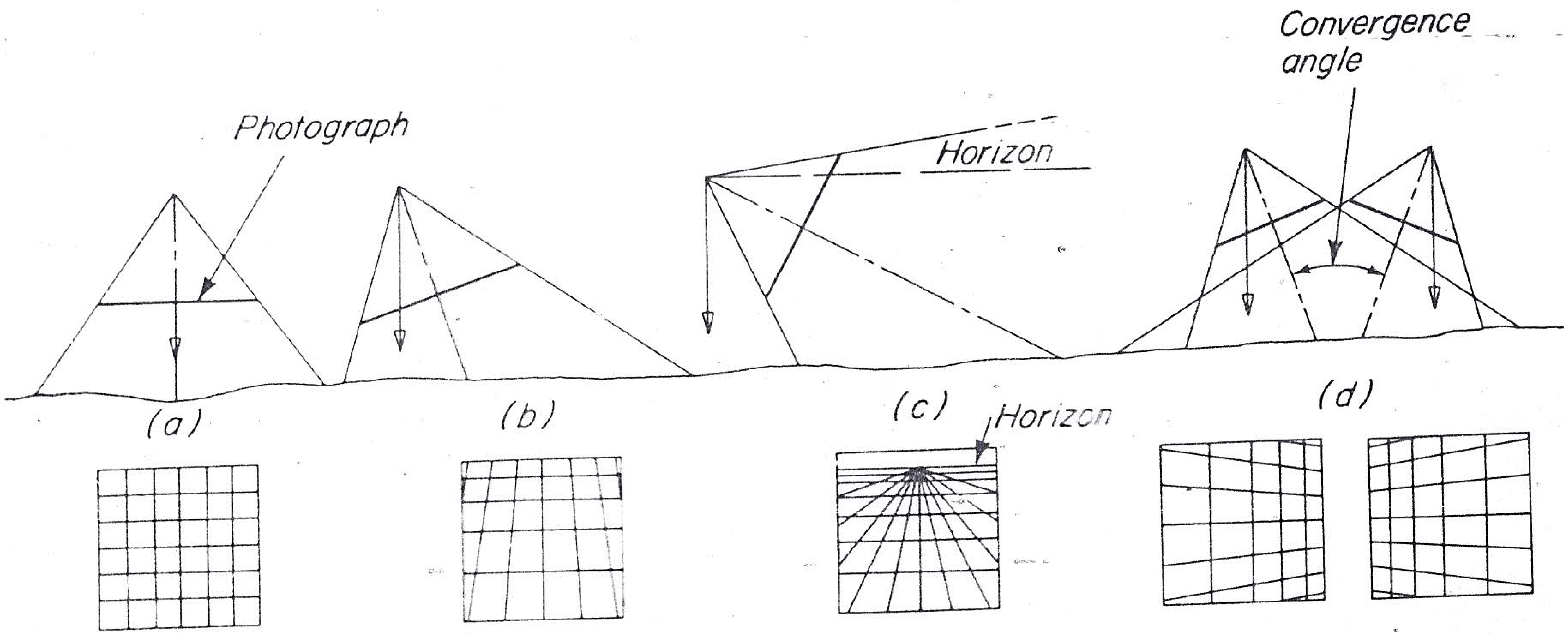


Figure 1-10. (a) Vertical photograph. (b) Low oblique. (c) High oblique. (d) Convergent pair of photographs.

3. LOW Oblique: In this camera optic axis is strongly tilted but not enough to show the earth's horizon.
4. convergent photography: It comprises a sequential pair of low oblique photographs. Here the camera optical axis converge toward one another. Each photograph covers essentially the same portion of the ground.

Usually, in a vertical photograph, the optical axis of the camera is unintentionally got tilted a slight amount from the vertical. It is usually ~~lee~~ less than 2°. ~~the~~ This unintentional tilt is owing to earth's movement, rotation and other factors in the solar system.

B ANGULAR COVERERE: It is a function of camera focal length and format size.

1. Narrow Angle - 10 degrees to 20 degrees. Focal lengths of 610 and 915 mm. Used for intelligence, general interpretation and mosaics making
2. Normal Angle - 50 degrees to 75 degrees. Focal lengths of 210 and 300 mm. Used for interpretation, mapping, colour photography, mosaics and orthophotography
3. Wide Angle - 85-95 degrees. Focal length~~s~~ of 153 mm. This is commonly used for mapping.

7/5/5

4. Ultra ~~on Sup~~ on Super wide angle!
110° - 130° degrees. Focal length of 88mm.
Used ~~map~~ for mapping of areas with very little relief.

C EMUSION TYPE

1. Panchromatic black and white. This is widely used for mapping and interpretation
2. COLOUR : It is used for interpretation ~~and~~ ~~for~~ mapping, to a limited extent
3. Infra-red black and white. It is used for interpretation and intelligence. I penetrates haze and cloud than panchromatic emulsion. ~~its~~ It is used to detect camouflage and seldom used for mapping
4. Infrared Colour: (false colour), It is used for interpretation, analysis of ~~crop~~ plant and crop diseases, soil analysis and water pollution.

Therefore aerial photograph type is chosen in accordance with the type of investigation. interpretation and analysis.

HISTORY OF AERIAL Photography. II/, 1/3 ~~/~~ 4

(3 pages) (1-3)

Introduction

Aerial photography is the most common, versatile and economic form of remote sensing. The advantages are (a) It provides improved vantage point, and gives birds eye view of large areas. It enable to see earth's surface features in their spatial ~~co~~ context. All the features are recorded simultaneously. It is useful for all user agencies.

(b) It has the capability to stop action view of dynamic conditions. ~~e~~ Thus used in ~~stg~~ studying floods, moving wildlife population, traffic, oil spills and forest fires.

(c) It provides a permanent recording. It can be compared with similar data acquired at previous times and useful for monitoring.

(d) It has broad band spectral sensitivity, from 0.3 - 0.7 μm.

(e) With proper film and flight parameters, it provides increased resolution and geometric fidelity.

Early history of Aerial photography

Photography was first made known in 1839 by ~~N.~~ Niepce, Fox Talbot and Mande Daguerre. These authors announced ~~pioneering~~ photographic processes in public. In 1840, ARGO, Director of the Paris Observatory, France ~~ad~~ advocated photography use for topographic surveying.

The first known aerial photography was taken in 1858 by Parisian photographer, Gaspard ~~R~~ Felix Tourna-chon. The photography was known as "NADAR" and a baloon was used to a height of 80m to get the photograph over a place BIEVRE in France. The earliest existing photograph was taken from a baloon ~~over~~ over Boston, USA in 1860 by James Wallace Black.

Photographs were used to obtain meteo~~log~~rological data and kites were used in 1882. The first aerial photograph from a kite by an English meteorologist, E.D. Archibald. In the early 1900, the kite photography of G.R. Lawrence, an American brough him worldwide appreciation. On April 18, 1908, he photographed the city of San Francisco, USA after it was affected by a great earthquake and fire. He hoisted his camera at a height of 600m. It was ~~susp~~ suspended from a battery of 17 kites above ship in SanFrancisco bay. The camera was very big, yielding 1.4 x 2.4m negative and very heavy.

The airplane was invented in 1903 ~~an~~ and it was used as a platform for ~~aerial~~ aerial photography in 1909 onwards. In April 24, 1909 a "biosphere" motion picture photographer, accompanied Wilbur Wright in his airplane and took the first aerial motion pictures. The photos were taken over CENTOCELLI, Italy for Italian Naval Officers. Photography became practical with airplanes than in kites and baloons. Photography from air-craft received great attention in military reconnaisance during World War I.

PTO

Much of the technology and interpretation of aerial photography is an outgrowth of early military development.

1-S-Epaper (III) 1/11

SCALE OF A VERTICAL PHOTOGRAPH

Scale is defined as the ratio of a distance measured on a map or drawing to the corresponding distance on the ground. For example, if ~~1 inch on a map~~ ~~1 cm~~ 1 ~~meter~~ cm on the map represents 100 metres on the ground, then the scale of the map is expressed as "1 ~~meter~~ cm = 100 meters." This is also known as "Engineer's scale". If for example, for this scale, the ~~map~~ distance on the map between two features measures 2.50 ~~metres~~ cms, the correspon-ding survey or ground distance between these two points is 2.50 ~~metres~~ cm × ~~100 metres~~ 100 m/cm
= 230 metres.

In practice, map scale is commonly expressed as a fraction, with the numerator and denominator in the same units. For example, if 1 cm on the map represents 50 m on the ground, then the scale is expressed as 0.01 m/50 m or 1/5000. The type of scale expression is called a Representative Fraction (RF). All are in the same units and the numbers are converted into whole numbers (no fraction / decimal). This same is also put in the form a ratio of

1 : 5000 OR 1 to 5000.

MAP VS AERIAL PHOTOGRAPH

A map is an orthographic (vertical) projection of the ground surface. Therefore all the ~~po~~ points on the map are in their true relative horizontal positions. Therefore "map position" means true horizontal position. As a consequence, the scale of the map is uniform throughout its extent.

Vertical aerial photographs exhibits many characteristics of a map. If it has no tilt, and the ground is flat and level, the photograph is just like a map. But in reality it is ~~not~~ not so. ~~Photographs~~ Photograph is a perspective projection. Areas of the terrain closer to the camera at the instant of exposure will appear larger than the corresponding areas lying farther from the camera. In ~~this~~ addition ~~is a~~ apparent leaning of the features are observed. This is called relief desplacement. These are the manifestation of perspective projection of aerial photograph — viz different sizes and leaning of the same images. This is not observed in the map which are true orthographic projection

SCALE of vertical Photograph

Moffit Fig 1:12 P. 11

This is illustrated in the figure III — 1 (a). It is a section taken through a vertical photograph, with the lens positioned at the point L. It is called the camera on exposure ~~position~~ station. The elevation of the lens above the datum is called Flying height (H). The ground is flat and its elevation above the datum is ground height (h). Point "o" is the principal point of the photograph.

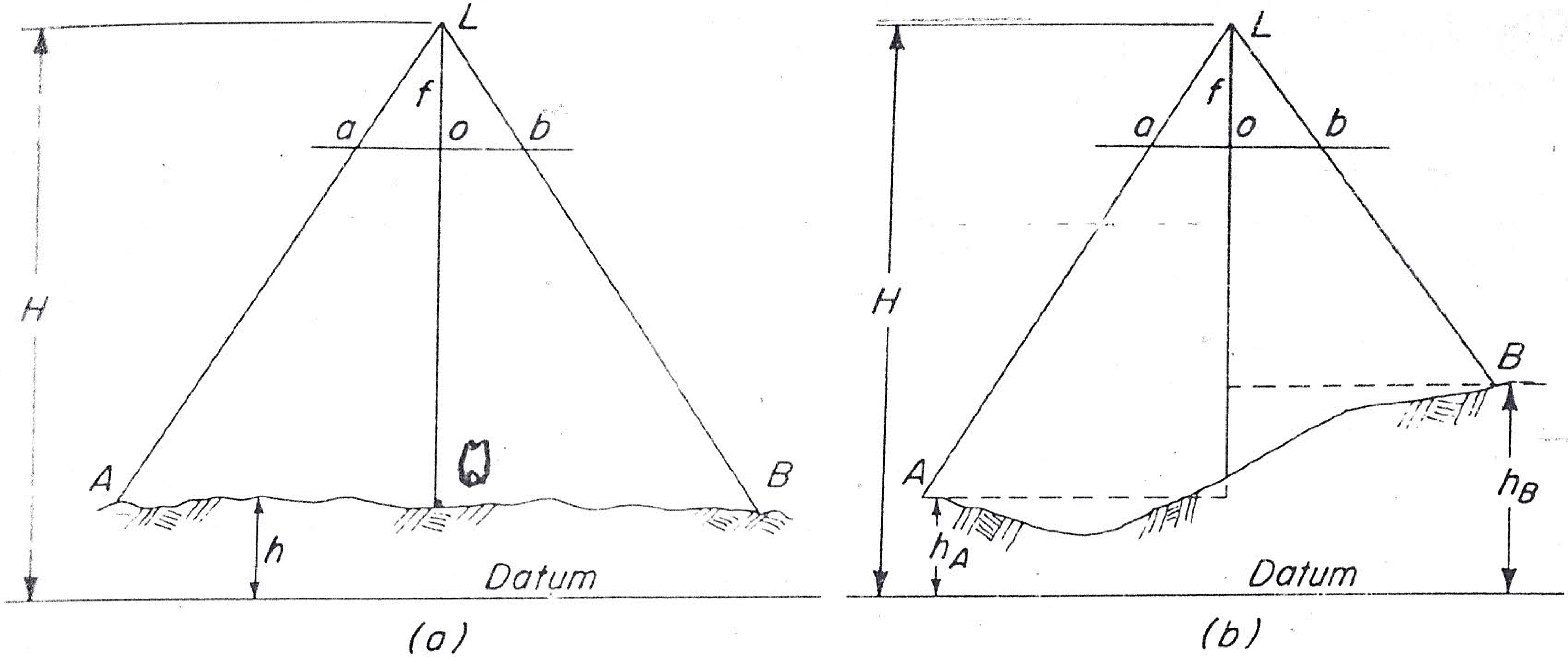


Figure 1-12. Scale of a photograph.

Its corresponding position on the ~~groun~~ ground is 'O'
The distance from the lens to the photograph, Lo is called the focal length of the camera optical lens. (f)

Scale of the photograph $= \frac{\text{Photo distance}}{\text{ground distance}} = \frac{ab}{AB}$

Consider similar triangle relationship of triangles Lab and LAB,

$$\frac{ab}{AB} = \frac{Lo}{oO} = \frac{\text{focal length}}{H-h} = \frac{f}{H-h}.$$

Scale at the elevation of h.,

$$S_h = \frac{f}{H-h}$$

f = focal length of the camera
H: Flying height
h: height of the ground.

__Example__: Given. Flying height 5200 ft
ground elevation. 980 feet above sea level
focal length = 8.25 inches
Give the scale in Engineer's scale as RF

(a) ~~Engineer's scale~~

$$S_{980} = \frac{f}{H-h} = \cancel{\frac{8.25/12}{5200-980}} = \frac{8.25/12}{4220} = \frac{1 \text{ inch}}{512 \text{ feet}}$$

$$= \frac{8.25''}{5200-\cancel{4220}\,980} = \frac{8.25'}{4220'ft} = \frac{1 \text{ inch}}{512 \text{ feet}}$$

$$S_{980} = \frac{1 \text{ inch}}{512 \text{ feet}}.$$

(a) Scale in Engineer's Scale: $\frac{1 \text{ inch}}{512 \text{ feet}}$ OR 1 inch = 512 feet

(b) Representative fraction: $RF = \frac{8.25''}{5200-980'} = \frac{8.25/12}{6138.} = \frac{1}{6138}$ or $\frac{1}{6140}$

RF: 1/6140 OR 1:6140 OR 1 to 6140.

Photographic scale is a function of focal length and the flying height, modified by the elevation of the ground. It varies from point to point. In general the ground is not having uniform height and may vary in nature. Thus terrain with variable elevation is common and rule of the nature. Thus scale for every elevation is determined in the same way and the scale for average elevation of the ground is obtained for practical purposes.

For example, the exposure station is 1450 m above sea level. It is the flying height of the aircraft. There are two points on the ground named A and B at elevations of 90 m and ~~120~~ 190 m respectively. The average ground elevation is 120 m. Camera focal length = 152 mm

$$\text{Scale}_{A(90)} = \frac{152/1000 \text{ m}}{1450 - 90 \text{ m}} = \frac{.152}{1360} = \frac{1}{8950}$$

$$\text{Scale}_{B(190)} = \frac{152/1000 \text{ m}}{1450 - 190} = \frac{.152}{\cancel{825}\ 1260} = \frac{1}{8250}$$

$$\text{Scale}_{120} = \frac{152/1000 \text{ m}}{1450 - 120} = \frac{0.152}{1330} = \frac{1}{8750}$$

PTO

III 5/5

Photo Scale:

In general there are three types namely

1. SMALL SCALE: In this, features appear smaller and only lesser details are obtained. The scale is ~~1:50,000~~ 1:50,000. Useful for mosaic preperation and regional map preperation

ii. MEDIUM SCALE: The scale is 1:12000 to 1:50,000. The features appear fairly prominent and useful for reconnaissance survey

iii. LARGE SCALE: upto 1:12000. Here features appear prominent and larger, but few features are observed. Useful for resource analysis and interpretation.

~~STEREOSCOPY AND STEREOMODEL~~ ✓

~~Stereoscopy, stereomodel and Monoscopic~~ (4 pages)

~~Monos~~

STEREOMODEL, MONOSCOPIC OBSERVATION ①
1/4

AND STEREOSCOPY:

~~Monoscopic~~ Monoscopic or Monocular vision permits the perception and ~~det~~ determination of the distances and positions in their ~~d~~ direction within the field of view. ~~A kind~~ A kind of depth perception or three dimensional ~~view~~ view is perceived. It is only a FALSE depth perception. It is produced on account of smaller scale of object with the ~~d~~ increasing distance and the overlapping of the rear objects with the frontones.

On the otherhand, binocular vision only ~~can produce~~ provides depth perception (3-dimensional view) provided the objects are far away from the eyes as the interpupillary distance is about 2.625 inches. ~~It has been found~~ It is impossible to distinguish objects in depth ~~of~~ a difference of the angle of coverege ($\theta = \theta'' - \theta'$) is less than 20 seconds of an arc.

The aim of stereoscopic viewing is to provide 3-dimension or depth perception (Fig. 1.)* When objects located at different distances, are viewed from a set of two viewing centres, the viewing centres subtend different perceptive angles at the objects. The perspective angle depends on the distance / depth. Larger the ~~angle~~ distance, smaller the angle. They have inverse relationship. The effect of relative distance is conveyed by perspective angle. For relative depth perception (3 dimension) it is necessary that the same object to be viewed from two perceptive centre. In other words, binocular vision is essential.

Depth Perception:

Objects P and Q are ~~situd~~ situated at distance of Dp and DQ. They are viewed by two eyes, namely L and R. and subtend ~~subt~~ angles ϕP and ϕQ respectively. These angles are termed as PARALACTIC ANGLE.

If $D_p < D_Q$, then $\phi P > \phi Q$

Distance is inversely proportional to the paralactic angle.

3/4

Distance $\propto \frac{1}{\text{paralactic Angle}}$.

The two points P and Q, are imaged at slightly different positions on the sensitive portion of the eye, namely RETINA, known as FLOVEA CENTRALIS. The brain interprets the difference in these position as a difference in the two angles ~~ϕp ϕq~~ $\phi p - \phi Q$, subtended ~~at~~ by the interpupillary distance "be" (eye base) This provides the impression or recognition of the distance d $(Dp - DQ)$ between the two object points, ~~ϕp~~ ϕp and ϕQ are called paradlactic angle ~~of the two points~~. for the two points.

The limitions of our eyes for stereoscopic viewing are: (a) averege seperation of eyes for distance vision is 10" or 25 cms. The upper limit of paralactic angle is 16° and the minimum or lower limit of parallactac angle is 10 to 20 seconds of an arc. The distance variation is 1700 to 2400 feet. (600 - 800m). Thus stereoscopic vision is not possible for less than 10" eye distance and beyond 2000 feet, ~~&~~ because the parallactic angle is very small beyond that distance. This is the phenomenon of Stereoscopy.

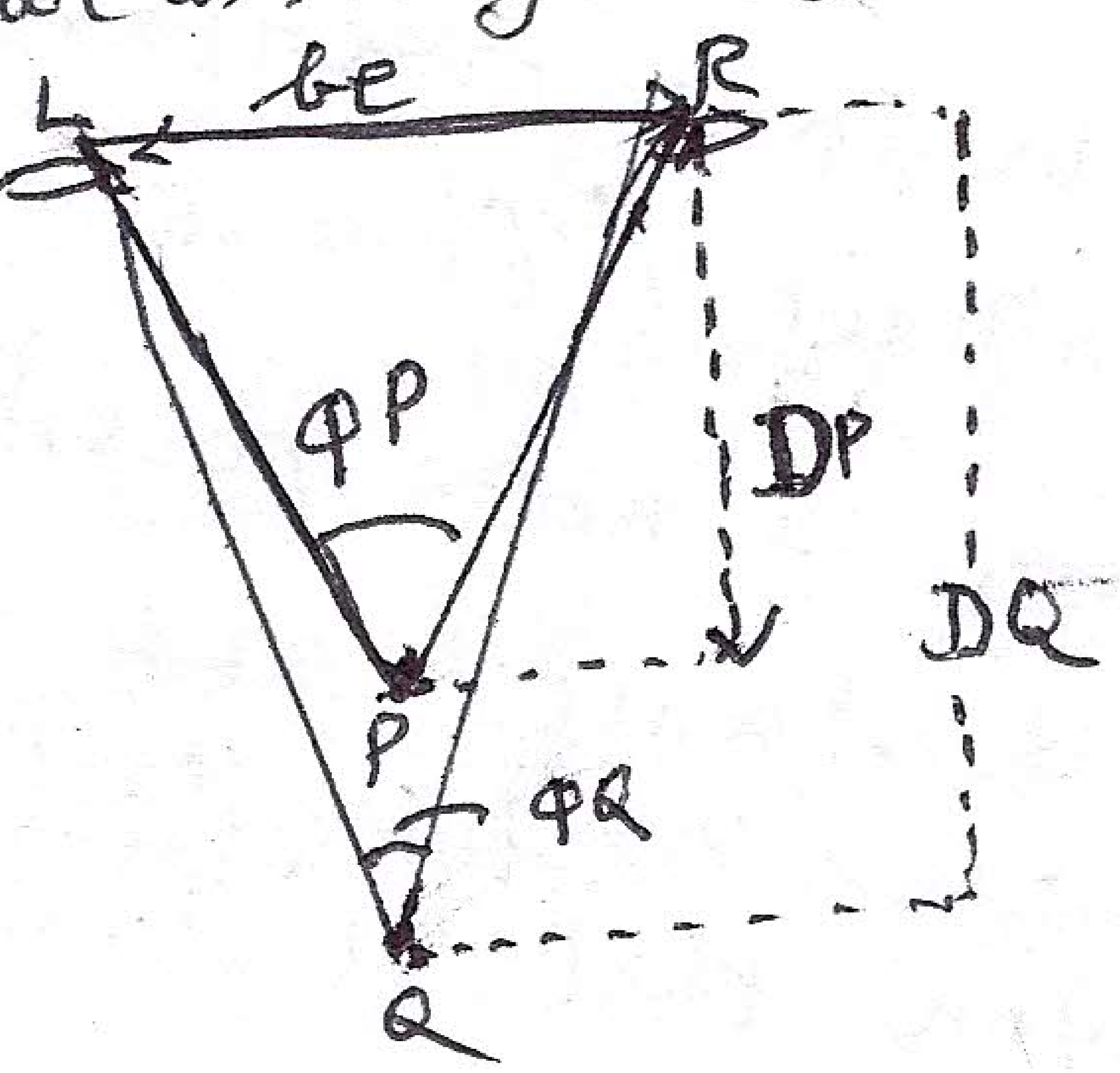
4/4

Stereoscopy with aerial photographs :

If an area is photographed from two stations, the set of photographs or images can be used for stereoscopic viewing. The left photo-graph is viewed ~~from~~ by left eye and the right photograph is viewed by right eye, with the ~~help of~~ help of stereoscopic instrument. When these two, left and right images ~~fuse~~ or merge into each other, a three-dimensional mental model is ~~produced~~ perceived. It is called the STEREOSCOPIC MODEL / STEREOMODEL and the technique is called stereoscopy.

In one way, the process virtually transposes the eye, in such a manner, that the eyebase (distance between the two eyes) is enlarged to airbase. (horizontal distance between 2 successive photographic stations).

If per change, ~~the relative~~, the relative positions of the photographs are ~~changed~~ interchanged, (the left photo on the right side and the right photo on the right ~~side~~ side) the mental model shows reverse relief; ridges appears as valleys and valleys appear as ridges. This is called PSEUDO-SCOPY.



@ Fig 5.12 p. 121 moffit

Stereomodel observation / stereoscopic viewing

Before the stereomodel observation, proper orientation of photographs under stereoscope is essential. This enables the ~~recognition~~ realisation three-dimensional impression of the terrain. The orientation is performed in the following manner.

1. The photographs are consequently numbered and in the same flight line. This numbering helps to identify a pair of adjacent overlapping (long) photographs. ~~e.f.~~ (FIG. 1) @

moffit Fig 5.12 p 121

2. Lay one phonograph down on the other so that overlap areas coincide.

3. (a) When using a lens stereoscope, seperate the photographs in the direction of the flight line, ~~such as~~ until conjugate images such as a and a' are seperated by about the same distance as are the centres of the lenses. This is the distance "d" in the figure.

(b) While using mirror stereoscope, seperate the two photographs in the direction of the flight line ~~untile~~ until conjugate images, namely b and b' are about the same distance apart as are the centres of the large wing measures. This distance is called 'm'.

4) The stereoscope is placed over the photograph such that the line joining lens or eyepiece centres is parallel with the direction of the ~~plis~~ flight

(5) While looking through the stereoscope, some adjustments are to be made to see a stereoscopic image comfortably. The adjustments are changing the seperation of photographs slightly, rotation of either photograph or rotation of the stereoscope or carry out a combination of these slight adjustments.

If the two photographs are picked up and interchanged, the left-eye may see right-hand photograph and the right eye may see left-hand photograph. As a result of this valleys look like ridges and hills appear as depressions. This is called pseudoscopy or pseudoscopic viewing. This is also useful in delineating ~~draimin~~ a drainage lines because they appear quite unnaturally as knife-edge ridges.

fej Moffit pp 121/5-12

...apping photographs. See Fig. 5-12(a). of adjacent over-

2. Lay one photograph down on the other so that their overlap areas coincide, as shown in Fig. 5-12(b).

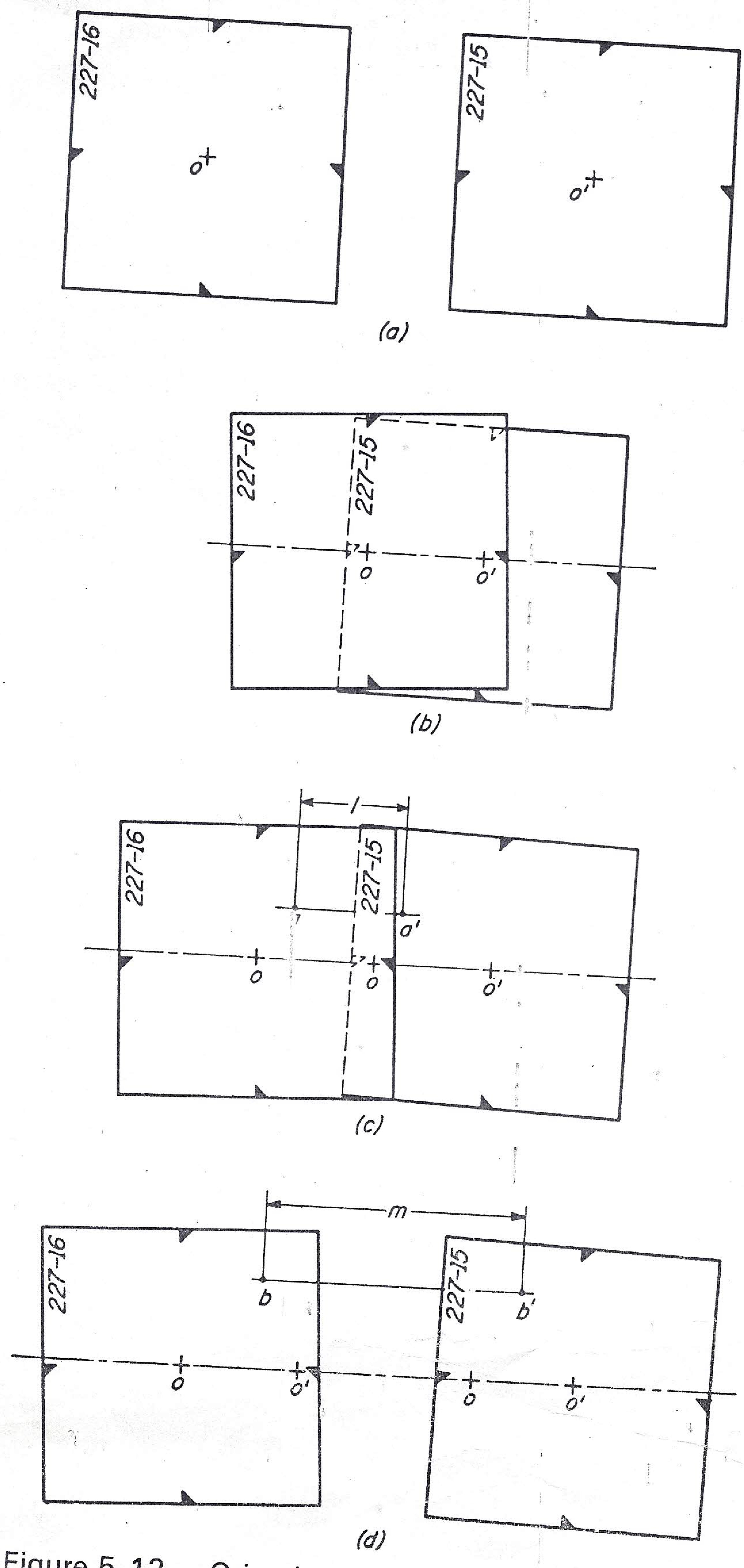


Figure 5-12. Orienting photographs for viewing under stereoscope.