

UNIVERSITY OF SOUTHAMPTON

AIR ARCHAEOLOGY
IN THE VALLEY OF THE RIVER SEVERN

VOLUME 2 of 3

PART I

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Thesis submitted for examination for
the degree of Doctor of Philosophy

Department of Archaeology
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APRIL 1992

VOLUME 2: CONTENTS

FIGURES IN TEXT OF VOLUME 1

SUBJECTS INVOLVED IN THE APPLICATION OF AERIAL RECONNAISSANCE IN ARCHAEOLOGY

ARCHAEOLOGY	GEOLOGY	AGRICULTURE	PHOTOGRAPHY	FLYING
Neolithic Bronze Age Iron Age Roman Viking Saxon Medieval	Strata Ice Age Gravels Sands Soils Water Table	Crops Ploughing Drains Spray Hedgerows Cultivation Pasture Farm Husbandry	Camera Format/Film Lens/Filters Aperture Speed Vertical Oblique Lighting Other Sensors	Aircraft Performance Accommodation Visibility Endurance Meteorology Navigation Air Traffic Mode of Operation

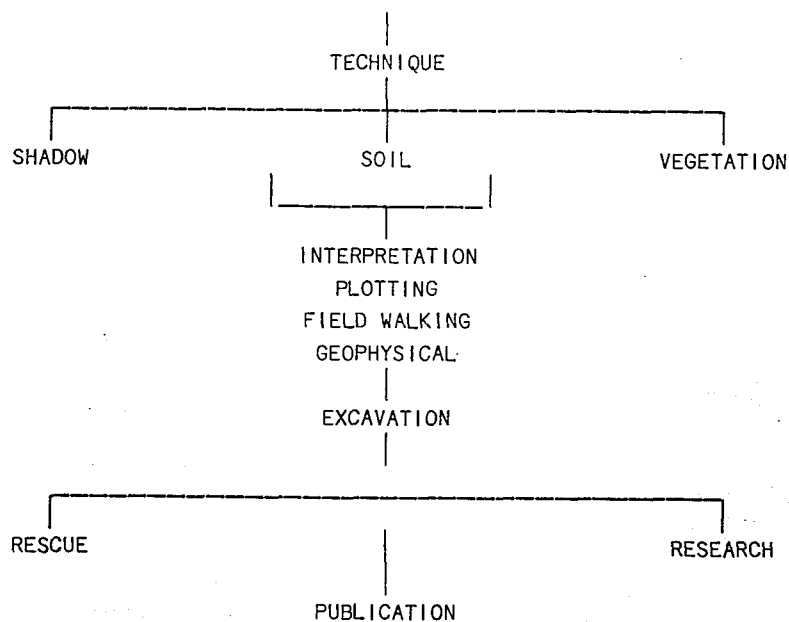


Fig. 1.1



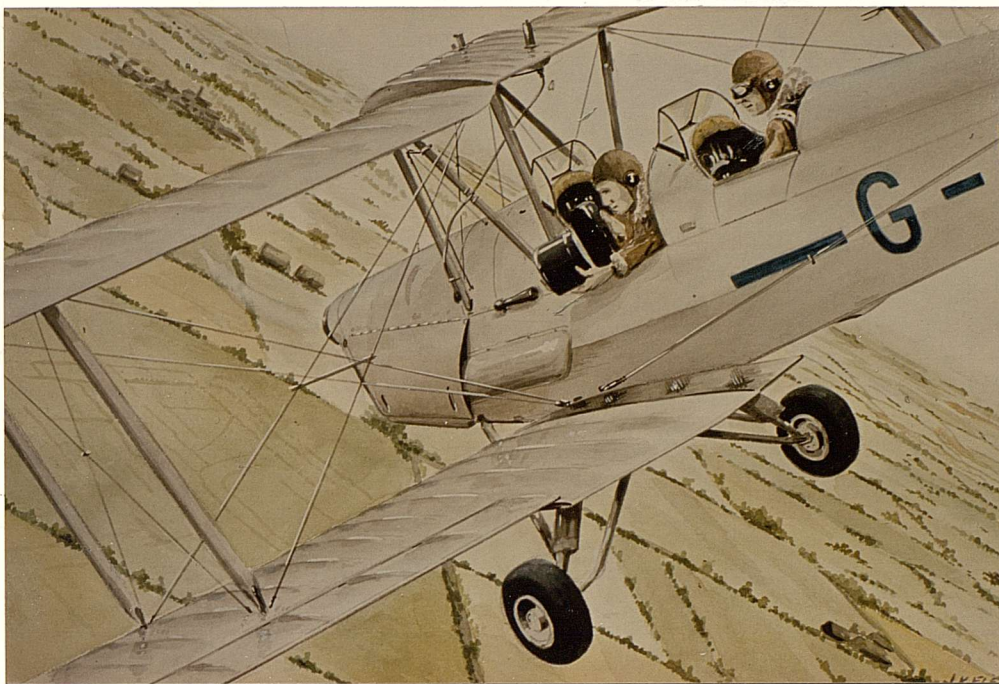
The writer with a DH82A (Tiger Moth)

Fig. 2.I



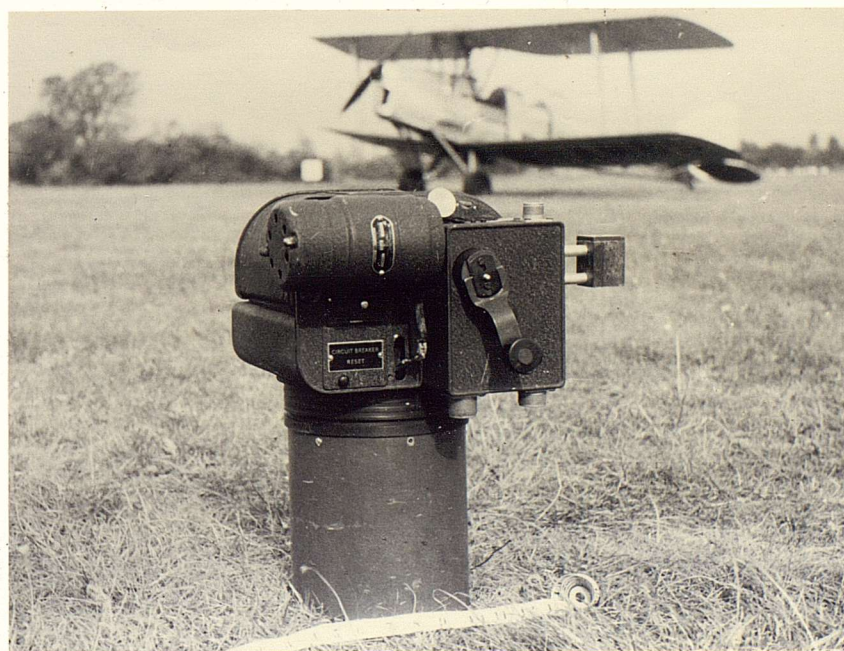
Observer and camera position with the writer
as pilot in the rear cockpit.

Fig. 2.2



Camera operating position in flight for
oblique photography (artists impression)

Fig. 2.3



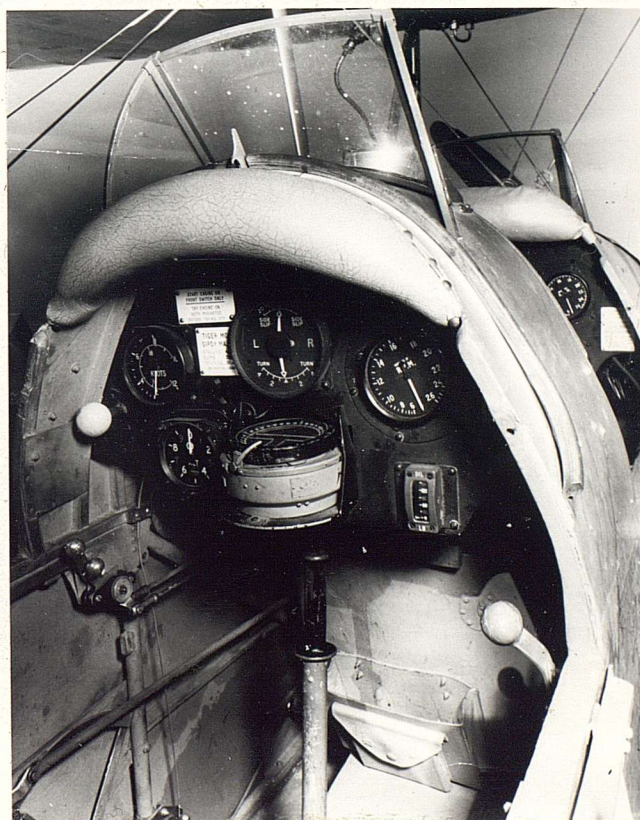
K24 type reconnaissance camera.

Fig. 2.4



Piper Cub with starboard panels opened for photography, the observer's position is in the rear cockpit.

Fig. 2.5



DH82A cockpit arrangement and instrument panel.

Fig. 2.6



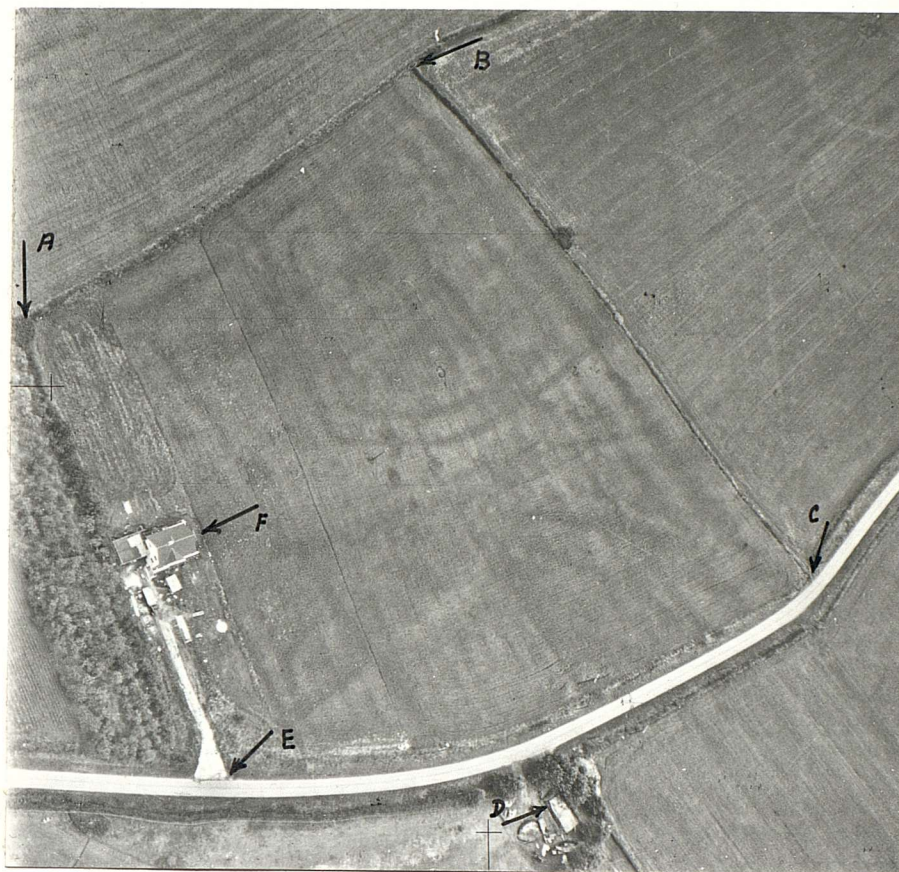
Outline of enclosure near Bishampton, Worcestershire

Fig. 3.I(a)

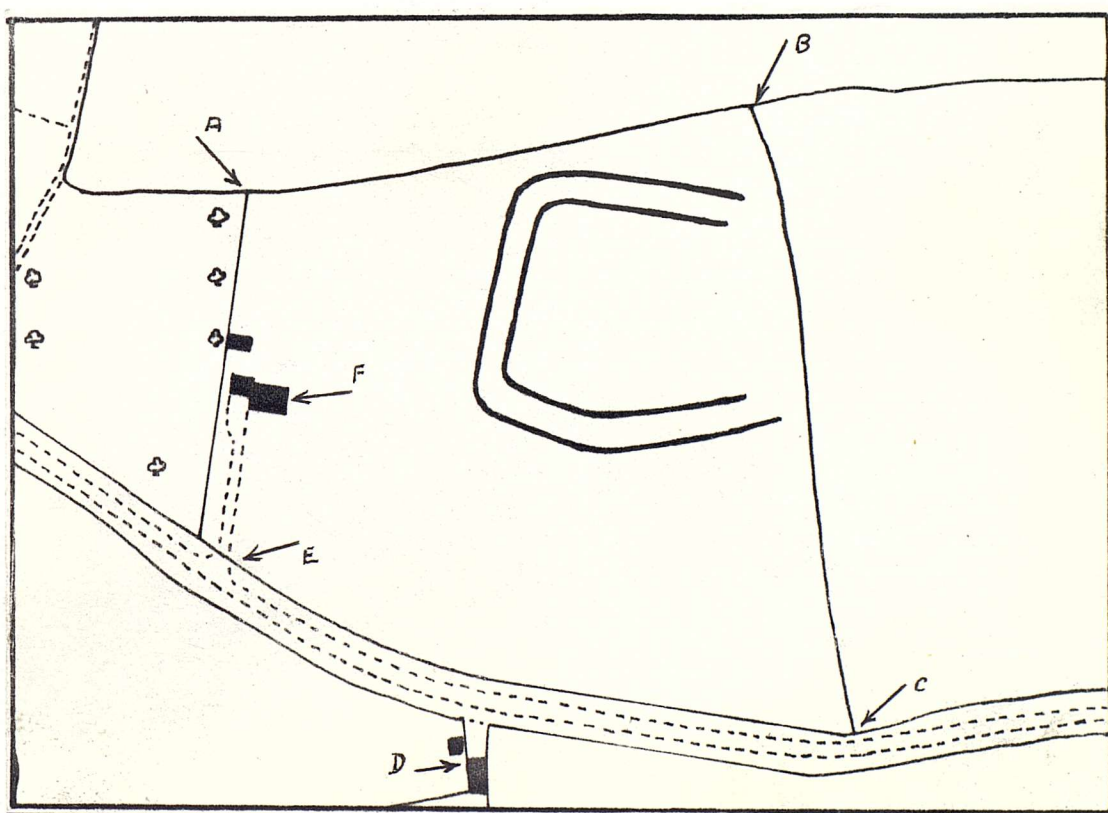


Enclosure near Bishampton, Worcestershire, outline improved with a small change in aspect

Fig. 3.I(b)



Enclosure near Bishampton, Worcestershire Fig. 3.1(c)



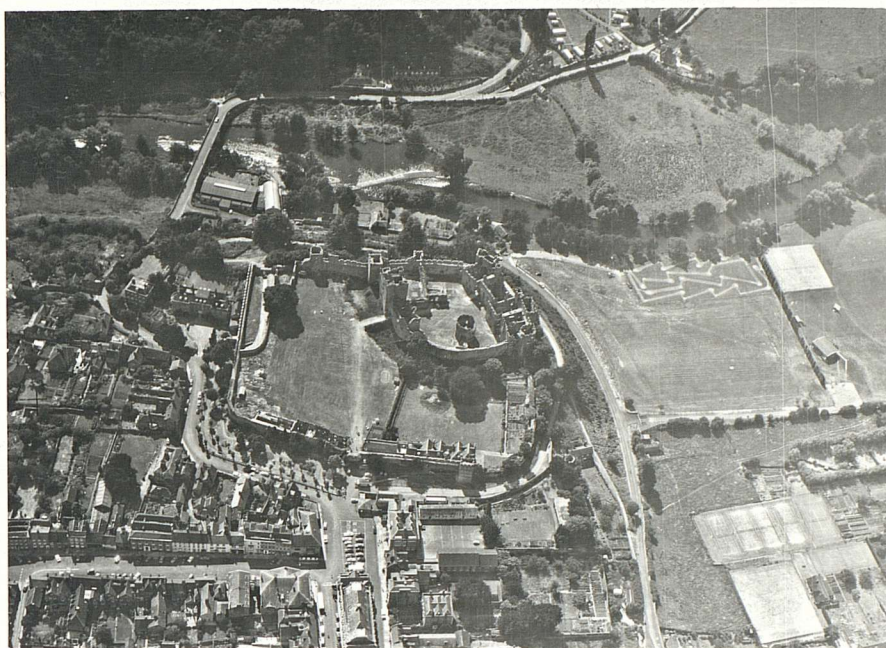
Enclosure plotted on 1:2500 scale Ordnance Survey map using control points as indicated (↑) Fig. 3.2



View of Warwick Castle

Fig. 4.I(a)

In the overcast conditions the general arrangement and structural details can be appreciated together with its position in the landscape, with no interference or obstructions such as would result from the presence of highlight and shadow.



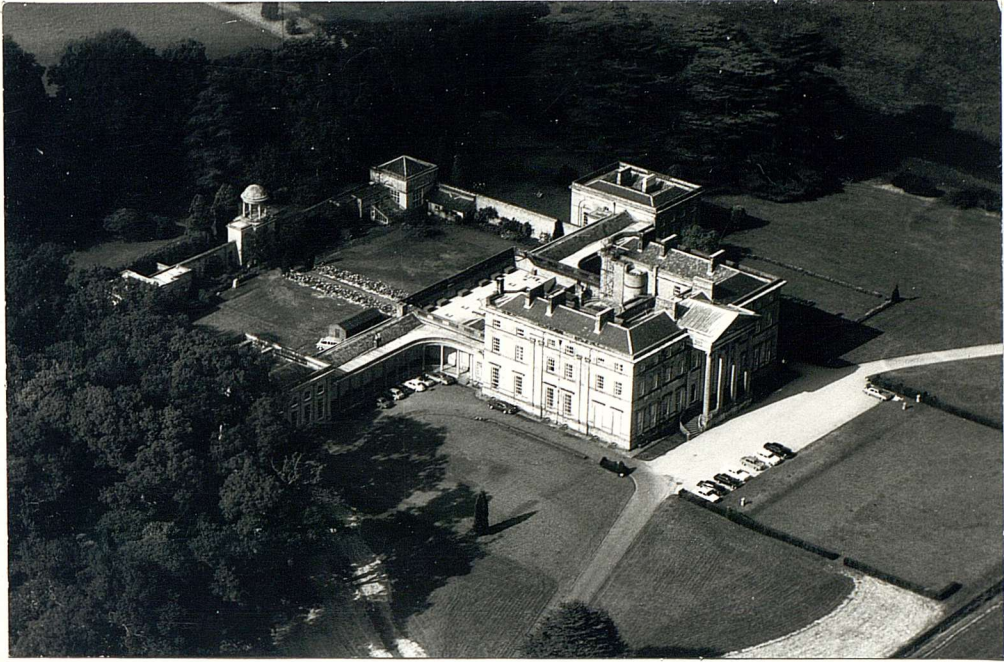
Ludlow Castle, Shropshire
view into sun.

Fig. 4.I(b)

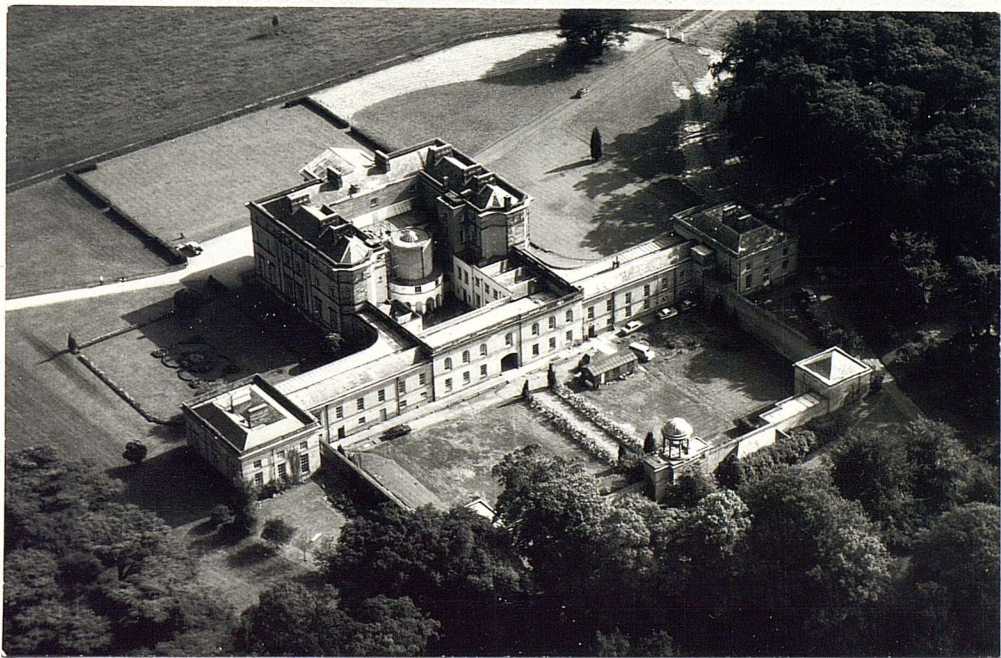


Ludlow Castle, Shropshire
view down sun.

Fig. 4.I(c)



Attingham Park, Shropshire
 view of the house at an angle of approximately 45 degrees
 down sun. Fig. 4.2(a)

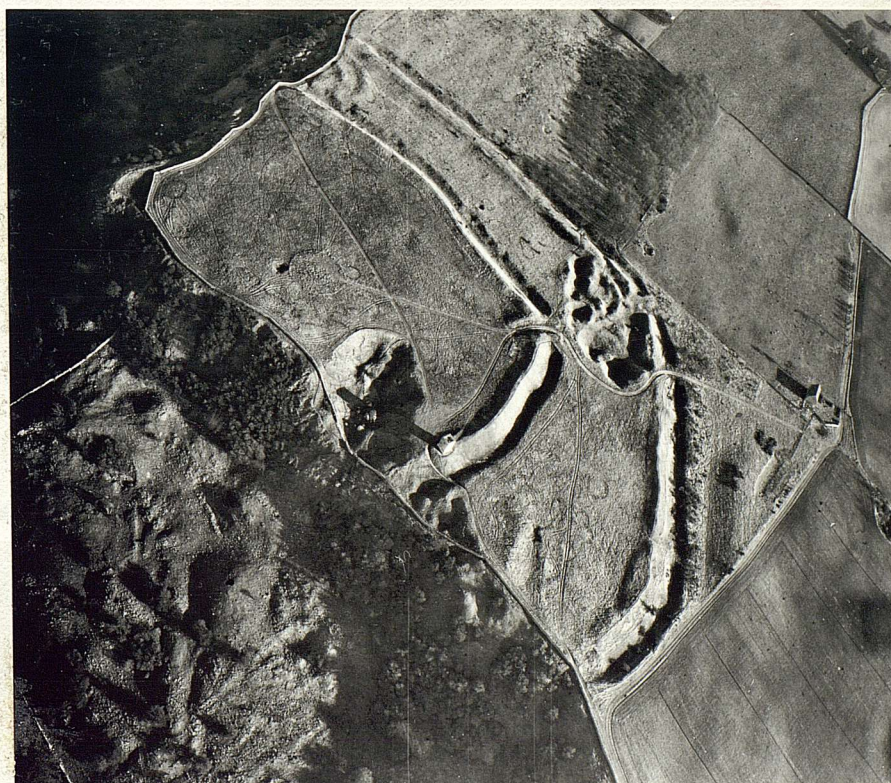


Attingham Park, Shropshire
 view of the rear of the house and outbuildings at an angle
 of approximately 45 degrees up sun. Fig. 4.2(b)



Iron Age fort on Bredon Hill Worcestershire
with the sun at a high angle of incidence.

Fig. 4.3(a)



Iron Age fort on Bredon Hill Worcestershire
with the sun at a low angle of incidence.

Fig. 4.3(b)



Iron Age fort Conderton Hill, Bredon
Worcestershire.

Fig. 4.4



Elmley Castle on Bredon Hill, Worcestershire.

Fig. 4.5



Billings Ring Iron Age fort, Choulton
Shropshire, view down sun.

Fig. 4.6(a)



Billings Ring Iron Age fort, Choulton
Shropshire, view into sun.

Fig. 4.6(b)



Caer Caradoc Iron Age hill-fort
All Stretton, Shropshire.

Fig. 4.7



Herefordshire Beacon Iron Age hill-fort
Malvern, Worcestershire, view in snow. Fig. 4.8



Soil marks of a Celtic field system
on Berwick Down, Wiltshire.

Fig. 4.9



Ditches of a circle and a settlement in pasture
at Astley, Worcestershire.

Fig. 4.10



Viroconium, Shropshire, parch marks of roads and building foundations in pasture.

Fig. 4.II



Fifield, Gloucestershire, the ditches of a complex settlement appear as lighter lines in the crop with their darker infill visible in an adjacent gravel pit.

Fig. 4.I2



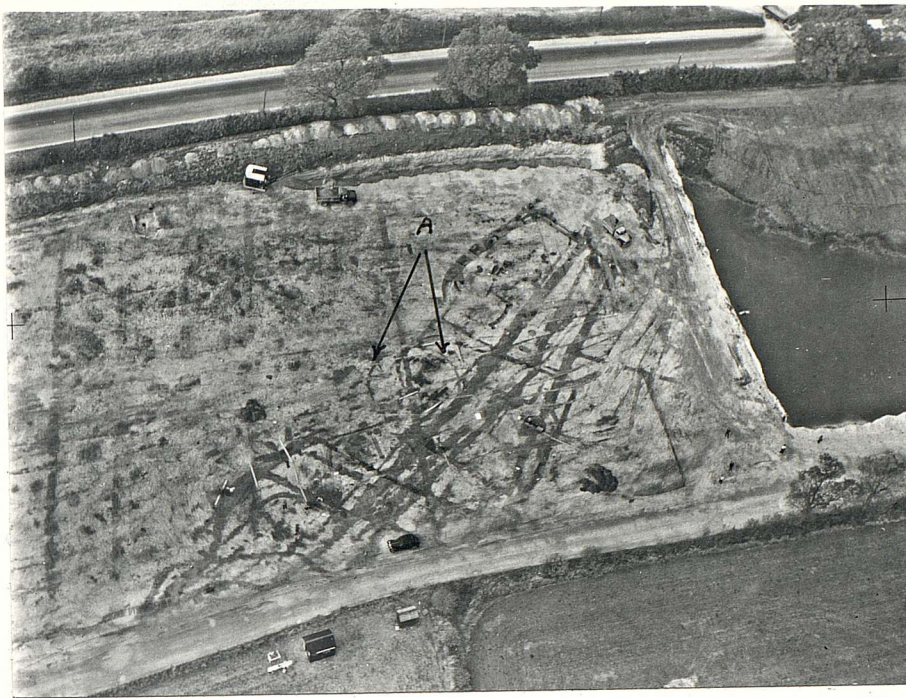
Lechlade, Thames valley, a pattern of ditches and pits, cut into the gravel and revealed by their darker infill.

Fig. 4.I3



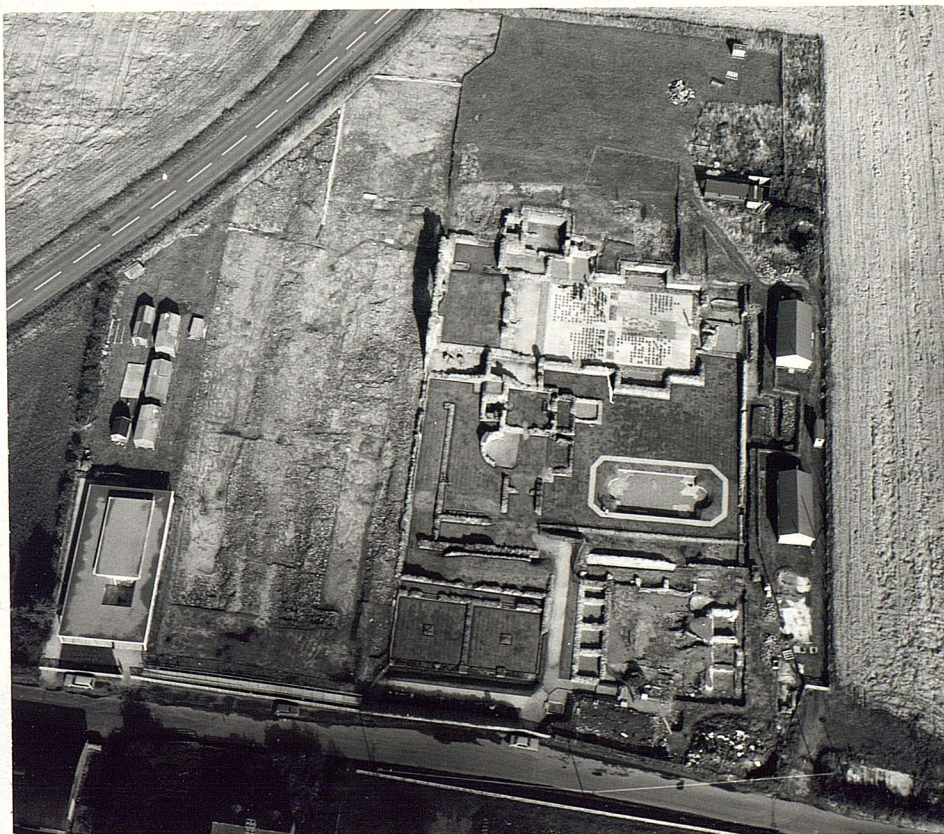
Lechlade, Thames valley, the ditches of a complex settlement revealed through their darker infill, with the remains of a circular ditch at point A.

Fig.4.I4



Lechlade, Thames valley, the settlement as in Fig.4.I4 but photographed from a different viewpoint to reveal the circular ditch at point A.

Fig. 4.I5



Viroconium, Shropshire, showing the excavated remains of the Baths site.

Fig. 4.I6



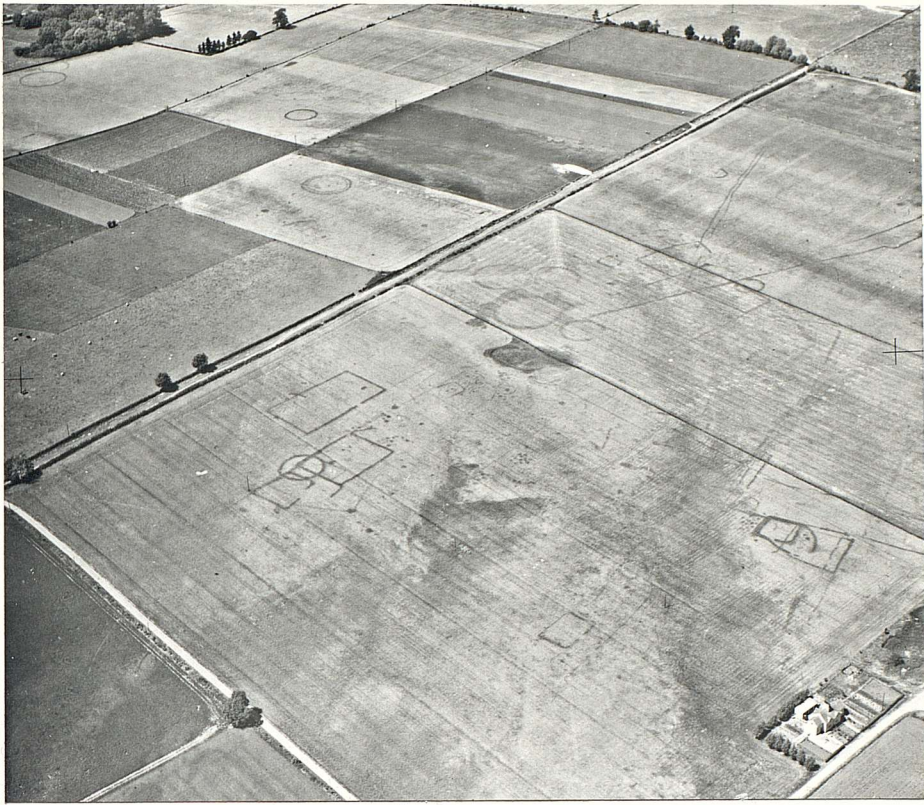
Positive crop-marks at Wickhamford, Worcestershire.

Fig. 5.I(a)



Positive crop-marks at Wickhamford, Worcestershire.

Fig.5.I(b)



Enclosures and ringed ditches at Long Wittenham, Oxfordshire. The crop over the enclosures in the foreground is still green in contrast with the surrounding crop in the process of ripening.

Fig. 5.2



Crop-marks of a complex settlement at Broadway, Worcestershire. The crop over the ditches is still growing and the surrounding crop ripe.

Fig. 5.3



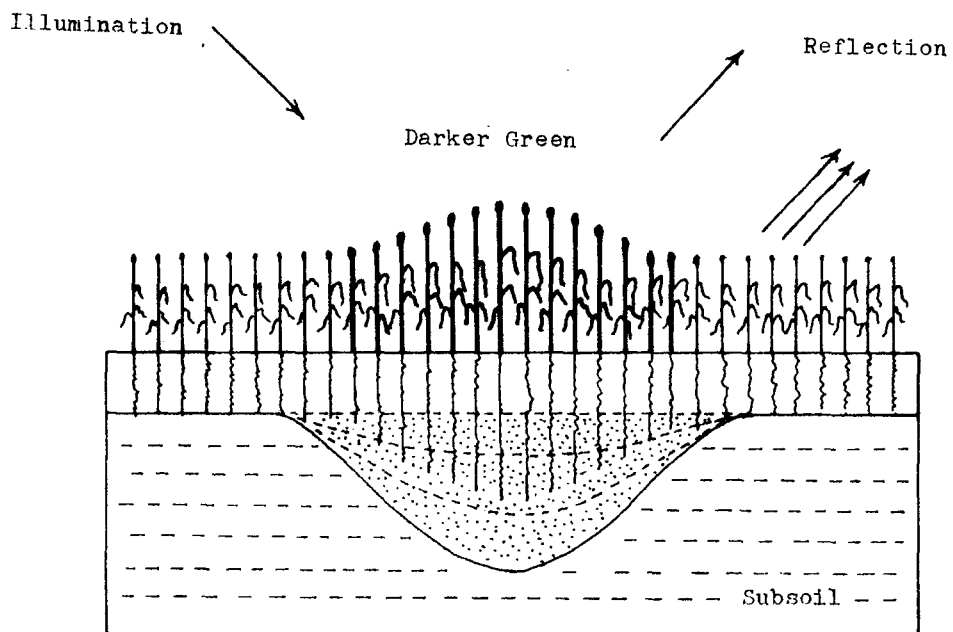
Crop-marks at Foxley Farm in the upper Thames valley illustrating the effect of differential ripening over the conjoined circular features.

Fig. 5.4(a)

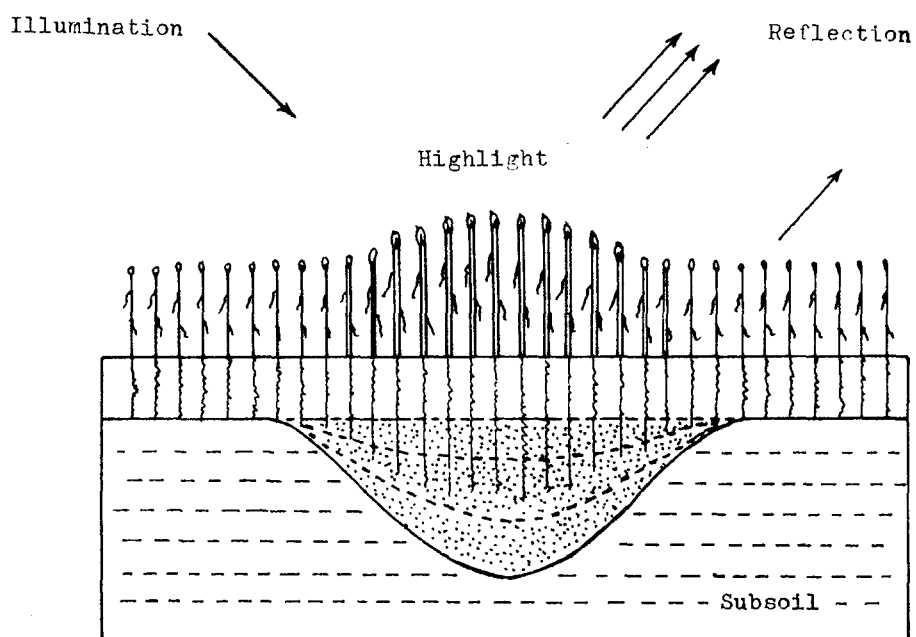


The crop-marks at Foxley Farm from a viewpoint of 180 degrees to show the effect of a crop reversal over the features in the foreground.

Fig. 5.4(b)



Positive crop-mark as it appears over a ditch in unripe cereal.
Fig. 5.5(a)



Positive crop-mark as it appears over a ditch in ripe cereal.
(crop reversal) Fig.5.5(b)



Settlement site near Pershore, Worcestershire.
Continuity of ditches screened by equivalent
growth over damp areas.

Fig. 5.6



Double ditched enclosure near Ettington on
the Foss Way, view looking West.

Fig. 5.7(a)



Double ditched enclosure near Ettington on
the Foss Way, view looking East. Fig.5.7(b)



Double ditched enclosure near Ettington on
the Foss Way, view looking North down sun. Fig.5.7(c)



Enclosure near Lower Slaughter on the Foss Way
with a viewpoint into sun.

Fig. 5.8(a)



Enclosure near Lower Slaughter on the Foss Way
with a viewpoint down sun.

Fig. 5.8(b)



Enclosure near Lower Slaughter on the Foss Way
looking West across the line of the sun.

Fig. 5.8(c)



Crop-marks East of Sherborne near the river Dickler on the Cotswolds, with the viewpoint down sun. Fig. 5.9(a)



Crop-marks East of Sherborne near the river Dickler on the Cotswolds, with the viewpoint into sun. Fig. 5.9(b)



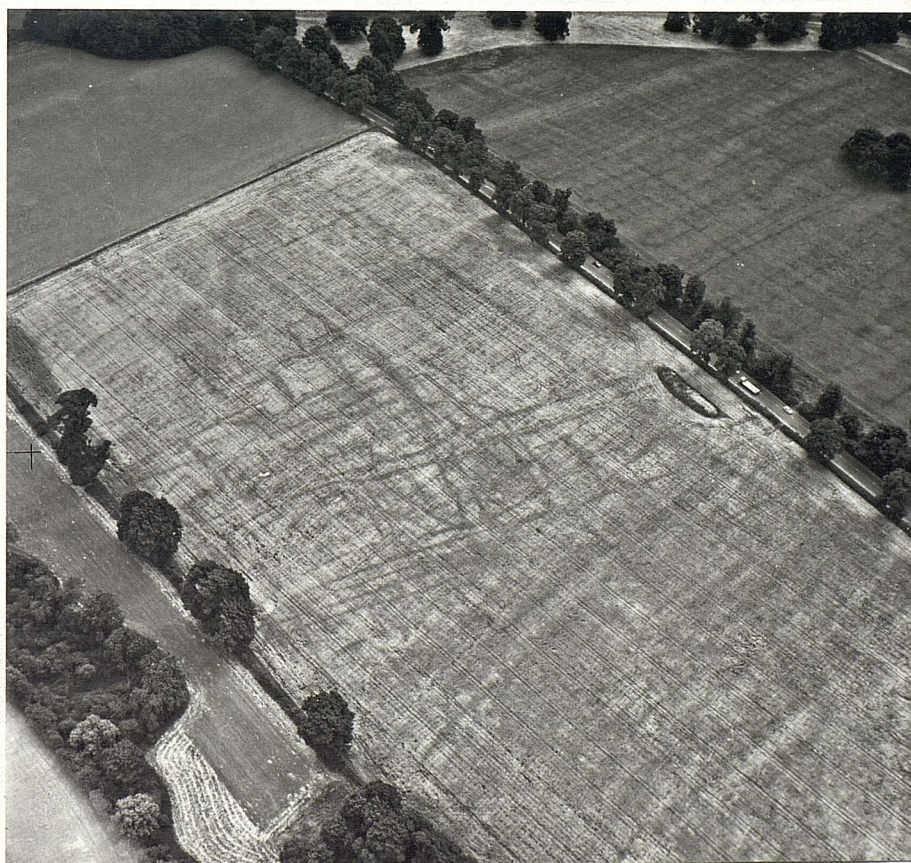
A pattern of ditches at Sherbourne on the Warwickshire Avon, in a view looking North.

Fig. 5.10(a)



A pattern of ditches at Sherbourne on the Warwickshire Avon, looking Northwest.

Fig. 5.10(b)



A pattern of ditches at Sherbourne on the Warwickshire Avon, looking Southwest.

Fig. 5.10(c)



View of Roman Fort at Stretton Mill, Staffordshire,
looking Northeast down sun.

Fig. 5.II(a)



Roman Fort at Stretton Mill, Staffordshire, high
oblique looking Southwest into sun.

Fig. 5.II(b)



Roman Fort at Stretton Mill, Staffordshire, with a viewpoint Southeast across the sun. Fig. 5.II(c)



Roman Fort at Stretton Mill, Staffordshire, looking Northeast down sun. Fig. 5.II(d)



Crop-marks in the vicinity of Stanton Harcourt
in the upper Thames valley, with a viewpoint
down sun.

Fig. 5.I2(a)



Crop-marks in the vicinity of Stanton Harcourt
in the upper Thames valley, looking toward the
sun.

Fig. 5.I2(b)



Enclosures and ditches East of Culham, Oxfordshire, in a viewpoint to the Northeast, with the crop in the process of ripening.

Fig. 5.I3(a)



Enclosures and ditches East of Culham, Oxfordshire, in a viewpoint to the Northeast, showing the effects of differential ripening.

Fig. 5.I3(b)



Enclosures and ditches East of Culham, Oxfordshire,
looking to the Northwest, with increased contrast.

Fig. 5.I3(c)



Enclosures and ditches East of Culham, Oxfordshire,
with a viewpoint to the West, revealing the site detail.

Fig. 5.I3(d)



Crop-marks at Foxley Farm in the Thames valley,
with the viewpoint down sun. Fig. 5.I4(a)



Crop-marks at Foxley Farm in the Thames valley,
looking across the sun to reveal the site detail. Fig. 5.I4(b)



A group of pits at Foxley Farm in the Thames valley,
from an aspect directly into sun. Fig. 5.I5(a)



A group of pits at Foxley Farm in the Thames valley,
from a different viewpoint into sun. Fig. 5.I5(b)



Crop-marks in ripe cereal, East of Harvington, Worcestershire, with a viewpoint South.

Fig. 5.I6(a)



Crop-marks in ripe cereal, East of Harvington, Worcestershire, with a viewpoint to the Northeast.

Fig. 5.I6(b)



Circles in Purple Vetch and Clover at
Stanton Harcourt, Oxfordshire. Fig. 5.I7



Settlement site in Wheat and Barley, East of
Pershore, Worcestershire, looking Southwest.

Fig. 5.I8(a)



Settlement site in Wheat and Barley, East of Pershore, Worcestershire, looking West.

Fig. 5.I8(b)



Settlement site in Wheat and Barley, East of Pershore, Worcestershire, looking East.

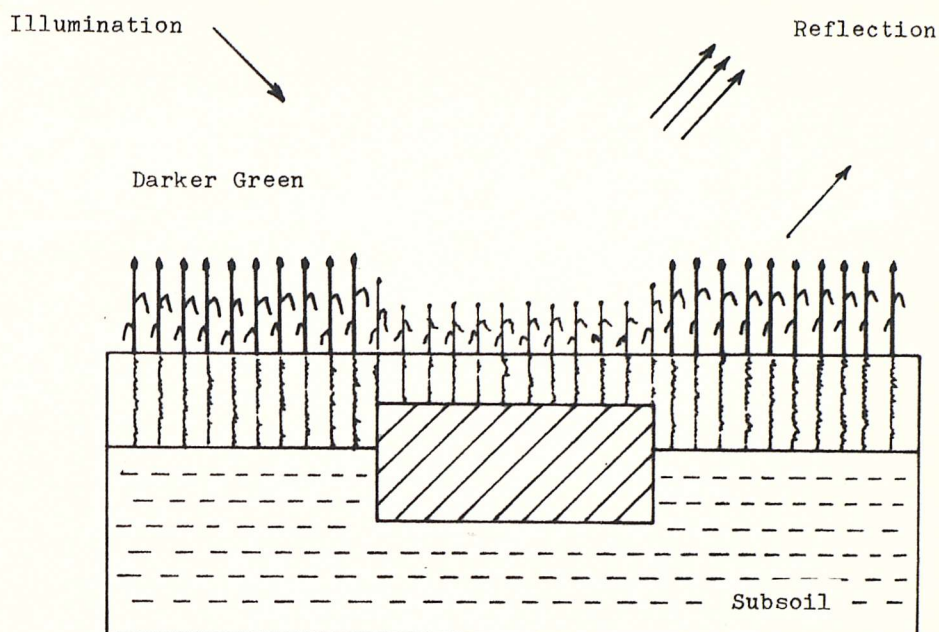
Fig. 5.I8(c)



Crop-marks near Bricklehampton, Worcestershire,
with a viewpoint into sun. Fig. 5.I9(a)



Crop-marks near Bricklehampton, Worcestershire,
with a viewpoint down sun. Fig. 5.I9(b)

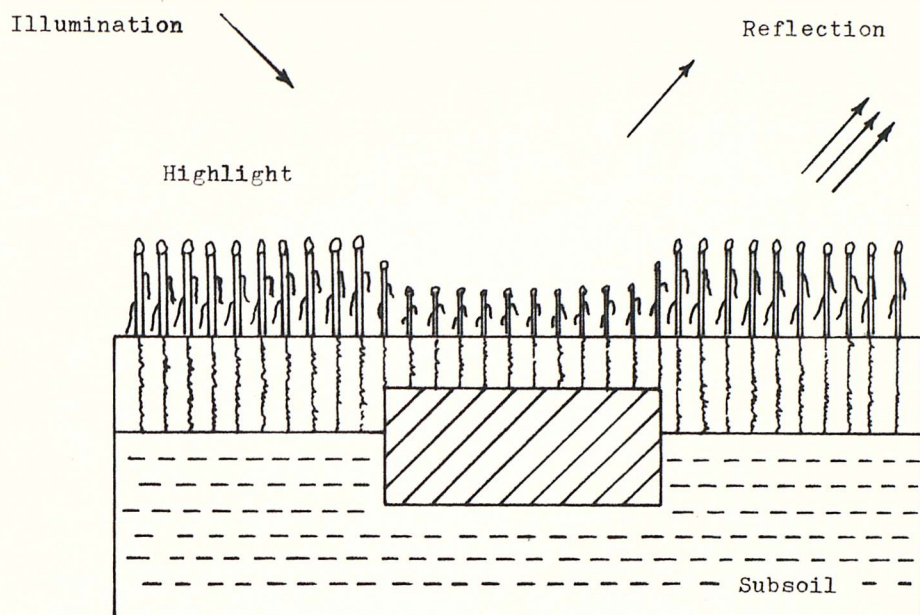


Negative crop-mark as it appears over hardcore in unripe cereal.
Fig. 5.20(a)

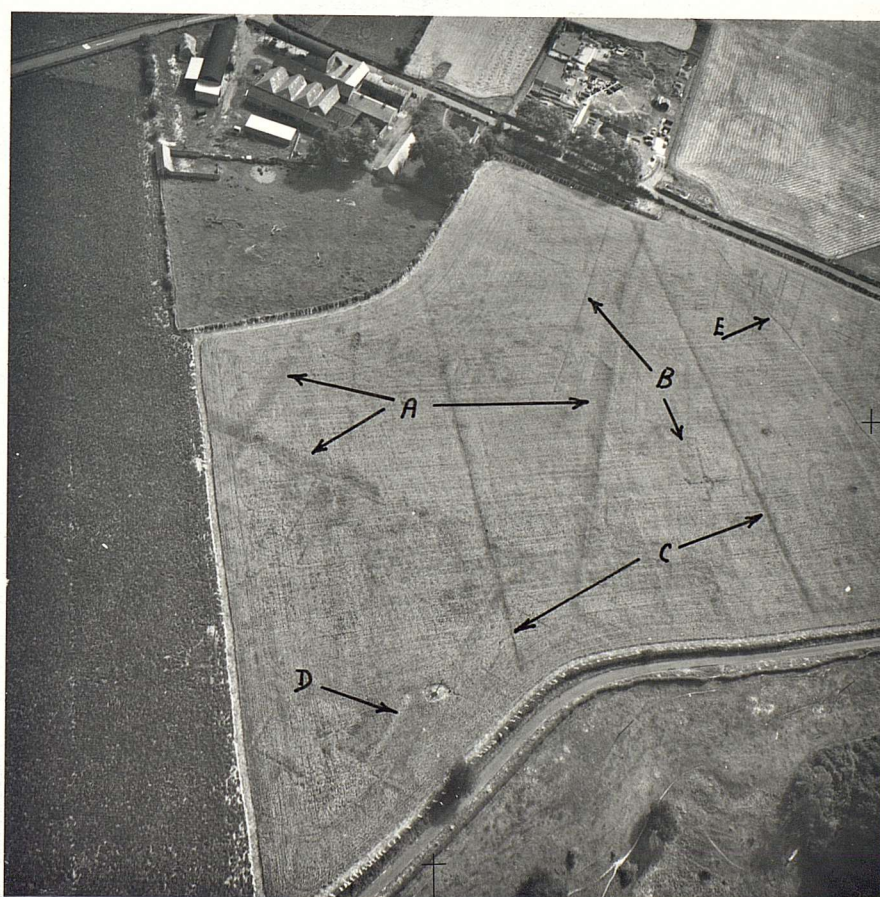


Negative crop-marks in unripe cereal, in the vicinity
of the Forum at Viroconium, Shropshire.

Fig. 5.20(b)



Negative crop-mark as it appears over hardcore in ripe cereal.
(crop reversal) Fig. 5.2I(a)



Negative crop-marks in ripe cereal, in the vicinity
of the Forum at Viroconium, Shropshire.

Fig. 5.2I(b)



Negative crop-marks at Castle Hill, Lower Fulbrook on the
Warwickshire Avon, viewpoint Northeast. Fig. 5.22(a)



Negative crop-marks at Castle Hill, Lower Fulbrook on the
Warwickshire Avon, viewpoint West. Fig. 5.22(b)



Negative crop-marks at Castle Hill, Lower Fulbrook on the
Warwickshire Avon, viewpoint Southwest. Fig. 5.22(c)



Negative crop-marks at Castle Hill, Lower Fulbrook on the
Warwickshire Avon, viewpoint Southeast. Fig. 5.22(d)



Negative and Positive crop-marks at
Viroconium, Shropshire.

Fig. 5.23(a)



Negative and Positive crop-marks at
Viroconium, Shropshire, with a change
in viewpoint and angle of oblique.

Fig. 5.23(b)



Negative crop-marks West of the Forum at
Viroconium, Shropshire, showing striations
in the crop.

Fig. 5.24(a)



Negative crop-marks West of the Forum at
Viroconium, Shropshire, with a change in
viewpoint.

Fig. 5.24(b)



Negative crop-marks of the Forum at Viroconium, Shropshire, with a high angle oblique down sun.

Fig. 5.25(a)



Negative crop-marks of the Forum looking into sun.

Fig. 5.25(b)



Negative crop-marks of the Forum with a low angle of oblique down sun.

Fig. 5.25(c)



Negative crop-marks of the Forum at Viroconium, Shropshire, looking down sun with an increased angle of oblique.

Fig. 5.25(d)



Negative crop-marks of the Forum with a small deviation from the line of the sun.

Fig. 5.25(e)



Negative crop-marks of the Forum looking almost across the sun with a decrease in height.

Fig. 5.25(f)



The outline of enclosures at Grimley, Worcestershire, revealed through weeds after harvesting. Fig. 5.26

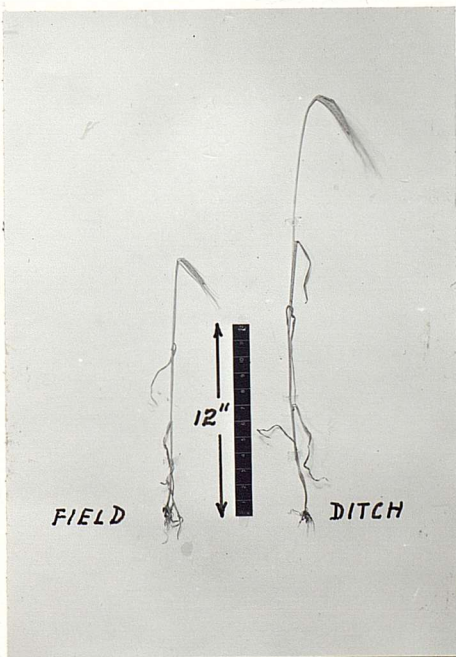


Gravel extraction and crop-marks at Stanton Harcourt, Oxfordshire. Fig. 5.27



Circular features at Stanton Harcourt, Oxfordshire, showing ditch infill with overburden removed, and continued as a crop-mark in the adjacent field.

Fig. 5.28



Crop sample (a)



Crop sample (b)

Fig. 5.29



Crop-marks show a double ditched enclosure in Wheat
at Bishampton, Worcestershire.

Fig. 5.30(a)



Crop sample from Bishampton.

Fig. 5.30(b)



Negative crop-marks of roads in the vicinity of
the Forum at Viroconium, Shropshire. Fig. 5.3I(a)



Crop sample from Viroconium. Fig. 5.3I(b)



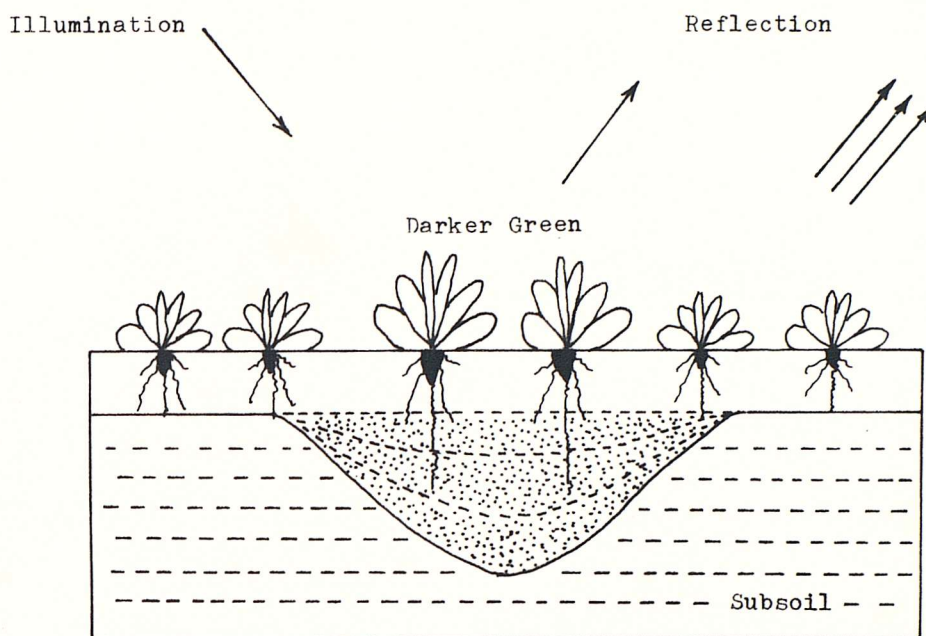
The defences of a Roman Fort in Oats at Jay Lane
near Leintwardine, Herefordshire.

Fig. 5.32(a)



Crop samples from Jay Lane.

Fig. 5.32(b)



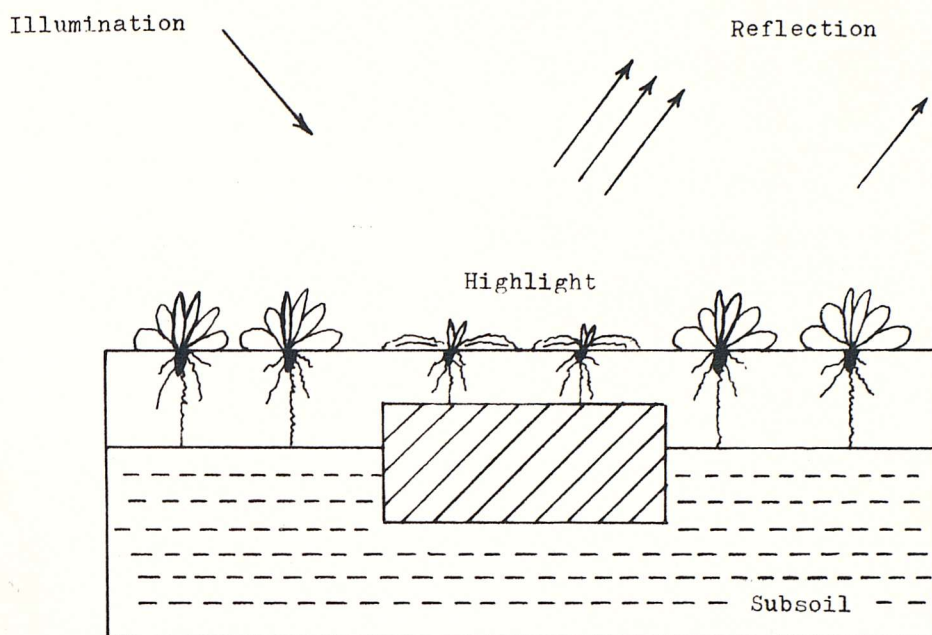
Positive crop-mark in Sugar-Beet, as it appears over a ditch.

Fig. 5.33(a)



Positive crop-mark of an enclosure in Sugar-Beet at Enville, Staffordshire.

Fig. 5.33(b)



Negative crop-mark in Sugar-Beet, as it appears over hardcore.

Fig. 5.34(a)



Negative crop-marks of roads and building foundations in Sugar-Beet at Viroconium, Shropshire. Fig. 5.34(b)



Negative crop-mark of the road alignment at Point A in Fig. 5.34(b), at Viroconium, Shropshire, from the ground viewpoint.

Fig. 5.34(c)



Negative crop-marks of roads and building foundations in Wheat at Viroconium, Shropshire, in the same field as for Fig. 5.34(b).

Fig. 5.35



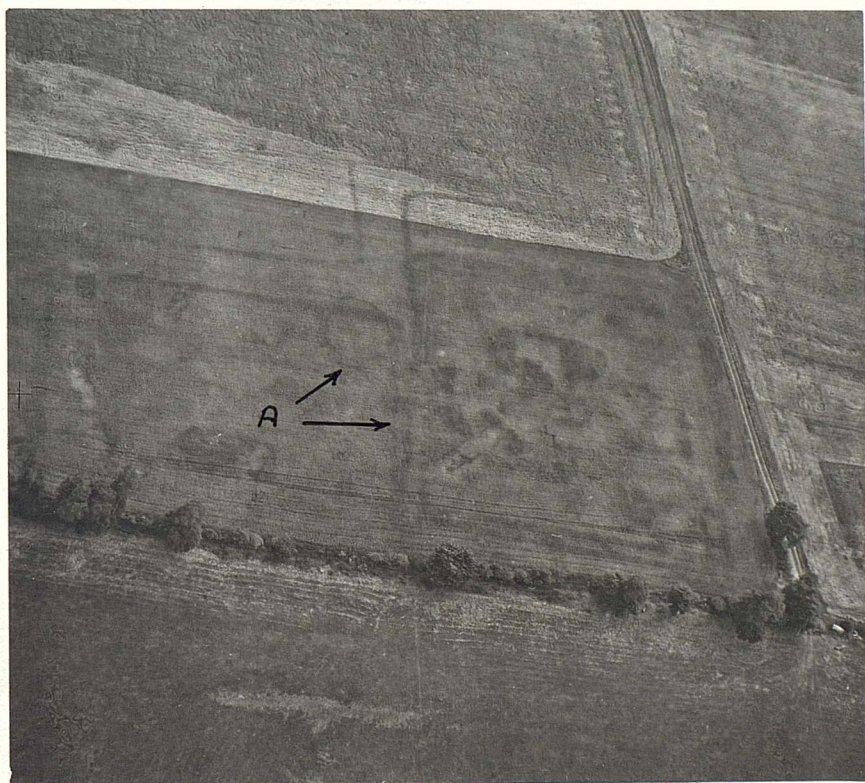
Negative crop-marks of roads and building foundations
in Barley at Viroconium, Shropshire, in the same field
as for Fig. 5.34(b).

Fig. 5.36



Ditched features near Appleford, Oxfordshire.

Fig. 6.I(a)



Ditched features near Appleford, showing the effects of rainfall.

Fig. 6.I(b)



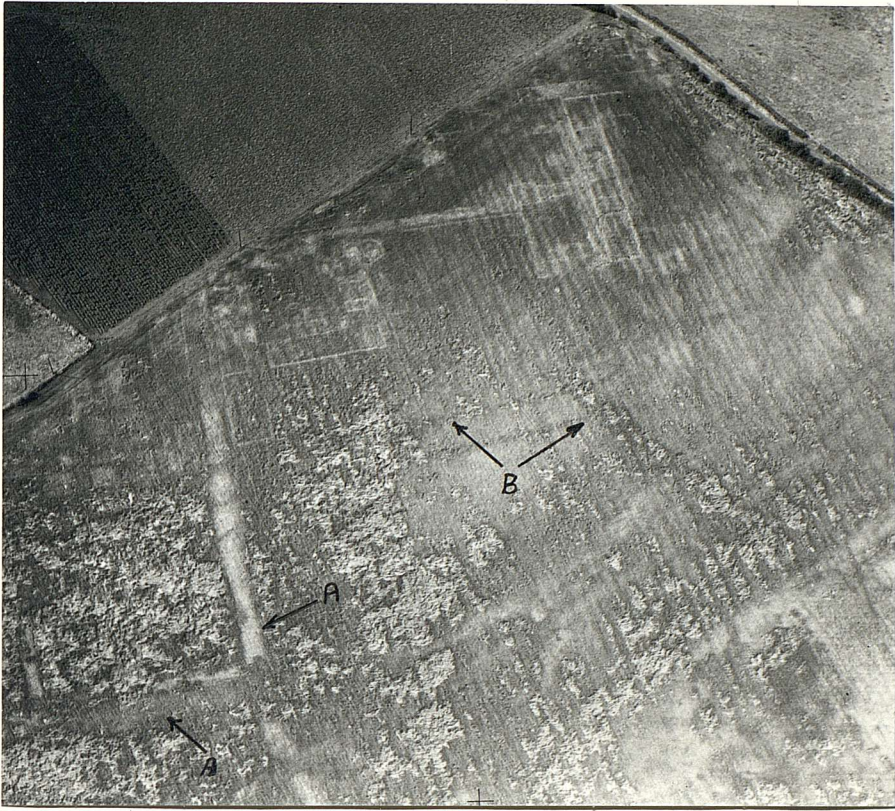
Partial lodging of Positive crop-marks in unripe cereal near Wick, on the Warwickshire Avon.

Fig. 6.2

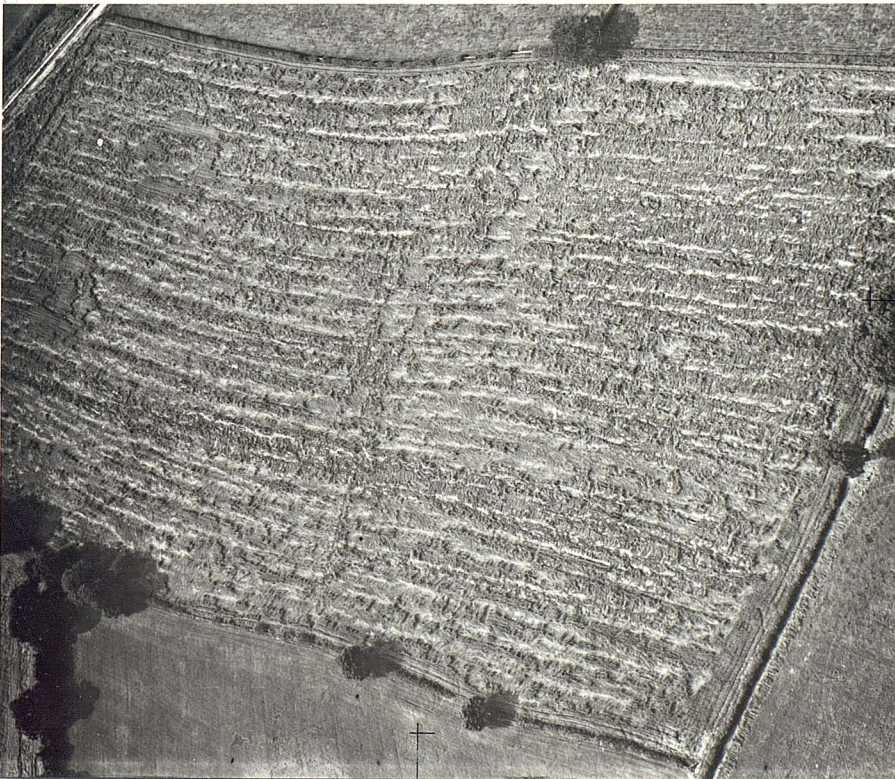


Positive crop-marks lodged in ripe cereal at Little Clanfield, Oxfordshire.

Fig. 6.3



The effects of heavy rainfall on crop-marks in
Barley at Viroconium, Shropshire. Fig. 6.4



Total crop destruction by wind and rain at
Wasperton, Warwickshire. Fig. 6.5



The effects of wind on Negative crop-marks in Barley at Viroconium, Shropshire. Fig. 6.6(a)



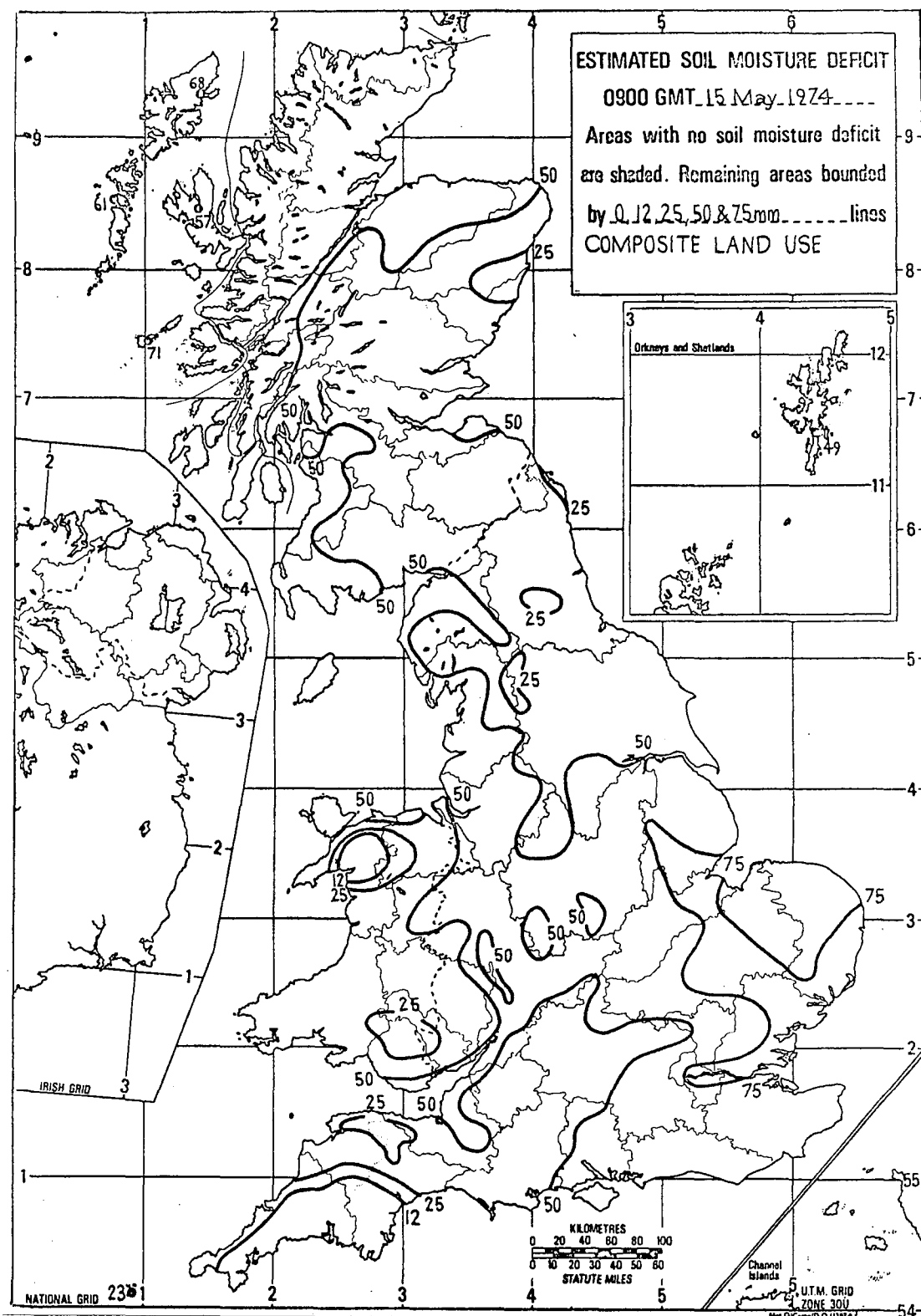
Improved definition of crop-marks in Barley with a viewpoint down sun and approximately in line with the wind. Fig. 6.6(b)



Crop-marks of an enclosure at Welford on Avon,
Warwickshire, in 1959. Fig. 6.7(a)

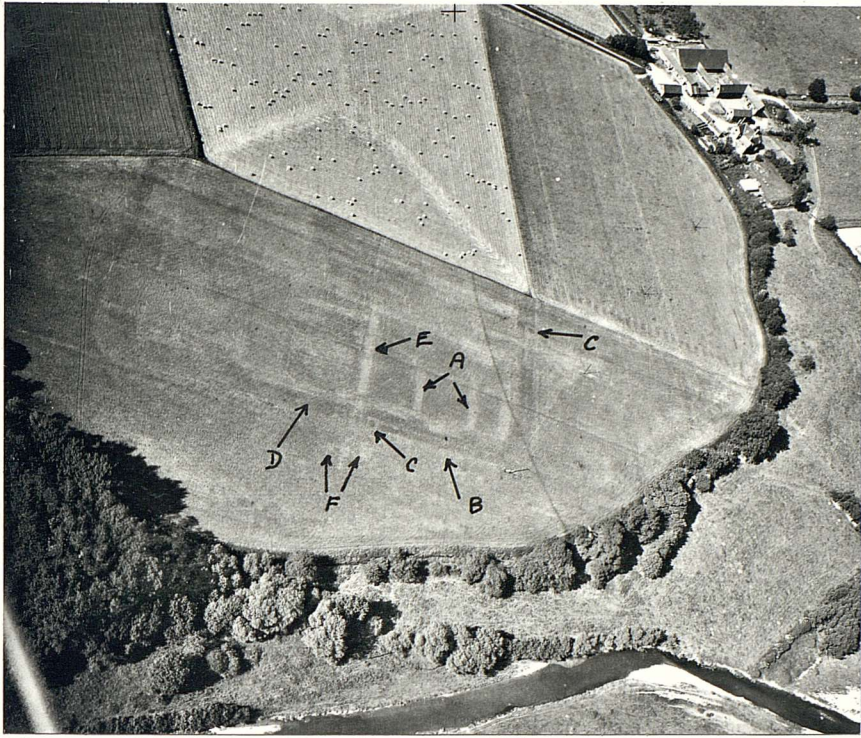


Crop-marks of the enclosure and a complex settlement
at Welford on Avon, in 1962. Fig. 6.7(b)



A plot of an Estimated Soil Moisture Deficit
 as supplied by the Meteorological Office.

Fig. 6.8



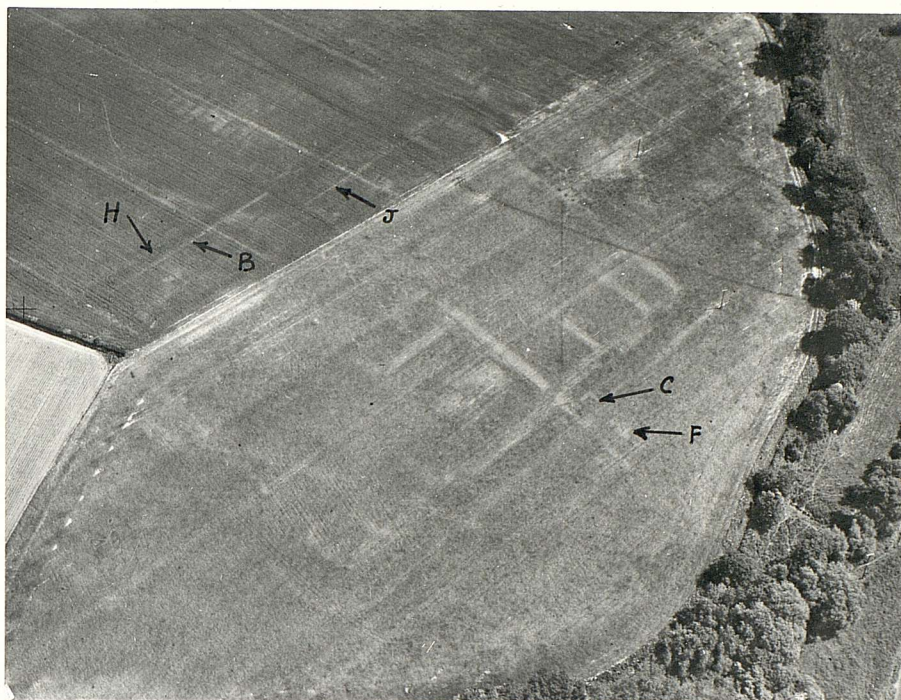
Crop-marks of a Roman auxiliary fort at Buckton,
Herefordshire, recorded in the summer of 1959.

Fig. 6.9(a)

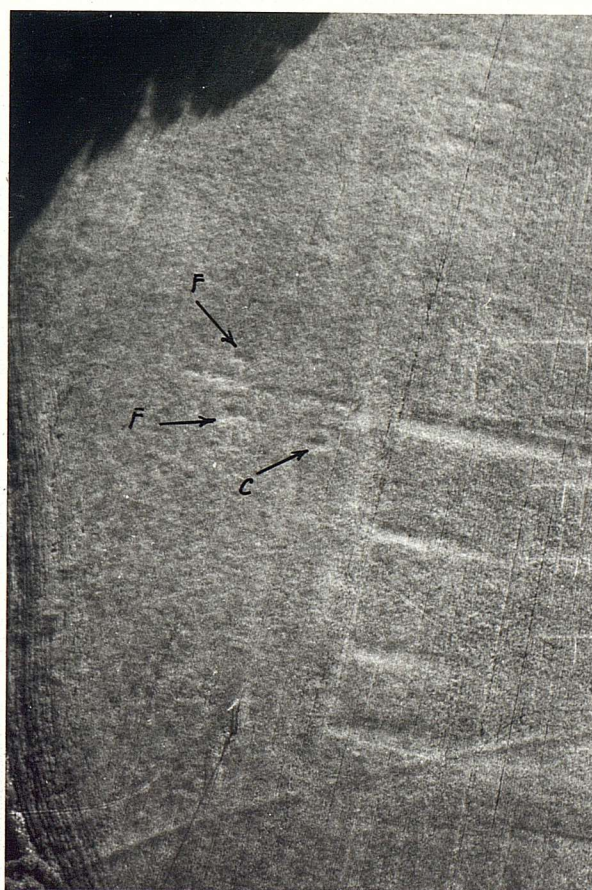


The fort at Buckton in 1960.

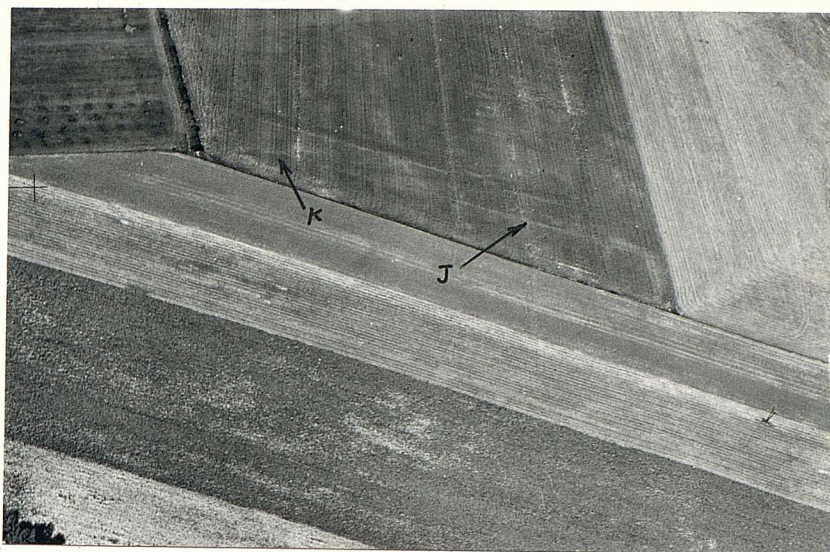
Fig. 6.9(b)



The fort at Buckton in 1962. Fig. 6.9(c)



Negative crop-marks of the road system and the South defences of Buckton fort, recorded as a shadow site in 1962. Fig. 6.9(d)



Buckton fort North defences, 1963. Fig. 6.9(e)

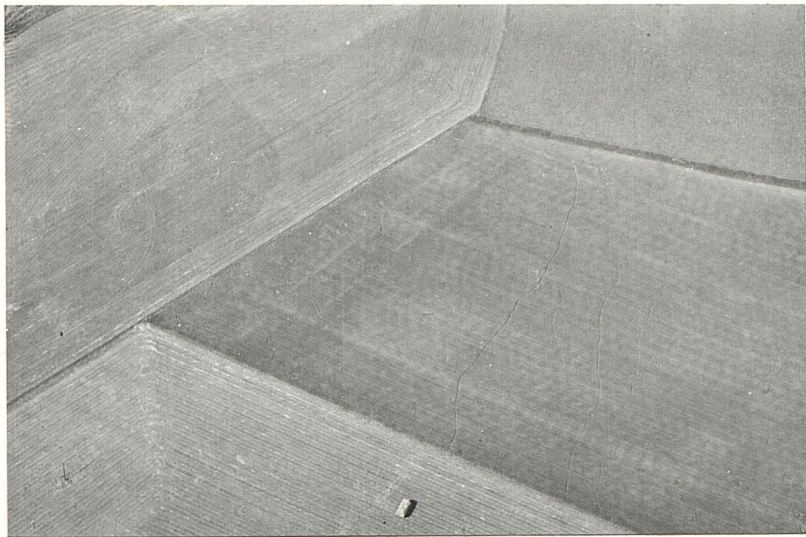


Crop-marks of Buckton fort, 1964. Fig. 6.9(f)



Buckton fort, part of North defences, 1965.

Fig. 6.9(g)



Buckton fort North defences, 1967.

Fig. 6.9(h)



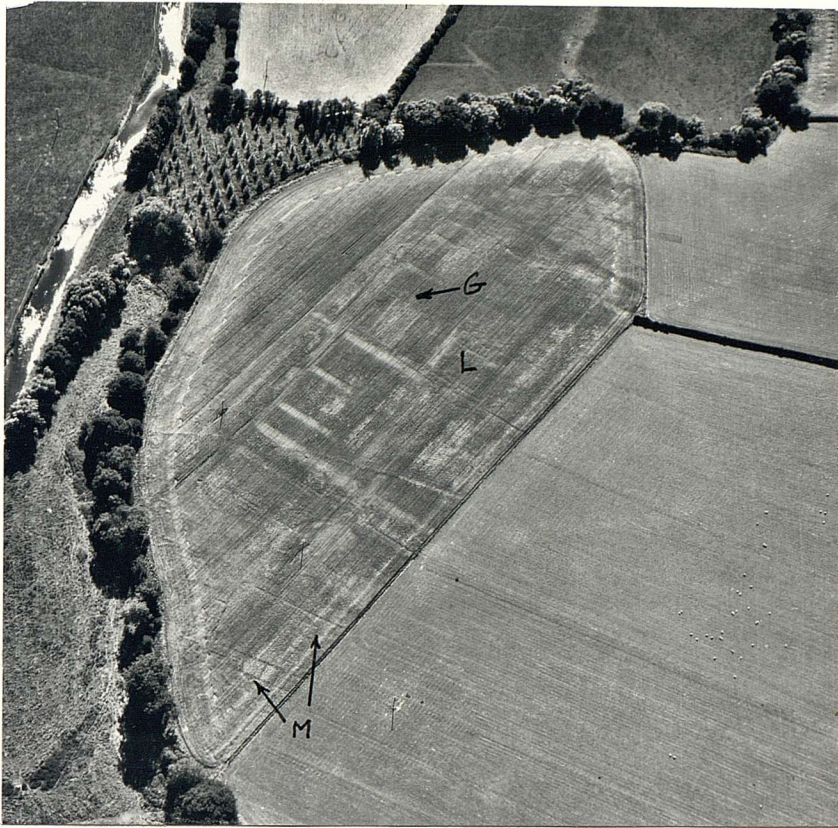
Negative crop-marks, Buckton fort, 1968.

Fig. 6.9(i)



Negative crop-marks, Buckton fort, 1969.

Fig. 6.9(j)



Crop-marks of Buckton fort and Bath-House, 1970.

Fig. 6.9(k)



Buckton fort, internal buildings in ripe cereal, 1970.

Fig. 6.9(L)



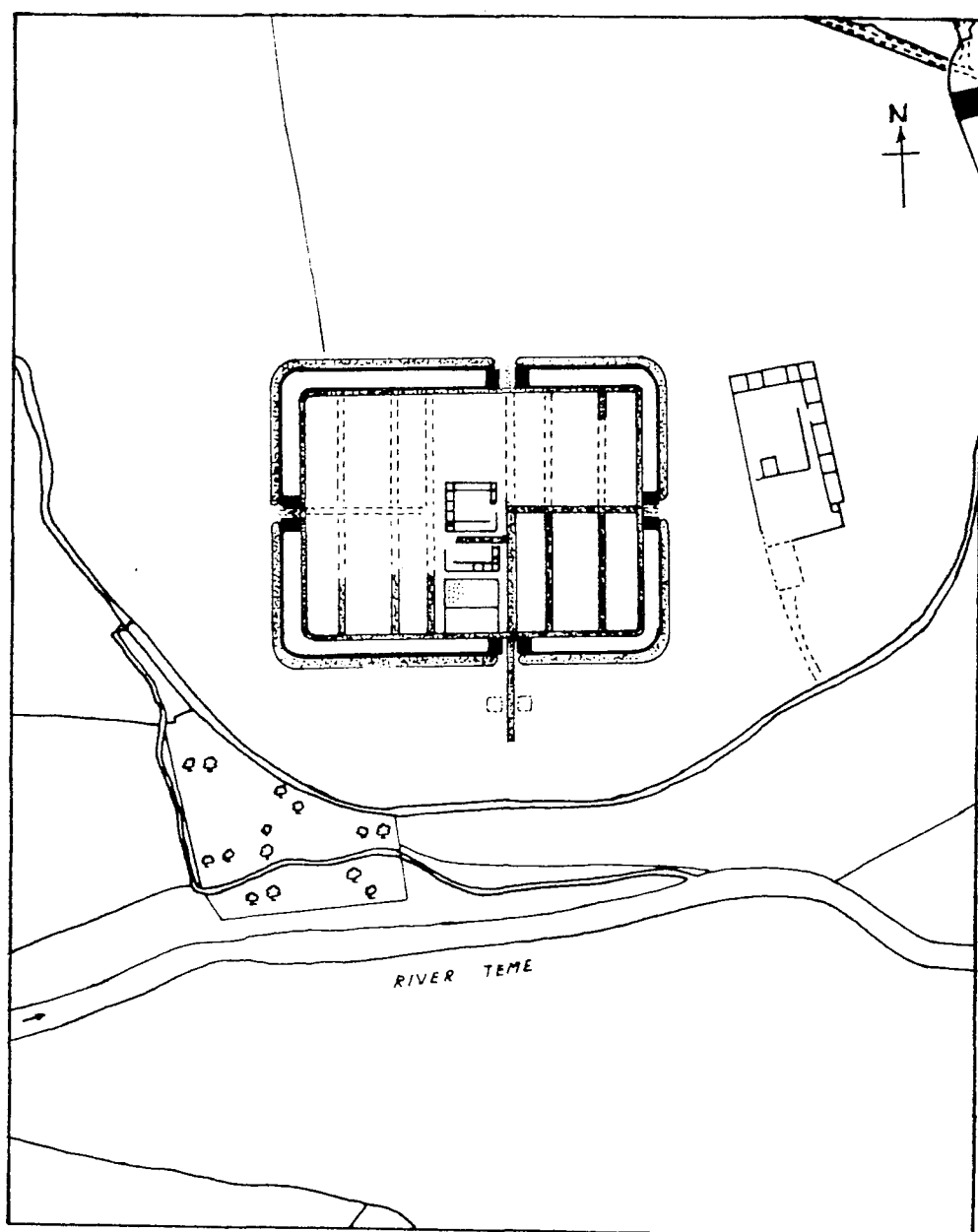
Buckton fort as it appeared in 1975.

Fig. 6.9(m)



Buckton fort Bath-House, 1975.

Fig. 6.9(n)



Sketch plan of the Roman auxiliary fort and Bath-House at Buckton Park Farm, Herefordshire, Grid Reference SO 390 733. The Period II fort as shown is 574 ft. by 451 ft. over the rampart walls, enclosing an area of 5.9 acres.

Fig. 6.10



Crop-marks of polygonal ice-wedges at Abbots Salford
in the lower Warwickshire Avon. Fig. 6.II



Polygonal structures and the ditches of a Roman
temporary camp at Atcham, Shropshire. Fig. 6.I2



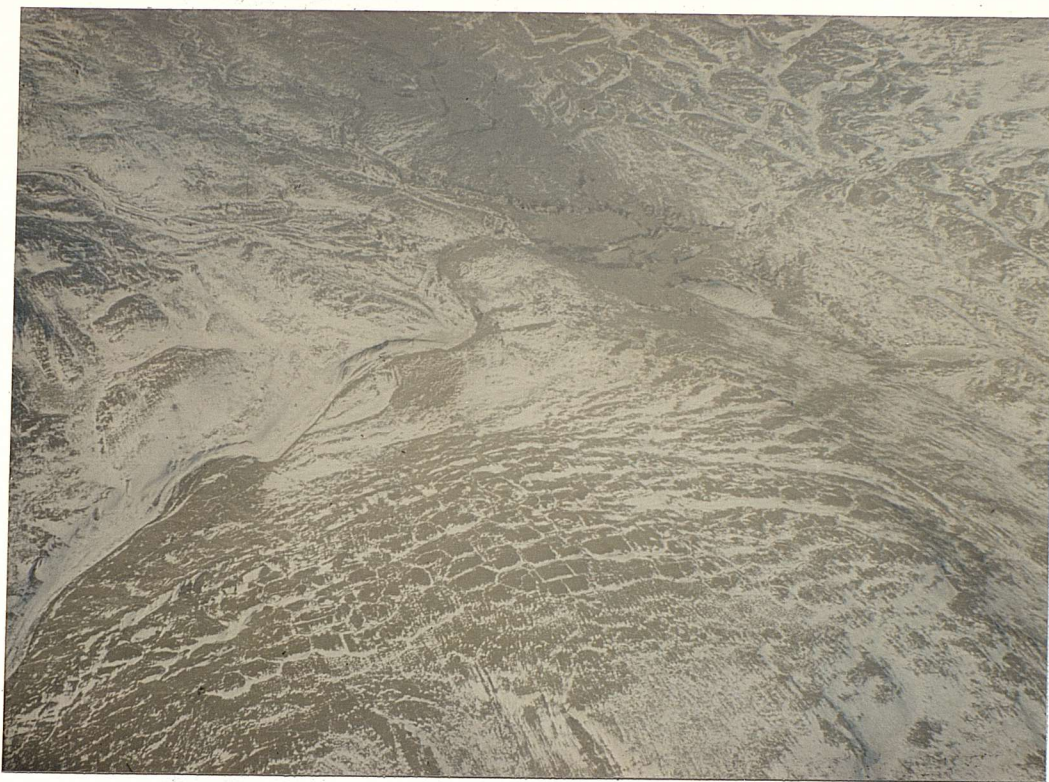
Ice-wedge casts at Brampton in the upper Thames valley.

Fig. 6.I3(a)



Ice-wedges and enclosure at Brampton in the upper Thames valley.

Fig. 6.I3(b)



Active formation of ice-wedges in the arctic on
Ward Hunt Island, 1971.

Fig. 6.14



Crop-marks of fractures in Limestone on
Wenlock Edge, Shropshire.

Fig. 6.15



Geological features at Cutsdean, Gloucestershire.

Fig. 6.I6



Geological features at High Wood, south of the
Malvern Hills, Herefordshire.

Fig. 6.I7



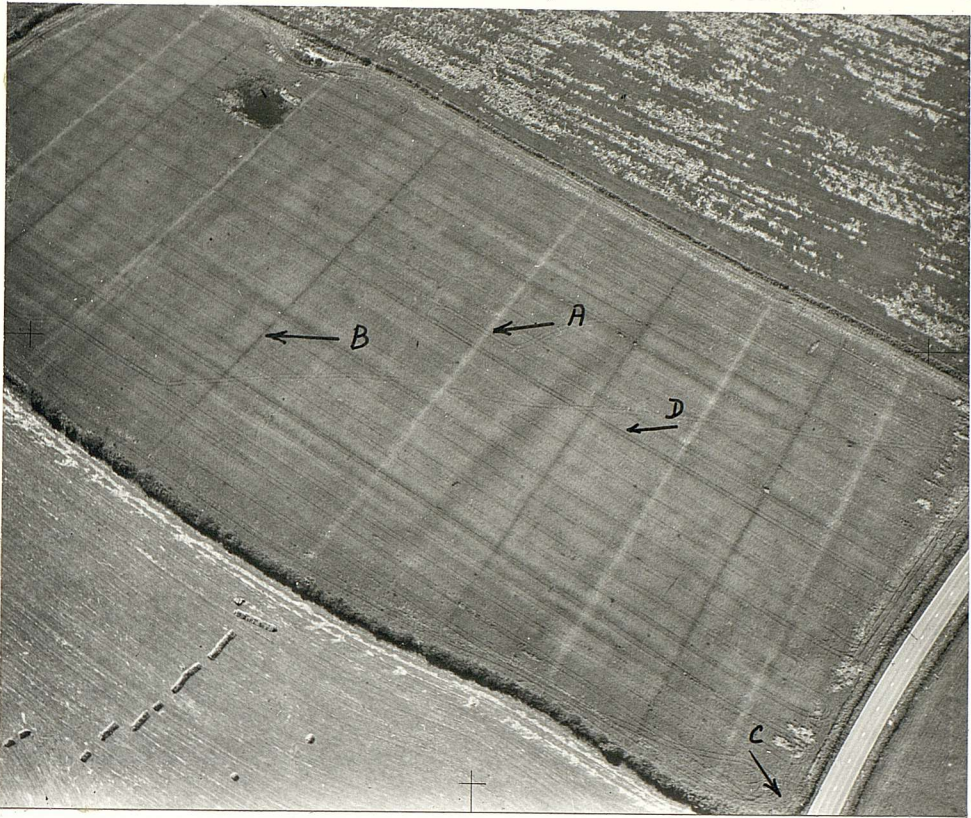
Crop-marks of river meanders and enclosures in the valley of the river Lugg, near Mortimer's Cross, Herefordshire.

Fig. 6.I8



Damp marks near Upton Snodsbury, Worcestershire.

Fig. 6.I9



Field ploughed in 'lands'.

Fig. 6.20



Ploughing in a square pattern.

Fig. 6.21



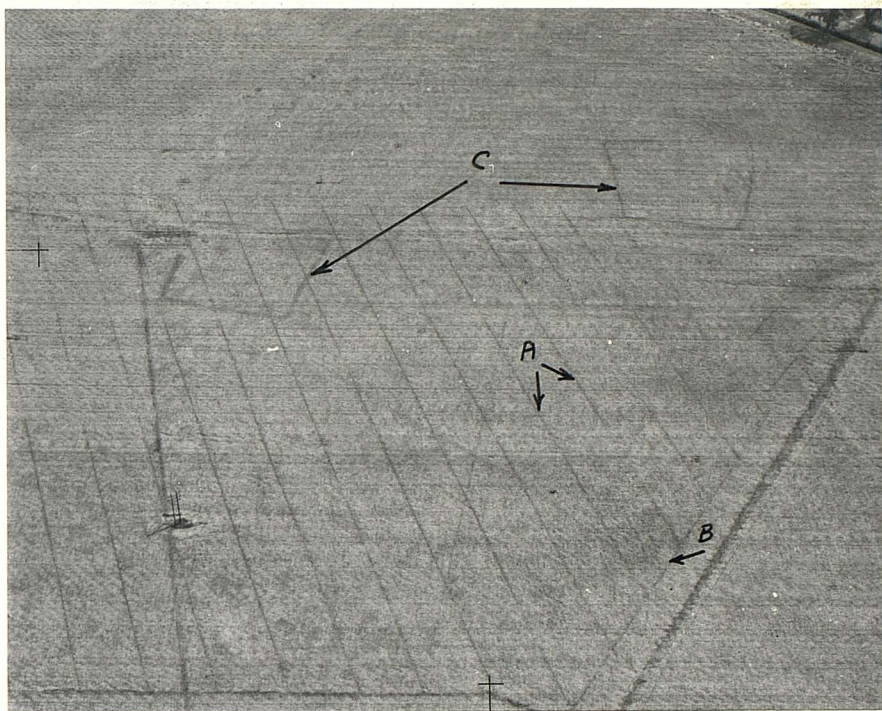
Circles in pasture produced by animals grazing
on a fixed tether.

Fig. 6.22



Damp marks from rotary irrigation.

Fig. 6.23



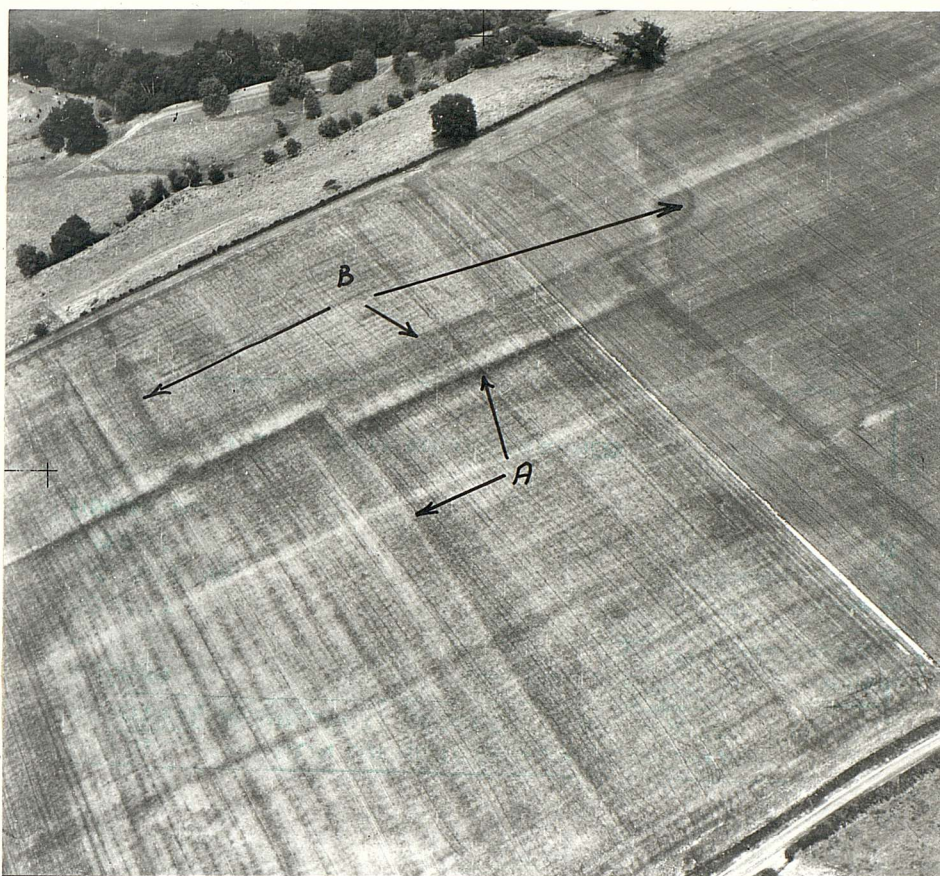
Crop-marks of a parallel drainage system, with the remains of enclosures on Bourton Heath, Warwickshire.

Fig. 6.24



Pits from the removal of tree stumps at Puckrup, in the Severn valley, Worcestershire.

Fig. 6.25



Crop-marks of vanished hedgerows, and the ditches of an auxiliary Roman fort near Wistanstow, Shropshire.

Fig. 6.26



Animal tracks in cereal.

Fig. 6.27(a)



Regular pattern of an animal track.

Fig. 6.27(b)



Remains of a formal garden layout at Witley Court,
Worcestershire.

Fig. 6.28



Crop-marks of a large square enclosure near
Foxley Farm, Oxfordshire.

Fig. 6.29(a)



Upstanding store or compound and remains of
contemporary structures near Foxley Farm,
Oxfordshire.

Fig. 6.29(b)



An enclosure in Attingham Park, Shropshire.

Fig. 6.30



A pipeline near Stratford on Avon, continuity of the alignment can be traced through gaps in the hedgerows.

Fig. 6.31



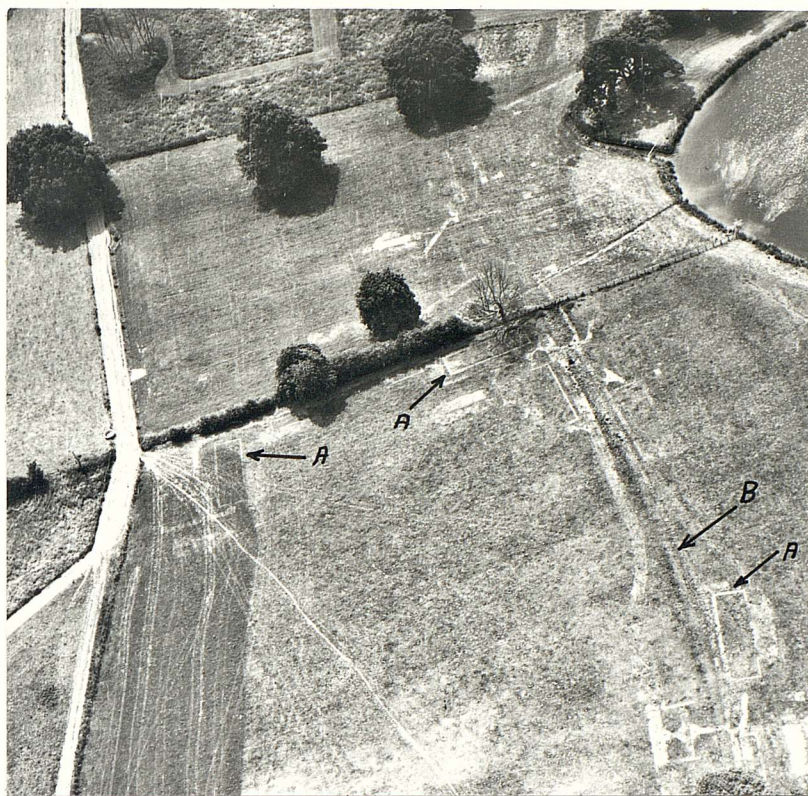
The Overy group and gravel pits at
Warborough, Oxfordshire.

Fig. 6.32



Crop-marks and gravel pits at Appleford
in the Thames valley.

Fig. 6.33



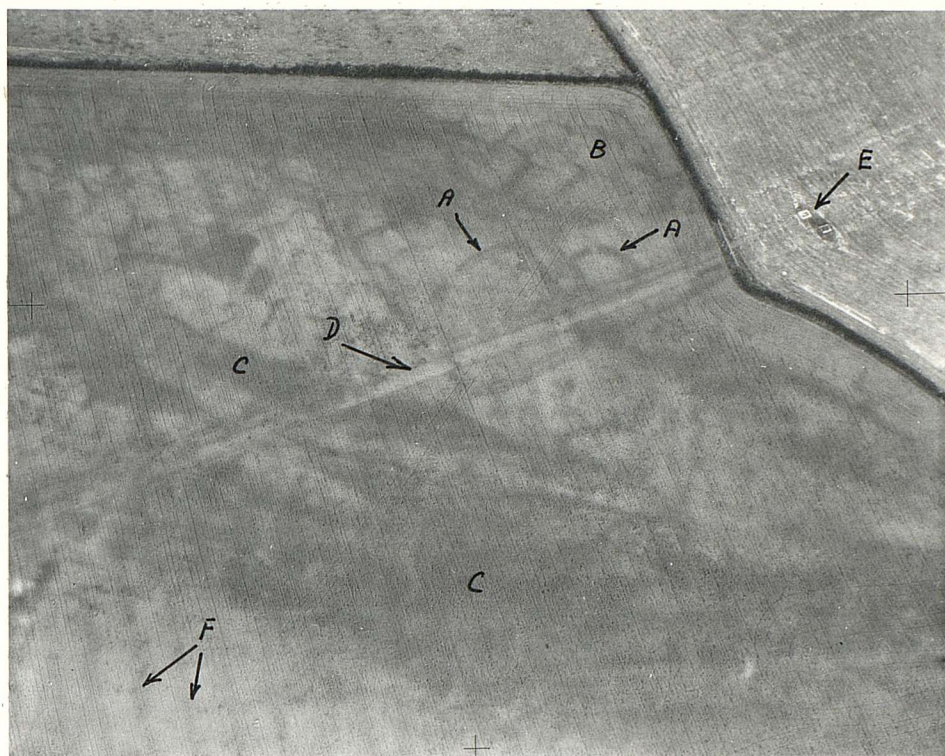
Parch marks in pasture , west of Hereford, reveal the remains of building foundations and other features associated with a disused railway line.

Fig. 6.34



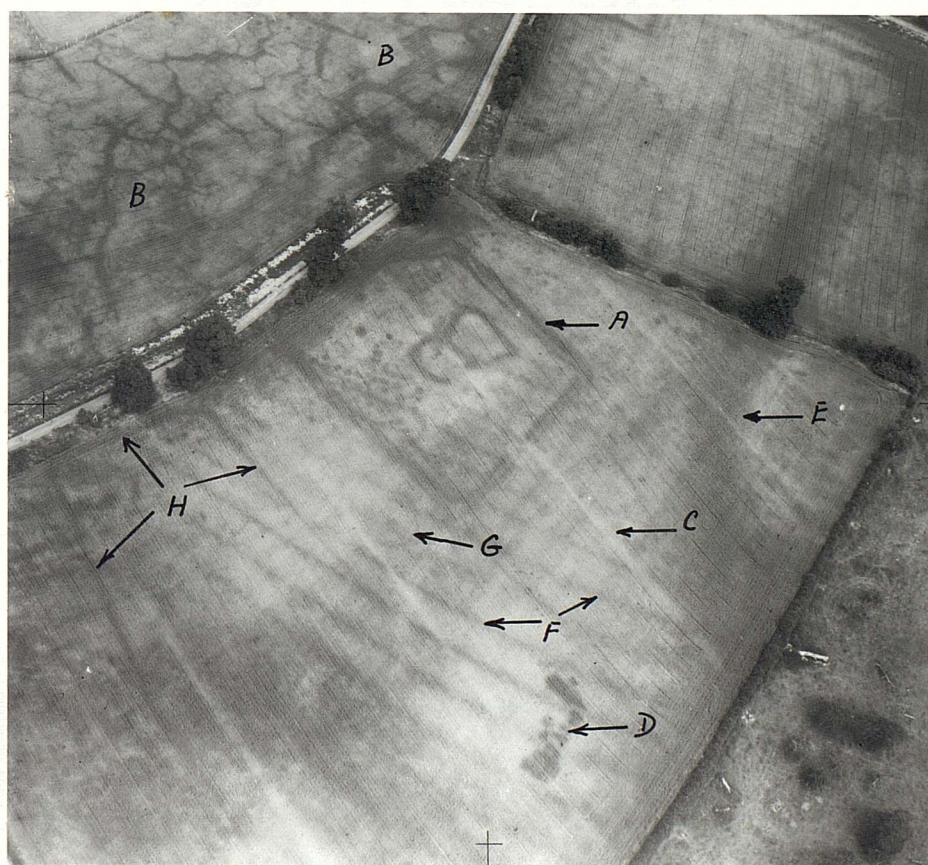
Crop-marks of ringed ditches south of Bishop's Tachbrook, Warwickshire.

Fig. 6.35



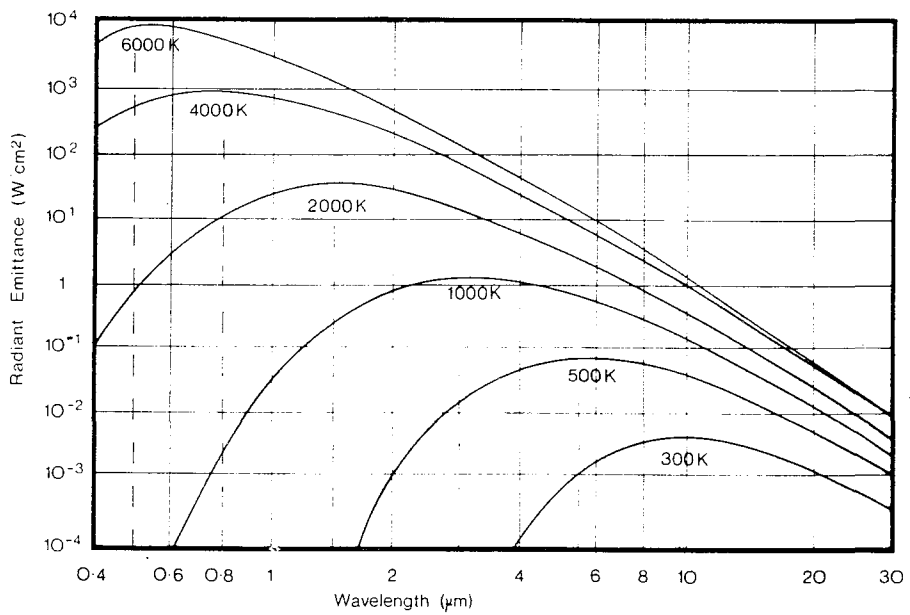
Crop-marks of a sewage pipe-line and enclosures
at Eckington, Worcestershire.

Fig. 6.36



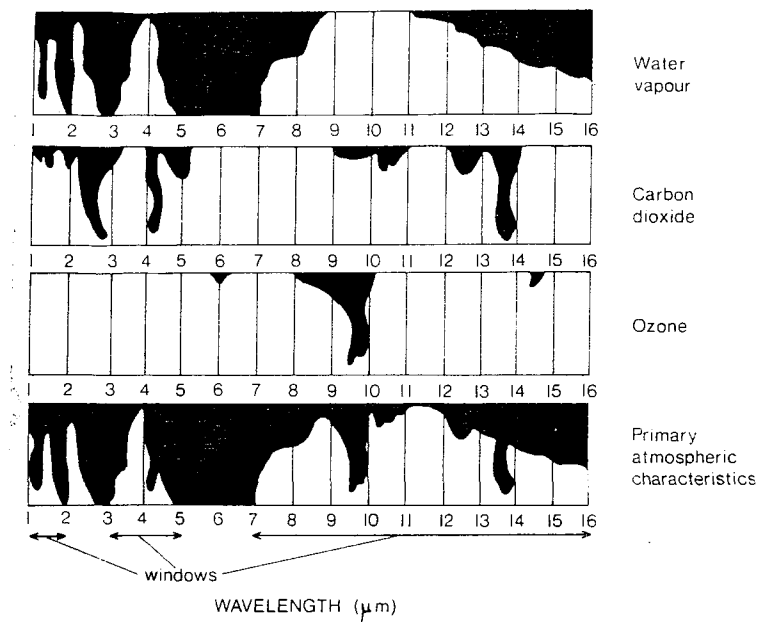
Crop-marks of an enclosure and other background
interference at Salford Priors, Worcestershire.

Fig. 6.37



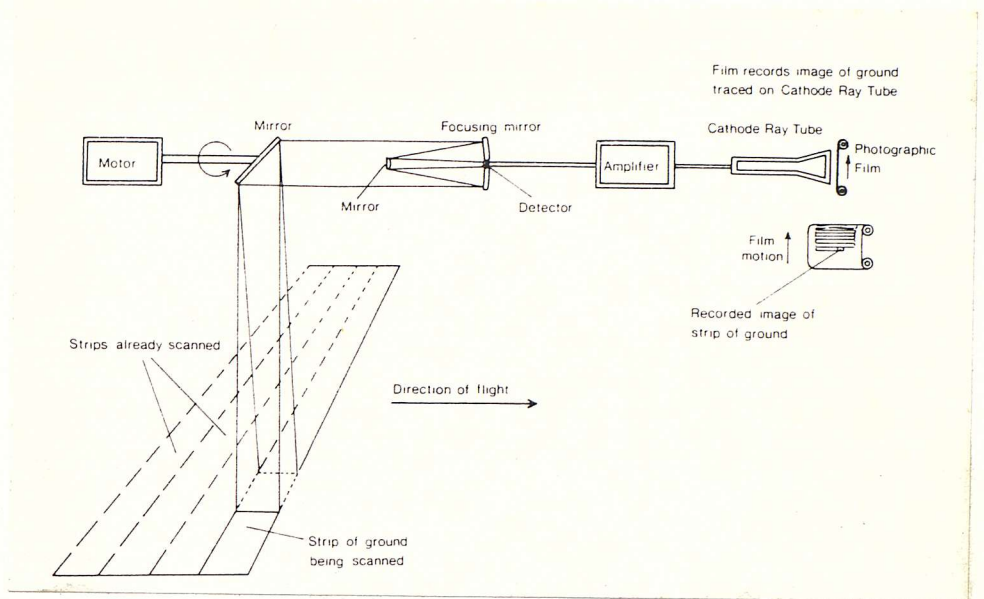
Wein's Law: effect of temperature on radiation.

Fig. 7.1



The infra-red spectrum, showing absorption of infra-red energy by various constituents of the atmosphere.

Fig. 7.2



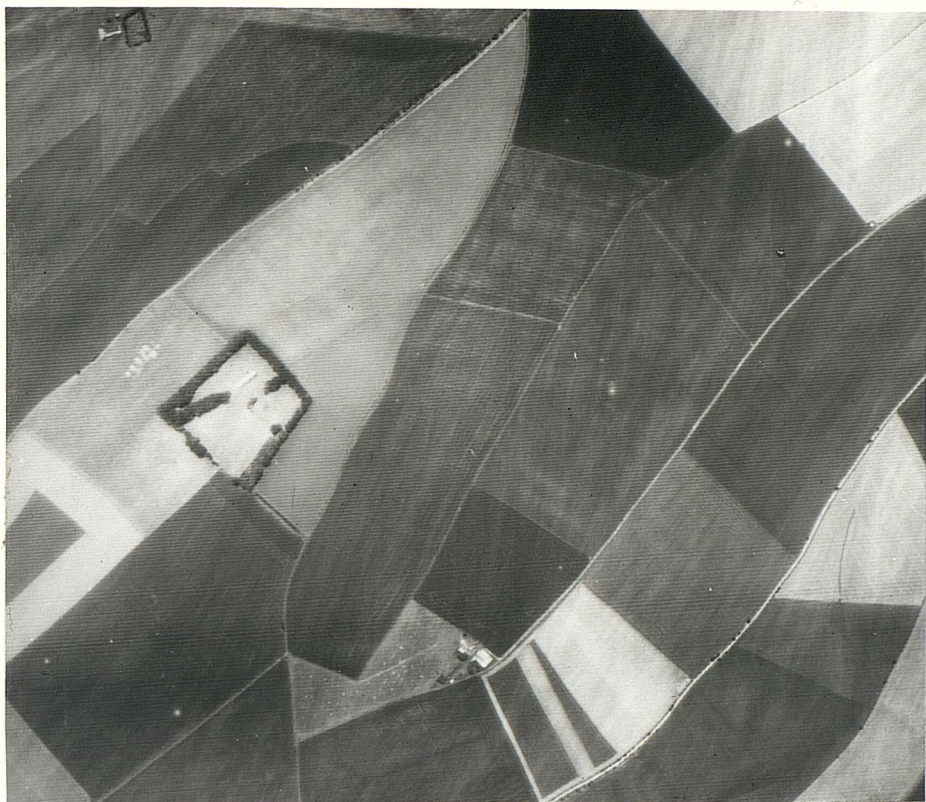
Schematic diagram of an infra-red Linescan system.

Fig. 7.3



Landscape by conventional photography.

Fig. 7.4



Landscape by infra-red Linescan.

Fig. 7.5



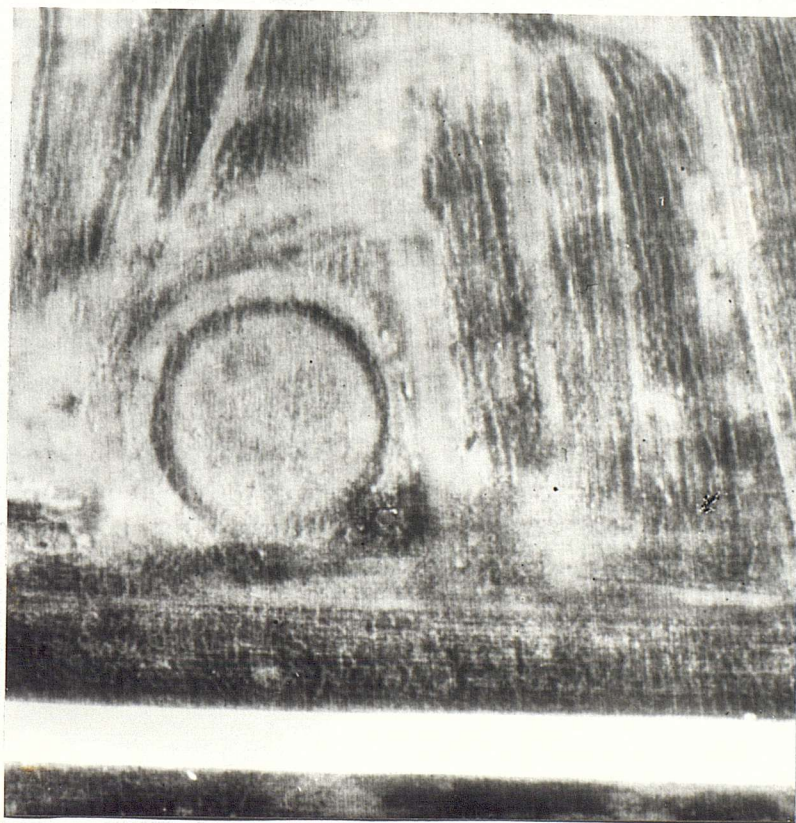
Golf course at Marlborough, Wiltshire,
infra-red Linescan.

Fig. 7.6



Paths and tracks in pasture, infra-red Linescan.

Fig. 7.7



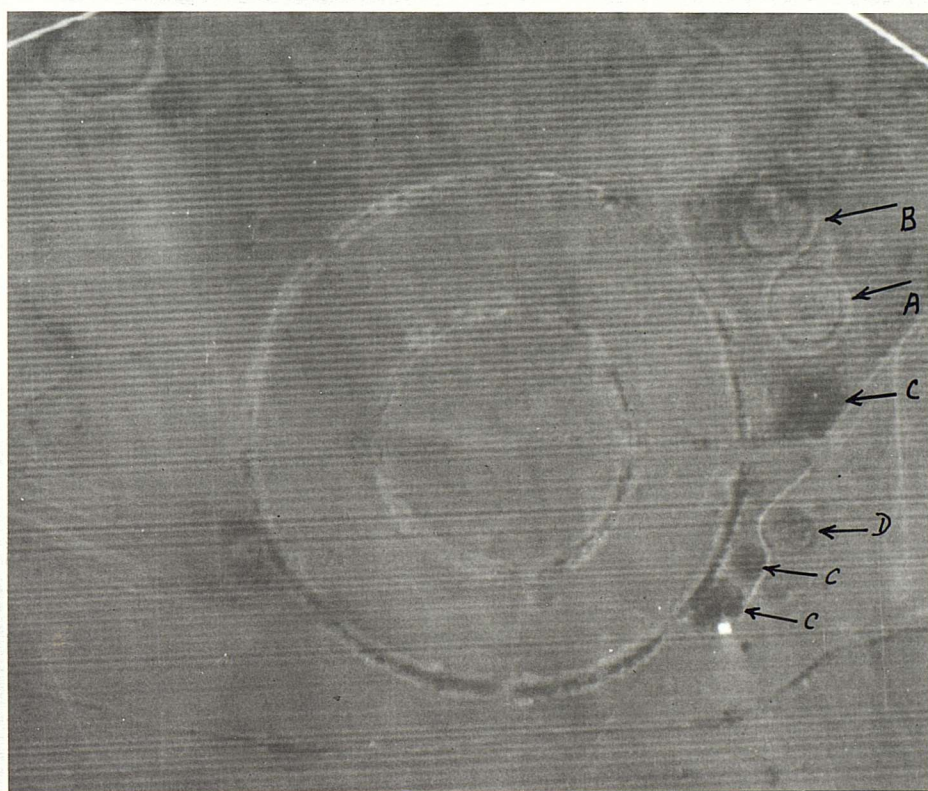
Crop-marks in cereal, infra-red Linescan.

Fig. 7.8



Pattern of field drainage systems,
infra-red Linescan.

Fig. 7.9



Rings in pasture at Idmiston, Wiltshire,
infra-red Linescan.

Fig. 7.10



Pattern of strip cultivation,
infra-red Linescan.

Fig. 7.II



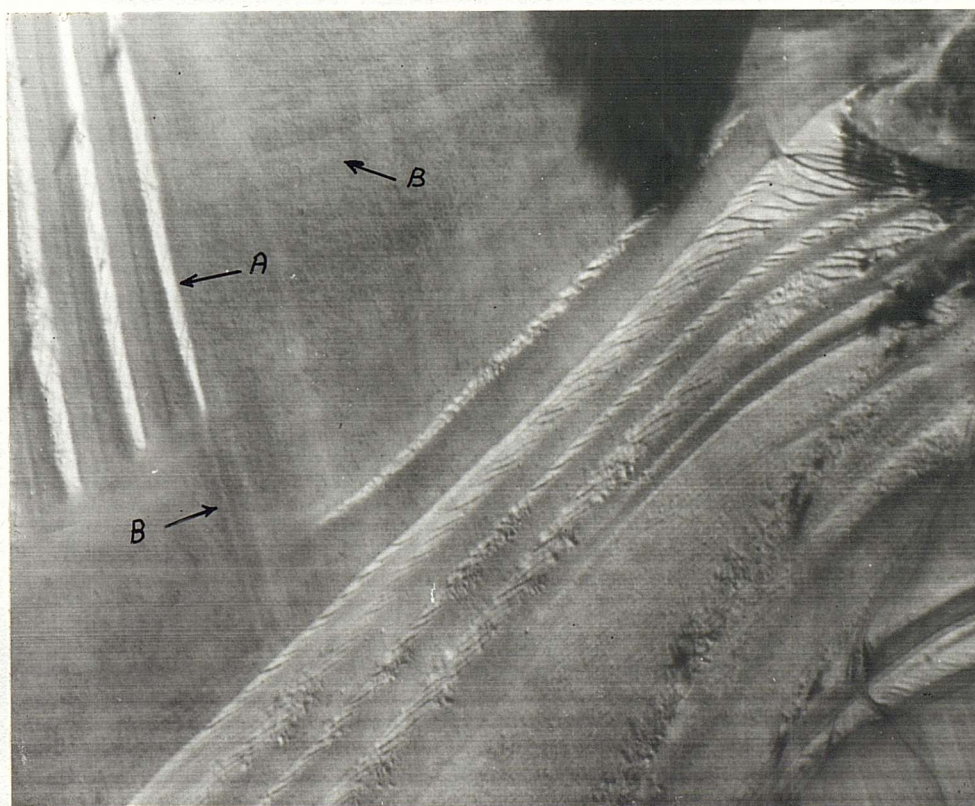
Field textures and the effects of wind,
infra-red Linescan.

Fig. 7.I2



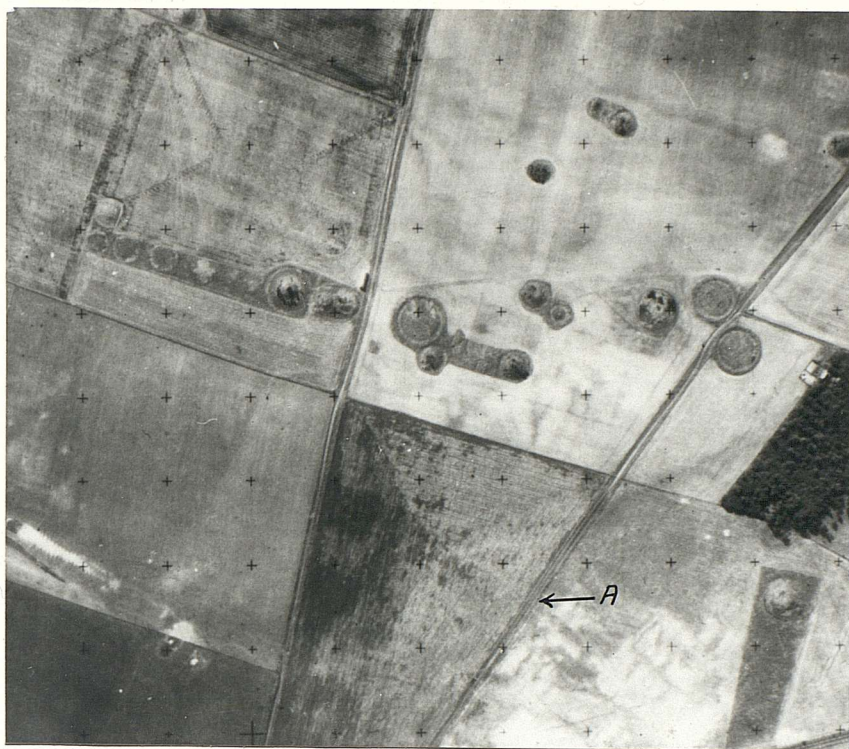
Lynchets - conventional photography.

Fig. 7.I3



Lynchets - infra-red Linescan.

Fig. 7.I4



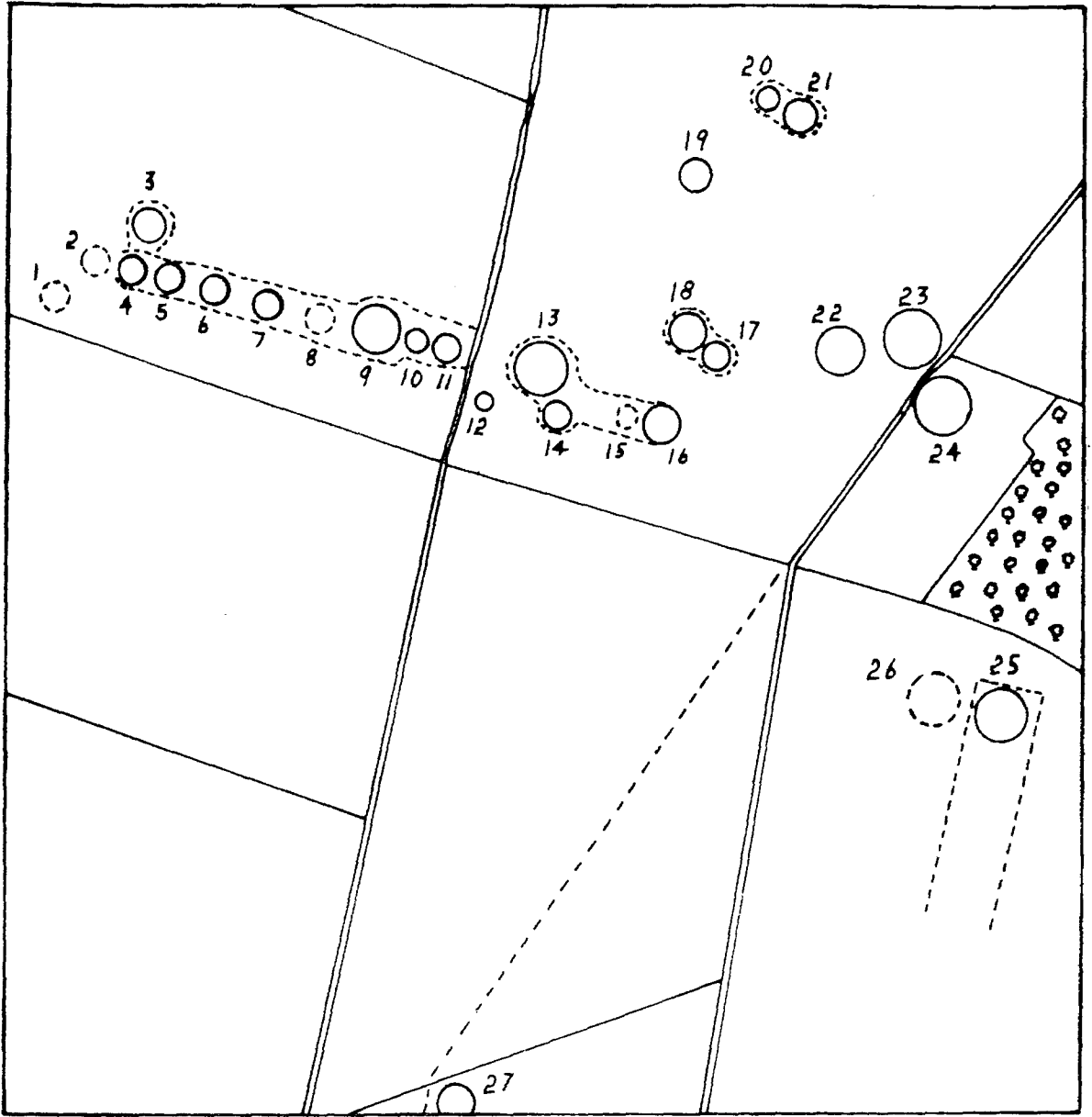
Barrow group on Normanton Down, Wiltshire,
conventional photography.

Fig. 7.I5



Barrow group on Normanton Down, Wiltshire,
infra-red Linescan.

Fig. 7.I6



Plan of the barrow group on Normanton Down.

Fig. 7.17