ACCELERATED EROSION OF ARABLE SOILS

WITH SPECIAL REFERENCE TO THE WEST MIDLANDS

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VOLUME 2

TEXT IS CLOSE TO EDGE OF PAGE IN ORIGINAL.

FIGURE 1

HEDGE ACTING AS A TRAP FOR DRIFTING SAND.

Strong to gale NNW winds averaging 28 km/hr caused wind erosion in these fields. Wind direction (right to left) was at right angles to tillage ridges 10 cm in height. Soil drifting would have been much greater if this hedgerow had been removed. Deposition of drifted soil amounted to 25 cm on the windward side and 15-19 cm on the lee side of the hedge where at one stage soil was avalanching over the lower section. This drifted soil which often contains a lot of nutrients and is quickly colonised by vegetation. The width of the hedgerow on the leeward side in this example has been permitted to increase. On the windward side there is a concentration of coarse grit on the surface of the drifted soil.

LITHOLOGY: Sandy drift (very stony in places) over Triassic Sandstone.

SOIL TYPE: Loamy sand.

SOIL SERIES: Bridgnorth.

SOIL STRUCTURE: Very weak.

SOIL ORGANIC MATTER: Drifted soil 3.8%. Field: 1.8%.

SLOPE: Gentle 2°.

ASPECT: S.E.

ELEVATION: 84 metres.

WIND DIRECTION: N.N.W.

WIND SPEED(MEAN): 28 km/hr gusting to 36 km/hr.

CROP: Spring barley.

DATE: 26.3. to 1.4.1968 (intermittent blowing).

LOCATION: Parish of Quatford SO 745 910.

Reference in text: Page 36.

FIGURE 2

TALUD OR STEP ALONG HEDGEROW RUNNING TRANSVERSE TO THE SLOPE

This example is typical of many hedgerows which are found in east Shropshire on undulating land. It is also an example of old enclosed land which could be in the order of 700-800 years old. How long these fields have been in arable cultivation during this period is difficult to ascertain. The break of slope here is 1.5 metres with the field slope averaging 9°. To the right of the picture the break of slope becomes 2.2 metres and the back slope 11°. Although there are several species making up the hedge, Holly, Hawthorn, Elderberry, Hazel, Willow, Elm and Oak, their presence cannot be used as a guide to dating.

SOIL TYPE: Newport (sandy phase). Soil in foreground has been affected by splash erosion and recently some soil drifting has taken place towards the hedgeline.

LOCATION: Parish of Claverley, SO 776 940.

Reference in text: Page 37.

FIGURE 3

TALUD IN THE PROCESS OF DEVELOPMENT

Confined rill and gully erosion on this site has resulted in the deposition of large fan against the hedgerow which shows a well developed talud or step. Material held against this thin hedgeline (which is backed by pig wire) amounted to an average of over 40 cm. It is estimated that much greater quantities of eroded soil were carried out of the field (through a gateway) in large gullies as well as overflowing the hedge line in many places. The break of slope here amounts to 1.2 metres. The age of the hedgeline is not known precisely but postdates 1800.

SOIL SERIES: Newport stony phase and Wick series.

LOCATION: Parish of Worfield, SO 756 963.

DATE: September 1976.

Reference in text: Page 38.

FIGURE 4

UNCONCENTRATED SOIL WASH AND INCIPIENT RILL EROSION

on severely compacted soil (sheep folded on roots).

This type of erosion is very common during wet spells in the winter. It results from surface compaction by the treading action of large flocks of sheep which are folded on root crops (or beet tops, corn stubble etc.). During wet weather treading causes a dense pattern of hoof marks which act as detention hollows for rain. Sheep often move across large fields along preferred routes and these frequently become the pathways for incipient rill activity which, if unchecked, develop into unconfined rills and incipient gullies. The vestiges of cultivation lines can still be seen, together with the shells of rotten roots. Run-off in the form of low energy flows moves down slope following cultivation lines (partially infilled furrows). On the steep section of slope overtopping takes place where slope direction changes relative to cultivation lines and concentrated flow develops usually along sheep walks. With the long tradition of sheep in east Shropshire this sequence of events must have been repeated many times.

LITHOLOGY: Sandy drift over Triassic Sandstone.

SOIL TYPE: Sandy loam - loamy sand.

SOIL SERIES: Bridgnorth. DATE: 10th January 1974.

STRUCTURE: Weak crumb. LOCATION: Parish of Claverley SO 769 946

ORGANIC MATTER: 3.2%.

SLOPE: 6°. Reference in text: Page 44.

ASPECT: N.E.

ELEVATION: 68 metres.

RAINFALL: 79 mm in 14 days with 3 events including

THUNDERSTORM: 16 mm in 5.5 hours RAINFALL RATE: 2.9 mm/hr.

CROP: Roots.

FIGURE 5

BASE OF SLOPE DEPOSITION. DELTAS AND FANS IN TEMPORARY POND

This example illustrates the classic combination of factors which lead to soil erosion on arable land: 1. down slope cultivation with potato furrows acting as ready made channels; 2. severe compaction from potato harvesting machinery during period when soil was at field capacity; 3. slope length increased by field amalgamation; 4. continuous arable cropping and low levels of soil organic matter and 5. heavy prolonged rainfall at rates of 1 mm/hr or more. A dense network of confined incipient rills channelled splashed and scoured sediment which collected in a large temporary pool. This overtopped into the adjoining country lane and run-off cut a large single unconfined gully through the adjacent field. The large deltaic growths of medium sand seen on the left and right of the picture were built by concentrated run-off from the intersection of several sets of wheelings. Fans represent a redistribution of soil amounting to an estimated 50 tons per hectare. Total soil loss unknown.

LITHOLOGY: Coarse loamy drift over Triassic Sandstone.

SOIL TYPE: Sandy loam.

SOIL SERIES: Upper and middle field - Bromsgrove; Lower - Newport (loamy phase).

STRUCTURE: Weak crumb.

ORGANIC MATTER: 2.3-2.5%.

SLOPE: 5°.

ASPECT: W.S.W.

ELEVATION: 76 m.

RAINFALL: 79 mm in 14 days: three events culminating in 16 mm in 5.5 hours.

RAINFALL RATE: 2.9 mm/hr. CROP: Potatoes.

LOCATION: Parish of Worfield SO 785 988

Reference in text: Page 44.

FIGURE 6

LAYERED HEDGEROW PARTIALLY BURIED BY ERODED SOIL

The burial or partial burial of layered hawthorn hedges provides some indication of the rate of eroded sediment which becomes trapped at the base of slope against hedgerows. In this example the age of the hedgerow is known to post-date 1800. Further evidence is afforded by a partially buried metal sheep fold which shows sediment accumulation of the order of 76 cm.

SOIL TYPE: Sandy loam.

SOIL SERIES: Bromsgrove.

LOCATION: Parish of Worfield SO 980 773.

Reference in text: Page 47.

FIGURE 7

DEEP TRUNCATION IN SANDY LOAM BY CONFINED GULLY EROSION

This is one of many examples of deep truncation of local soils by gully erosion and in this case of the burial of productive loamy Newport soils by a deep overwash of coarse sand and grit excavated from fluvioglacial drift up-slope. This field has eroded every year during the erosion survey (1967-1976) and base of slope sedimentation has been rapid and extensive. It is estimated that 1.5 m of material has accumulated since 1940 when the field was ploughed from rough grazing. An old pathway has disappeared and the well-defined hedgerow partially buried to produce a marked talud with a break of slope between 2 and 2.5 m in places. It is estimated that three storms in September 1976 produced a soil loss of over 116 tons per hectare for this 6.5 hectare field.

LITHOLOGY: Sandy drift over fluvioglacial deposits over Triassic Sandstone.

SOIL TYPE: Loamy sand to sandy loam.

SOIL SERIES: Newport.

SOIL STRUCTURE: Very weak.

ORGANIC MATTER CONTENT: 2-2.5%.

SLOPE: Average 8^{o}.

ASPECT: S.W.

ELEVATION: 61 metres.

RAINFALL: 83 mm in three storms.

RAINFALL RATE: 2.5 to 7.6 mm/hr.

CROP: Prepared for winter barley.

DATE: 25-27.9.1976.

LOCATION: Parish of Worfield (SO 778 952).

Reference in text: Page 53.

FIGURE 8

DISTRIBUTION OF SANDY ARABLE AND EARTHY PEAT SOILS LIABLE TO EROSION

Dominant Soil Group	Associated Soil Groups	Parent Material	Characteristics of dominant and associated soils
Earthy peat soil 9*	Humic Gley and sandy or humic-sandy gley soils	Peat over variable sub-strata	Peaty soils associated with sandy to clayey mineral (skirt) soils with humose or peaty top soils
Brown Sands 12*	Brown calcareous sands	Chalky drift	Deep well drained sandy soils
Brown Sands 13*	Brown earths and podzols	Permo-Triassic or Mesozoic Sandstone or glaciofluvial drift	Deep well drained sandy soils locally stony
Brown Calcar-eous Earths	Argillic brown earths and brown sands	Chalky drift	Moderately deep well drained coarse loamy (calc.)
Brown earths 20*	Brown sands	Glaciofluvial drift and asso-ciated cover loam	Deep well drained coarse loamy or silty soils associated with coarser textured sandy soils
Brown earths 25*	Podzols and brown sands	Cretaceous sand, sandstone and siltstone and associated drift	Well-drained coarse loamy and sandy soils, locally stony or shallow over rock
Gley Podzols 43*	Humic sandy gley soils and Stagno-gley soils	Glaciofluvial or Aeolian over finer glacial drift and Triassic or Jurassic clay	Deep sandy soils with high ground water and sub surface pan
65		Glaciofluvial or Aeolian drift over boulder clay	Deep sandy soils with high ground water and usually with subsurface pan
Sandy gley soils 47*	Brown sands podzols or gley podzols	Glaciofluvial or Aeolian drift	Deep sandy soils with high ground water associated with better drained soils

* Refers to map symbol on 1:1 million soil map of England and Wales (Soil Survey 1974) from which the figure is adapted. Reference in text: Page 68.

8.

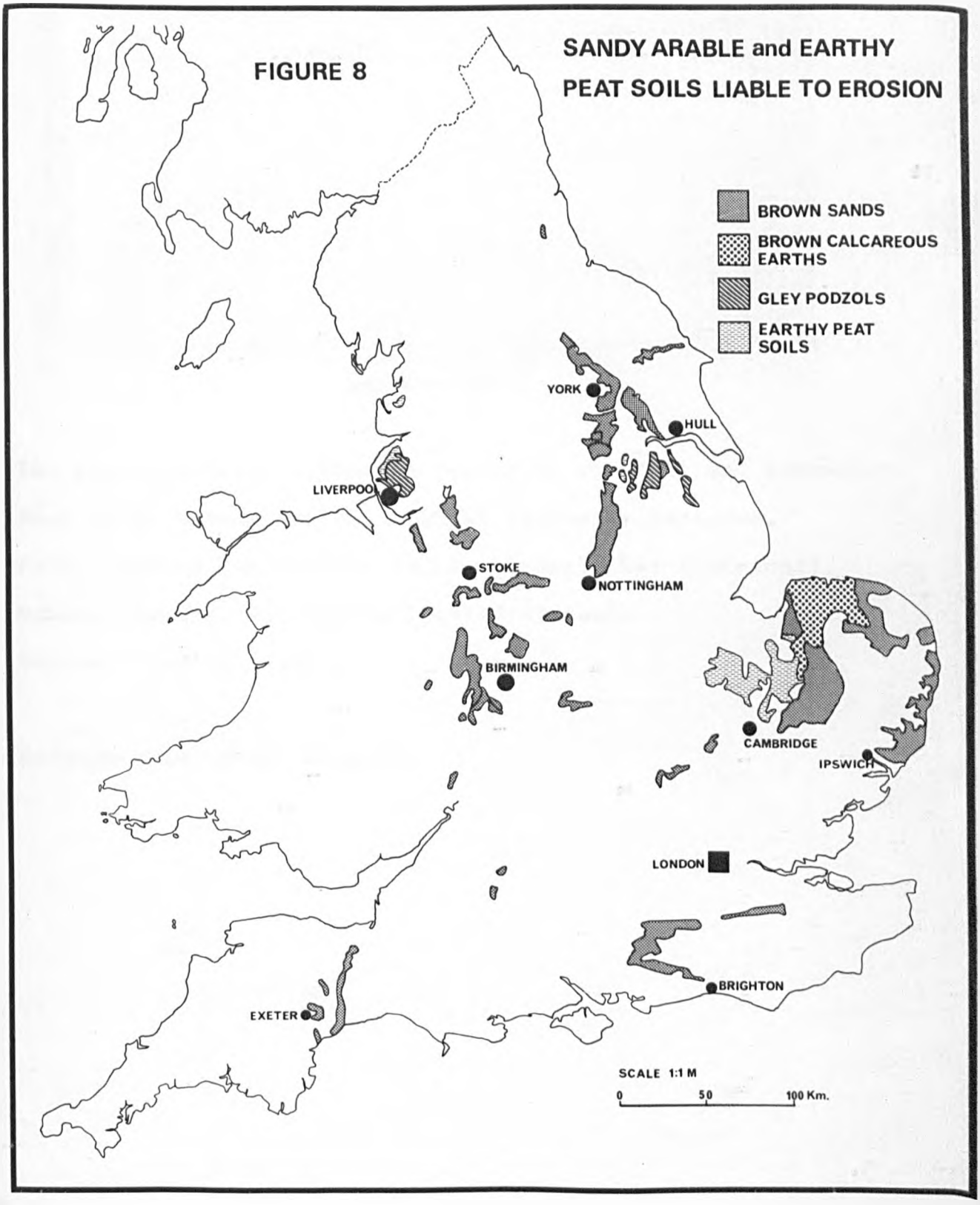
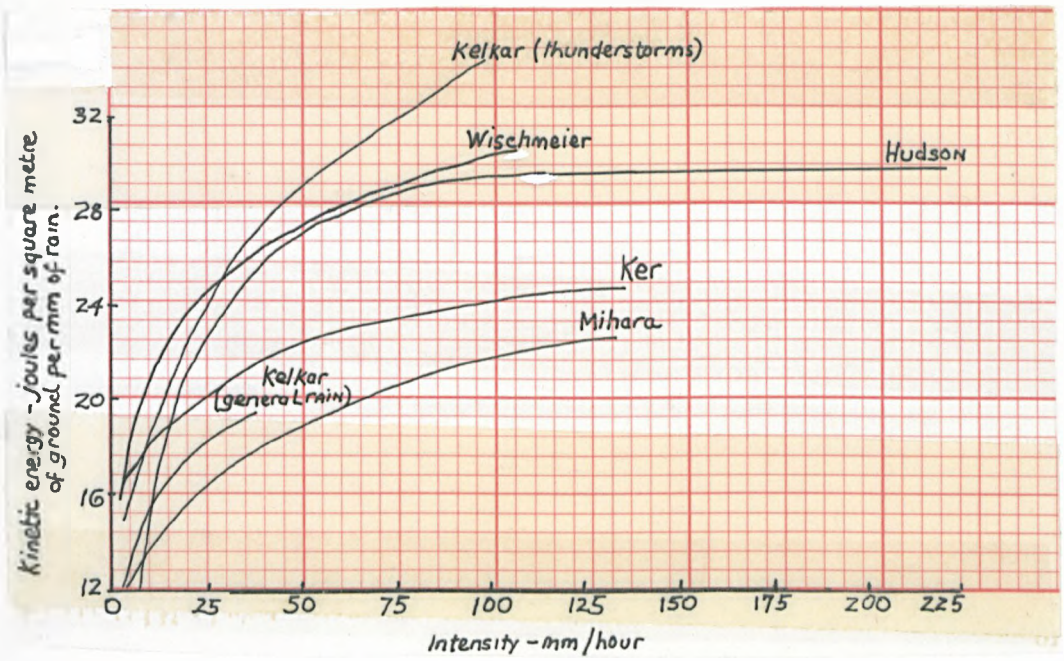


FIGURE 8
SANDY ARABLE and EARTHY PEAT SOILS LIABLE TO EROSION
BROWN SANDS
BROWN CALCAREOUS EARTHS
GLEY PODZOLS
EARTHY PEAT SOILS
YORK
HULL
LIVERPOOL
STOKE
NOTTINGHAM
BIRMINGHAM
CAMBRIDGE
IPSWICH
LONDON
BRIGHTON
EXETER
SCALE 1:1 M
0
50
100 Km.

FIGURE 9



The relation between kinetic energy of rainfall and intensity. Each curve extends to the highest intensity recorded.

From: Hudson (Rhodesia), Kelkar (India), Ker (Trinidad), Mihara (Japan), Wischmeier (United States).

Source: Hudson (1971).

Reference in text: Page 88.

FIGURE 10

TRANSPORT OF SOIL PARTICLES IN SNOW DRIFT

Soil particles contained in snow drifts are particularly noticeable in this area of dominantly red soils. During the hard winter of 1962-63 a large number of country lanes in the area were blocked by snow drift. Gale force winds caused widespread drifting though the total falls of snow were not in excess of 30 cm. Snow was completely stripped off the more exposed banks and sections of arable fields. Overnight hard frosts rapidly broke down soil aggregates and frozen particles were transported by surface creep and saltation. Drifting of frozen soil particles is a major problem in colder climatic areas where arable soils are exposed to strong winds.

LOCATION: Parish of Rudge.

DATE: January-February 1963.

Reference in text - Page 97.

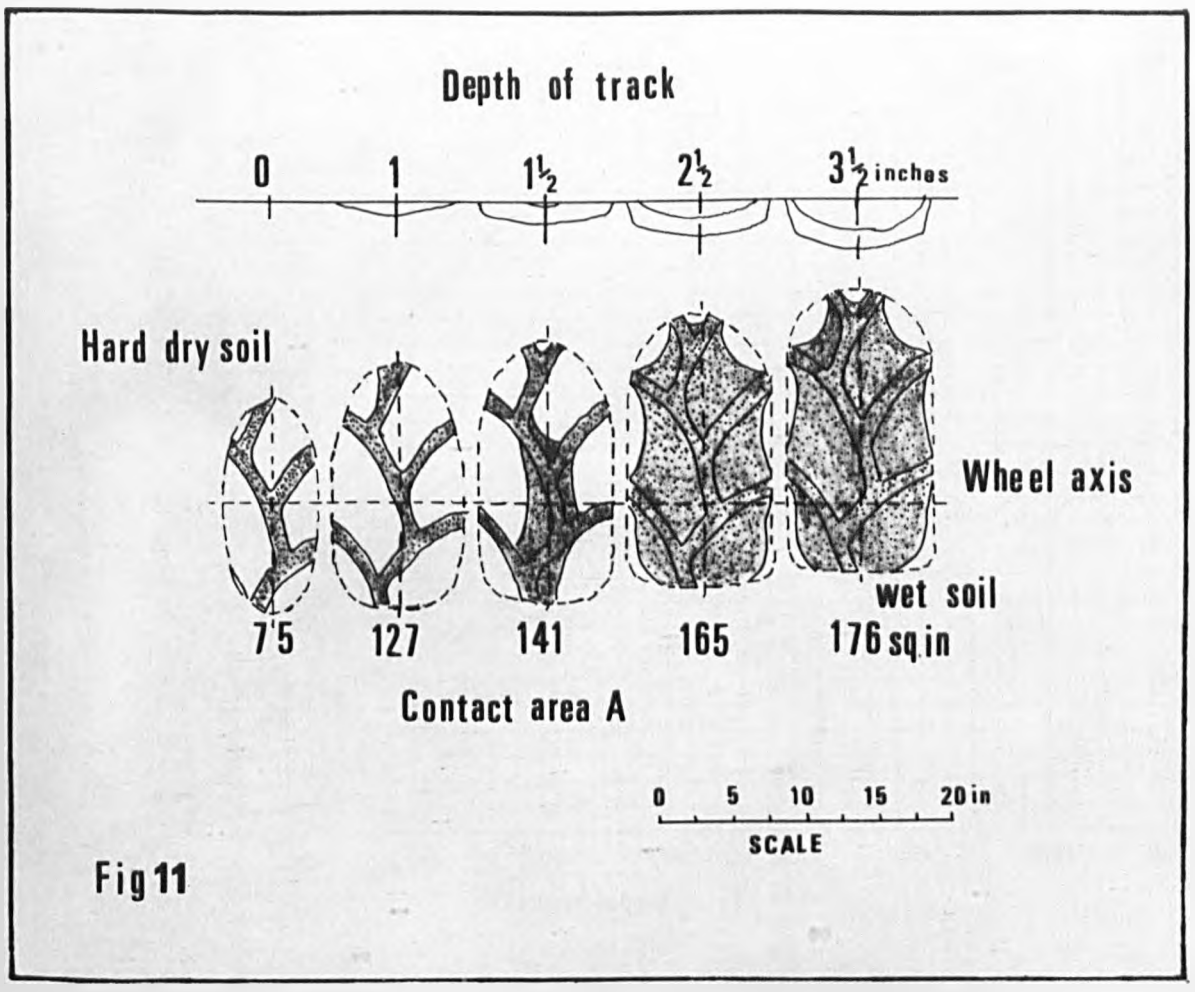


Figure 11

Contact areas between tyre and soil for different soil conditions. (after Soehne 1958). Page 277.

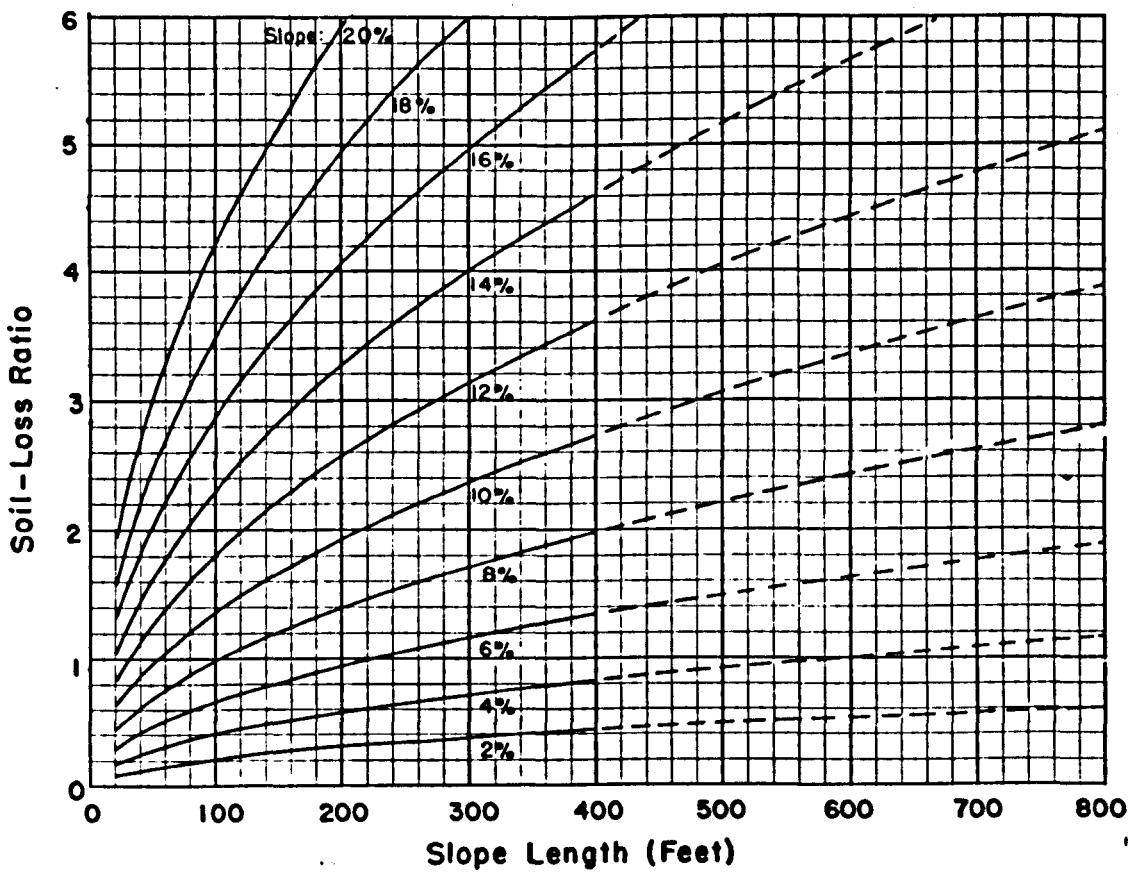


Figure 12

Slope-effect chart(topographic factor, LS) WISCHMEIER & SMITH (1965). Page 8.

FIGURE 13

LOSS OF STRUCTURE

Severely puddled surface in the early stage of drying with incipient desiccation cracks. No distinguishable soil aggregates remain. Larger clods exhibit a very rounded surface.

SOIL TYPE: Sandy clay loam.

CROP: Winter barley.

Reference in text: Page 125.

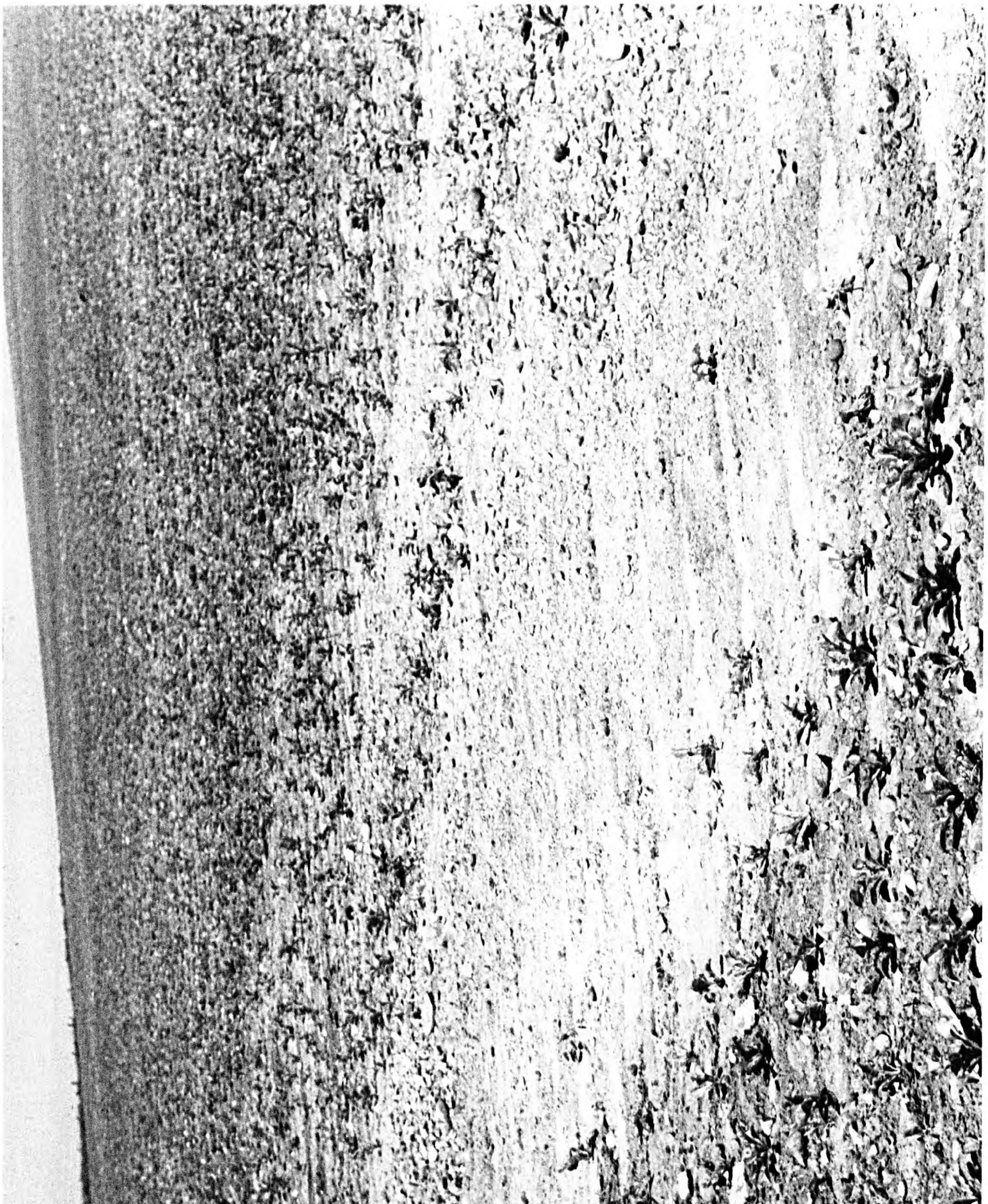


FIGURE 14

'FLASH' FLOODING

Run-off along wheelings and tillage lines which run parallel to contour concentrates along the main axis of a declivity as a broad shallow flow which has washed out all maturing beet plants in its path. On dry compact surfaces with a slow infiltration rate, run-off concentrates very quickly during intense rains. The resultant run-off resembles a miniature flash-flood. The greatest amount of damage is done where the largest concentrations of run-off occur and here considerable amounts of gravel are transported largely by rolling. Spreads of gravel can be seen in the centre of the photograph. Note that the field surface has been cultivated since the storm to break up a surface seal. A remnant of the storm flattened and washed surface soil can be seen as a band traversing the photograph from left to right.

LITHOLOGY: Stony sandy drift over sandy clay till overlying Triassic Sandstones.

SOIL TYPE: Sandy stony loam.

SOIL SERIES: Newport stony phase.

SOIL STRUCTURE: Weak crumb.

SOIL ORGANIC MATTER: No data.

SLOPE: 3^{o} (Straight).

ASPECT: N.E.

ELEVATION: 76 m.

RAINFALL: 22mm in 1.8hrs

RAINFALL RATE: 12.2mm/hr.

CROP: Sugar beet.

DATE: May 1967.

LOCATION: Parish of Stockton SO 735 987

Reference in text: Page 126.

FIGURE 15

CONFINED RILL EROSION

Developed in tractor and implement wheelings.

Incipient stage of lateral corrasion can be detected along the tractor wheelings. Micro-furrows (made by ribbed roller) are infilled with splashed sand eroded from micro-ridges.

LITHOLOGY: Sandy drift overlying Triassic Sandstone (Upper Mottled Sandstone).

SOIL TYPE: Loamy sand to sandy loam.

SOIL SERIES: Newport sandy phase. Wick.

SLOPE: 4 - 5° (straight).

ASPECT: N.N.W.

ELEVATION: 68 - 84 m.

RAINFALL: 26.9 mm in 12 hours.

RAINFALL RATE: Average 2.3 mm/hr.

CROP: Prepared for sugar beet.

DATE: 13 - 14 May 1967.

LOCATION: Parish of Claverley SO 791 923.

Reference in text: Page 128.

COMMENTS: Figure 53 shows a full slope view of this site.

FIGURE 16

UNCONFINED RILL, INCIPIENT GULLY AND GULLY DEVELOPMENT

The situation of this site is shown diagrammatically (Point d) in Figure 17. A large catchment above the crest supplied copious run-off via a network of tractor wheelings and tillage lines which ran parallel to the back slope which has subsequently been ploughed. On the main slope cultivation lines run parallel to contour and these have been breached by a dense network of predominantly single unconfined rills which merge along the concave slope facet into incipient gullies and to the right of the picture, deep gullies. The effects of slope convergence on channel development can be seen to the right of the picture at the head of a minor re-entrant valley.

LITHOLOGY: Steep facet; thin sandy drift over Triassic Sandstone. Back slope; sandy and occasionally marly drift over sandy clay till. Base of slope; deep sandy colluvium.

SOIL TYPE: Fine sandy loam to fine loamy sand.

SOIL SERIES: Bridgnorth.Newport sandy phase.

SOIL STRUCTURE: Very weak.

ORGANIC MATTER CONTENT: 1.9 2.2%

RAINFALL: 83 mm in three closely spaced storms.

RAINFALL RATE: 2.5 7.6 mm/hr.

CROP: Fallow (failed crop of carrots).

DATE: 25 - 27/9/1976.

LOCATION: Parish of Worfield (SO 779 952)

REFERENCE in text: Page 128.

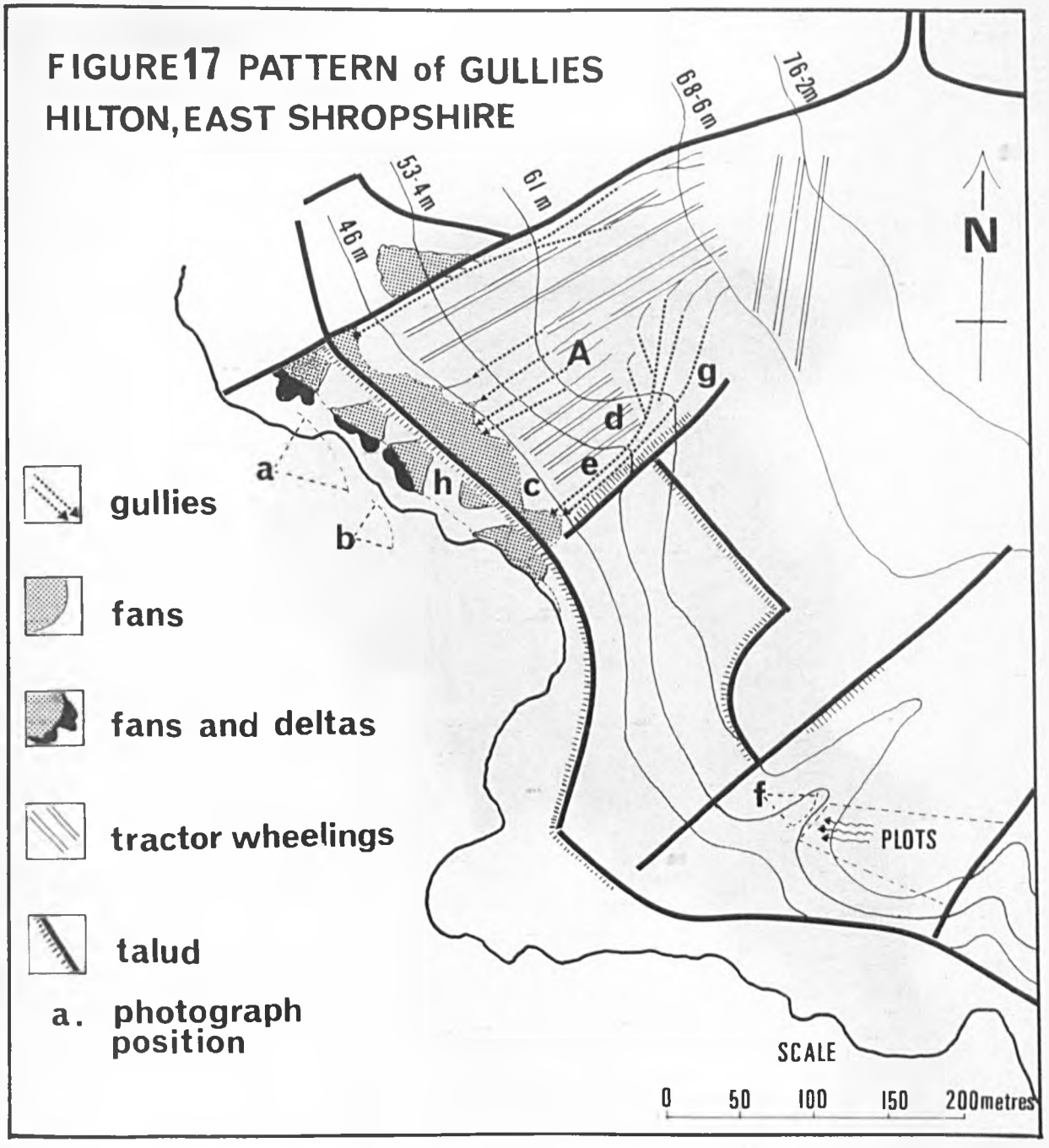


FIGURE 17 PATTERN of GULLIES
HILTON, EAST SHROPSHIRE
68·6m
76·2m
53·4m
61m
46m
N
A
g
d
e
a
h
c
b
f
PLOTS
gullies
fans
fans and deltas
tractor wheelings
talud
a. photograph position
SCALE
0 50 100 150 200metres

FIGURE 18

CONFINED AND UNCONFINED RILL EROSION.

A small re-entrant valley runs from left to right of picture. The steeper segment is grassed and slopes away to left. In the foreground, run-off follows seed drill furrows which run parallel to the cross-profile slope. To the right, up valley, seed drill lines run parallel to the long axis of the valley and run-off has concentrated here from adjoining slopes to form both confined and unconfined rills. On the opposite side of the valley run-off commences in confined rills which then become unconfined where a greater volume of run-off overtops wheelings and tillage lines and follows direction of longest slope.

LITHOLOGY: Sandy drift (glaciofluvial deposits) over Upper Mottled Sandstone.

SOIL TYPE: Sandy loam.

SOIL SERIES: Ebstree.

SOIL STRUCTURE: Weak.

ORGANIC MATTER CONTENT: 2.6 - 3.3%

SLOPE: 6 to 7° convex-concave.

ASPECT: South.

ELEVATION: 68m.

RAINFALL: 10.6mm in 3.7 hrs.

RAINFALL RATE: Average 2.8 mm/hr.

CROP: Winter barley.

DATE: 11 November 1969.

LOCATION: Parish of Claverley (SO 793 939)

Reference in text page 128.

FIGURE 19

CONFINED RILL EROSION

Incipient confined rills in tractor wheelings can be seen to the centre right of the picture and the effects of splash erosion are visible with trains of washed sand in the micro-furrows and older wheelings. Thin spreads of clean washed sand have been moved by unconcentrated surface wash where overtopping of micro-furrows and wheelings has taken place. Two sets of wheelings can be identified. The first set, which were formed during seed drilling, were eroded and sediment from up-slope infilled the wheelings seen in the picture. The second set (one pair of wheelings) is associated with subsequent spraying operations which took place after the first erosive event when the ground was very moist, (judging from the depth of wheel sinkage). The well-defined confined rill in the left-hand wheeling (in the centre of the picture) is the result of a greater concentration of run-off 'captured' from overtopping higher up slope.

LITHOLOGY: Sandy drift over Triassic Sandstones.

SITE: Details not known.

Reference in text: Page 129.

FIGURE 20

RAINDROP SPLASH AND SPLASH TRANSPORT ALONG SEED-DRILL FURROWS AND UNCONCENTRATED SURFACE WASH.

Tillage lines run parallel to slope with furrows partially infilled with splashed soil. Only larger soil aggregates remain and are well rounded. The ridge tops are appreciably flattened. Splashed soil in the furrows further reduces infiltration and facilitates the movement down slope of overtopped storage water between detention hollows. Transported sediment appears to be largely splash derived. Incipient rill development is apparent along partially collapsed mole run (centre.) Transported sediment infills mole run to left.

LITHOLOGY: Sandy stony drift over Triassic Sandstones.

SOIL TYPE: Loamy sand to sandy loam.

SOIL SERIES: Newport.

STRUCTURE: Weak to very weak.

ORGANIC MATTER CONTENT: 1.9 - 2.2%.

SLOPE: 5 - 6° slightly convex.

ASPECT: North.

ELEVATION: 61 - 68m.

RAINFALL: 11.3mm in 7 hours.

RAINFALL RATE: Average 1.6mm/hr.

CROP: Winter barley.

DATE: 25.11.67.

LOCATION: Parish of Claverley SO 798.938

Reference in text: Page 129.

FIGURE 21

CONFINED AND UNCONFINED RILL EROSION.

Site data as for Figure 18. Detail of incipient confined rills (top centre) with stone acting as nick point. Seed drill ridges are almost flattened by splash erosion and only large aggregates remain exhibiting characteristically rounded appearance.

Reference in text: Page 130.

FIGURE 22

CONFINED RILL EROSION

Channel development in tractor wheelings running directly down slope. Wheel sinkage in this stony soil in the foreground was minimal because of very dry condition of surface. However, splash erosion and unconcentrated surface wash has obliterated all trace of tillage lines and rill development has all but destroyed wheeling patterns. Although the slope is steeper than in figure 35 (both sites experienced the same storms) erosion is significantly less as the catchment area above the crest was minimal in this example.

LITHOLOGY: Sandy, stony drift over Triassic Sandstone.

SOIL TYPE: Sandy stony loam to stony loamy sand.

SOIL SERIES: Newport stony phase. Salwick (shallow phase).

STRUCTURE: Weak crumb.

ORGANIC MATTER CONTENT: 3.5 - 4.2%.

RAINFALL: 83mm in 3 storms.

RAINFALL RATE: 2.5 to 7.6mm/hr.

CROP: Prepared for winter barley.

DATE: 25 - 27.9.76.

LOCATION: Parish of Worfield (SO 474 960)

Reference in text: Page 130.

COMMENTS: Detail of the up-slope view of this field is shown in Figure 31 (Page 31).

FIGURE 23

DETAIL OF TRACTOR WHEELING WITH BEET SEED-DRILL ROLLER

Partially eroded tractor wheeling paralleled by sugar beet drill rollers, ('V' lug pattern downhill). Margin of lug pattern still discernible but centre part eroded by confined incipient rill development which is now infilled with transported sand. Contrast is evident between smoothed soil surface where beet rollers have compacted soil and the adjoining areas where natural compaction by raindrop-splash has rounded aggregates and concentrated tiny pockets of clean washed sand. Metre rule for scale.

Reference in text: Page 131.

FIGURE 24

DETAIL OF A TRACTOR WHEELING SHOWING LUG PATTERN

Detail of wheeling showing lug pattern and imprints made by the rear wheel of a tractor moving in an up-slope direction. The depth of sinkage averaged 7 cm along the centre of the track. The small soil plug which separates each limb of the lug imprints can be seen. The width of the track is 35 cm and the faint outline of the front wheel is just discernible. The lug imprints have a thin film of splashed sand and the area outside the wheeling has been affected by splash erosion. The soil surface has capped and only the larger rounded soil aggregates remain.

SOIL TYPE: Sandy loam.

Reference in text: Page 131.

25a.

25b.

25c.

FIGURES 25(a). 25(b) and 25(c)

SEQUENCE OF STAGES IN THE EROSION OF TRACTOR WHEELING

FIGURE 25(a) STAGE 1 APRIL

After the drilling of sugar beet the pattern of wheelings and seed drill rollers has been slightly modified by soil blowing with films of sand retained in the lug pattern. The surface is rough and contains a large number of angular to sub-angular soil aggregates. The adjoining crop of spring barley has lenses of splashed sand in the micro-furrows.

FIGURE 25(b) STAGE 2 MAY

After the first erosive rainfall (thunderstorm 18 mm - average rate 1.8 mm per hour). Raindrop impact and splash has affected the entire surface of the field with pockets of washed medium to coarse sand showing prominently along the lines, compacted by the beet seed-drill rollers (see Figure 26(a) Page 26) for detail. Run-off has concentrated along wheelings causing incipient confined rill erosion in the upper and middle section of the large field (slope length 500 m, average slope 5°) and deposition of eroded soil in the lower sections, all of which remains in the confines of the wheeling.

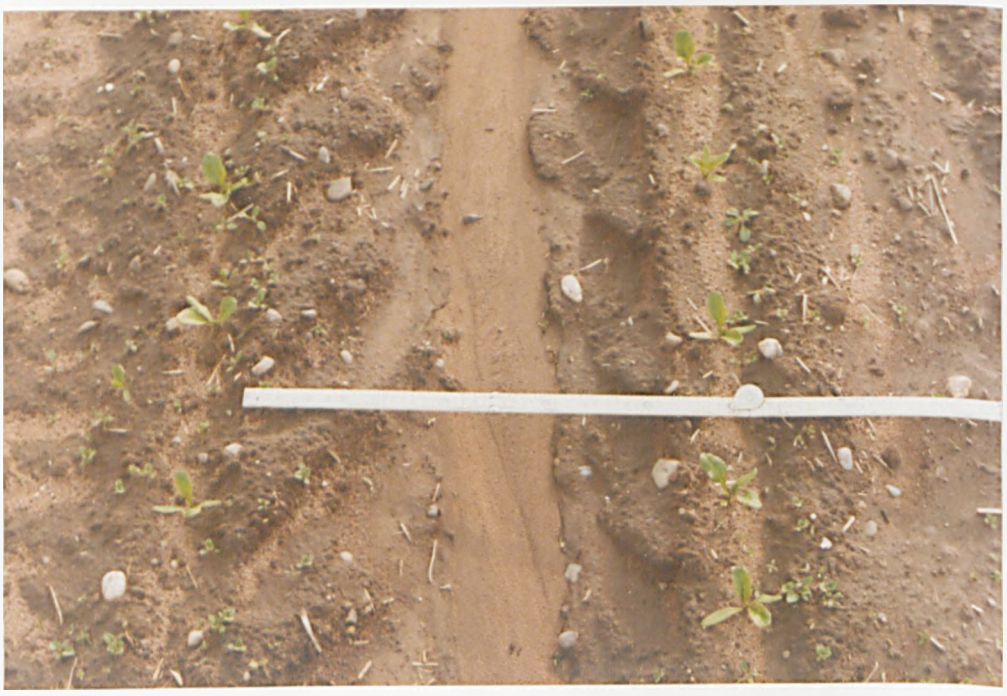
FIGURE 25(c) STAGE 3 JULY (2nd week)

At this stage crop cover affords a greater measure of protection to the soil from raindrop impact and splash. Some soil movement is still taking place along tractor wheelings (see Figure 26(b) Page 26) though this tends to involve a redistribution of material during run-off associated with non-erosive rainfalls.

Reference in text: Page 132.

Comments: Three former fields have been amalgamated to form this one large unit.

26a.



26b.

FIGURE 26(a) AND 26(b)

DETAIL OF EROSION PATTERN IN TRACTOR WHEELING

FIGURE 26(a)

The lug pattern is still discernible but the central portion has been eroded away by incipient rill action and infilled with medium to coarse sand. Washed out organic matter (from application of farmyard manure) is visible on the soil surface. Lenses of splashed sand occupy the beet seed drill roller line which is identified by growing sugar beet (mono-germ). To the right of the picture the soil surface is covered by a veneer of silt where temporary ponding and low energy surface flow has taken place.

FIGURE 26(b)

In this example a wider proportion of the wheeling has been eroded and infilled with sediment, most of which is red medium to coarse sand. Outside of the wheeling (to the left), areas of soil show clear signs of splash erosion and natural compaction. Overtopping of run-off water from the wheeling has produced temporary ponding along the lines of beet plants leaving behind a film of silt.

Reference in text: Page 132.

FIGURE 27

TRACTOR AND IMPLEMENT WHEELINGS.

A high density pattern of wheelings (over 14 hectare field) is shown diagrammatically on figure 28 (Page 28) The type of channel development from these wheelings is controlled by their direction relative to slope, the steepness of slope and the supply of run-off, which is supplied to the channel. Three well-defined sets of wheelings can be identified. The most prominent set was made last of all when the ground was very moist and wheel sinkage was marked. Only a vestige of the micro-ridge and furrow pattern remains in the foreground as a result of splash erosion and unconcentrated surface wash.

LITHOLOGY: Sandy stony drift over terrace deposits and Triassic Sandstone.

SOIL TYPE: Sandy loam.

SOIL SERIES: Newport. (Stony phase) Wick.

SOIL STRUCTURE: Weak.

ORGANIC MATTER CONTENT: 1.5 - 2.2%.

SLOPE: Straight - slightly undulating.

ASPECT: East to south-east.

ELEVATION: 68m.

RAINFALL: 83mm in three storms.

RAINFALL RATE: 2.5 - 7.6mm/hr.

CROP: Prepared for winter barley.

DATE: 25 - 27.9.1976.

LOCATION: Parish of Worfield.

Reference in text: Page 132

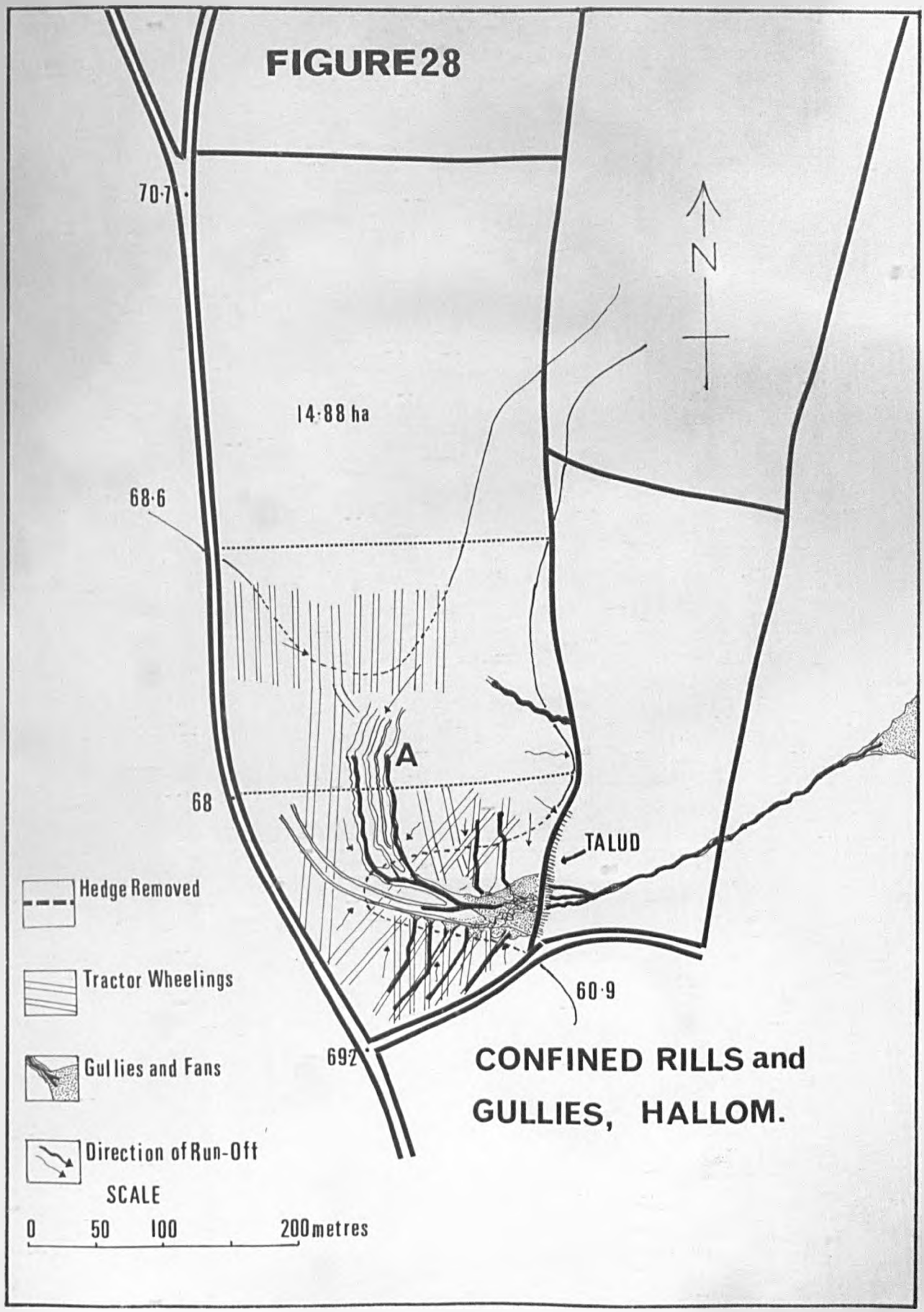


FIGURE28
70·7
14·88 ha
68·6
A
68
TALUD
60·9
69·2
N
Hedge Removed
Tractor Wheelings
Gullies and Fans
Direction of Run-Off
SCALE
0 50 100 200 metres
CONFINED RILLS and GULLIES, HALLOM.

FIGURE 29

UNCONFINED RILL EROSION

A high density of channels, some of which were wide (30 cm+) cut across tillage lines running parallel to contour. A short-lived localised thunderstorm (exact details unknown) during a longer period of rain caused rapid run-off from compacted field surface with well-defined pan at 18 cm. Debris trapped in hedge line showed a water level of 46 cm - 61 cm ($1\frac{1}{2}$ - 2 ft.) where large temporary pond formed before breaking through wall (bottom right). Cottage garden was covered with silt to depth of approximately 22 cm.

LITHOLOGY: Sandy drift over Triassic Sandstone.

SOIL TYPE: Loamy sand to sandy loam.

SOIL SERIES: Bridgnorth and Wick.

SOIL STRUCTURE: Weak.

ORGANIC MATTER CONTENT: 1.8 - 2.6%.

SLOPE: Convex 9^{o}.

ASPECT: South.

ELEVATION: 84 metres.

RAINFALL: Estimated at 40 mm in 10 hours.

RAINFALL RATE: Estimated at 4 mm/hr.

CROP: Recently sown ley grass.

DATE: 25.5.1968.

LOCATION: Parish of Rudge SO 809 793

Reference in text: Page 134.

Comments: Field surface was dry and compacted prior to storm.

FIGURE 30

UNCONFINED RILL EROSION

An example of unconfined rill erosion is illustrated here on the site of an experimental plot 60 m long by 10 m wide. No visible signs of surface compaction could be seen after surface was rotovated. Long straight single unconfined rills averaging 8-13 cm deep and 9-15 cm wide developed after three closely spaced storms. Base of slope fans merged into long grass around the lower margin of the plot.

LITHOLOGY: Sandy drift overlying Triassic Sandstone.

SOIL TYPE: Loamy sand to sandy loam.

SOIL SERIES: Bridgnorth.

SOIL STRUCTURE: Weak crumb.

ORGANIC MATTER CONTENT: 4-5%.

SLOPE: Convex 12-14°, straight 6-9°.

ASPECT: Due west.

ELEVATION: 61 metres.

RAINFALL: 83 mm in three closely spaced storms.

RAINFALL RATE: 2.5 to 7.6 mm/hr.

CROP: Fallow.

DATE: 25-27 September 1976.

LOCATION: Parish of Worfield SO 762 949.

Reference in text: Page 134.

Location of photograph is shown on Figure 17 (Page 17) Point f.

FIGURE 31

CONFINED AND UNCONFINED RILL EROSION

Rill systems can be seen traversing a complex pattern of tillage lines. The very limited catchment area above crest lines is cultivated parallel to slope. Tillage lines running down slope just below crest channelled run-off to form a moderately dense network of largely unconfined rills on the steeper convex slope segment (12-14°). Where the rills cut across a second set of tillage lines which run obliquely (top left to centre of photograph) to the first set, a change in direction of rills can be detected where the slope reduces (5-7°). Here rills become partially confined along tractor wheelings which because of the very dry soil leave only shallow sinkage lines. As run-off increased, overtopping took place in the direction of the longest slope facet. The surface roughness associated with the second set of tillage lines (made by a ribbed roller) is much lower in amplitude than the first set (made by a spring harrow) and therefore was less competent at diverting rill channels. A third set of harrow lines run from the left to right of picture meeting the second set at right angles.

LITHOLOGY: Sandy stony drift over Triassic Sandstone.

SOIL TYPE: Sandy loam. SOIL SERIES: Salwick (deep loamy phase) and Newport.

STRUCTURE: Weak crumb. ORGANIC MATTER CONTENT: 3.5 4.2%

RAINFALL: 83 mm in 3 storms. RAINFALL RATE: 2.5 to 7.6 mm/hr.

CROP: Prepared for winter barley. DATE; 25-27.9.1976.

LOCATION: Parish of Worfield (SO 747 960)

Reference in text: Page 135.

COMMENTS: Field surface very dry, moderately compacted with tillage lines parallel or oblique to slope.

Fig. 32.

FIGURES 32 AND 33

CONFINED GULLY EROSION

Confined forms of gullying occupying sections of tractor wheelings and tillage lines running up and down slope (some 350 metres long). Gullies form in tractor wheelings just below crest line on steepest part of slope facet (10-11°) excavating beds of rhythmites. A large single confined gully can be seen to bottom right of picture, cutting through a fan of sand and gravel. Another large confined gully is visible to the right just below the crest line. A close-up view of this gully is shown in Figure 33 and its position (marked A) is shown on the diagram Figure 17 (Page 17). A detailed cross section of this gully is given in Figure 34 (Page 33). Large base of slope fans overlap and build up against hedgerow. A second set of fans (out of view behind houses) build out into flooded water course (see Figure 51 Page 47).

LITHOLOGY: Sandy drift over fluvioglacial deposits over Triassic Sandstone.

SOIL TYPE: Sandy loam.

SOIL SERIES: Newport.

SOIL STRUCTURE: Very weak.

ORGANIC MATTER CONTENT: 2-2.5%.

SLOPE: Average 8°.

ASPECT: S.W.

ELEVATION: 61 metres.

RAINFALL: 83 mm in three storms.

RAINFALL RATE: 2.5 to 7.6 mm/hr.

CROP: Prepared for winter barley.

COMMENTS: This field of 6.64 hectares has eroded every year during survey (1967-1976), on some occasions 2-3 times per annum. Field amalgamation, continuous arable cropping and up and down slope cultivation practices have increased the risk of erosion.

DATE: 25-27.9.1976.

LOCATION: Parish of Worfield (SO 778 952).

Reference in text: Page 136-7. See also diagrammatic representation of site in Figure 17(Page 17) Photograph taken from point a

FIGURE 34

Confined gully (A)

in tractor wheeling

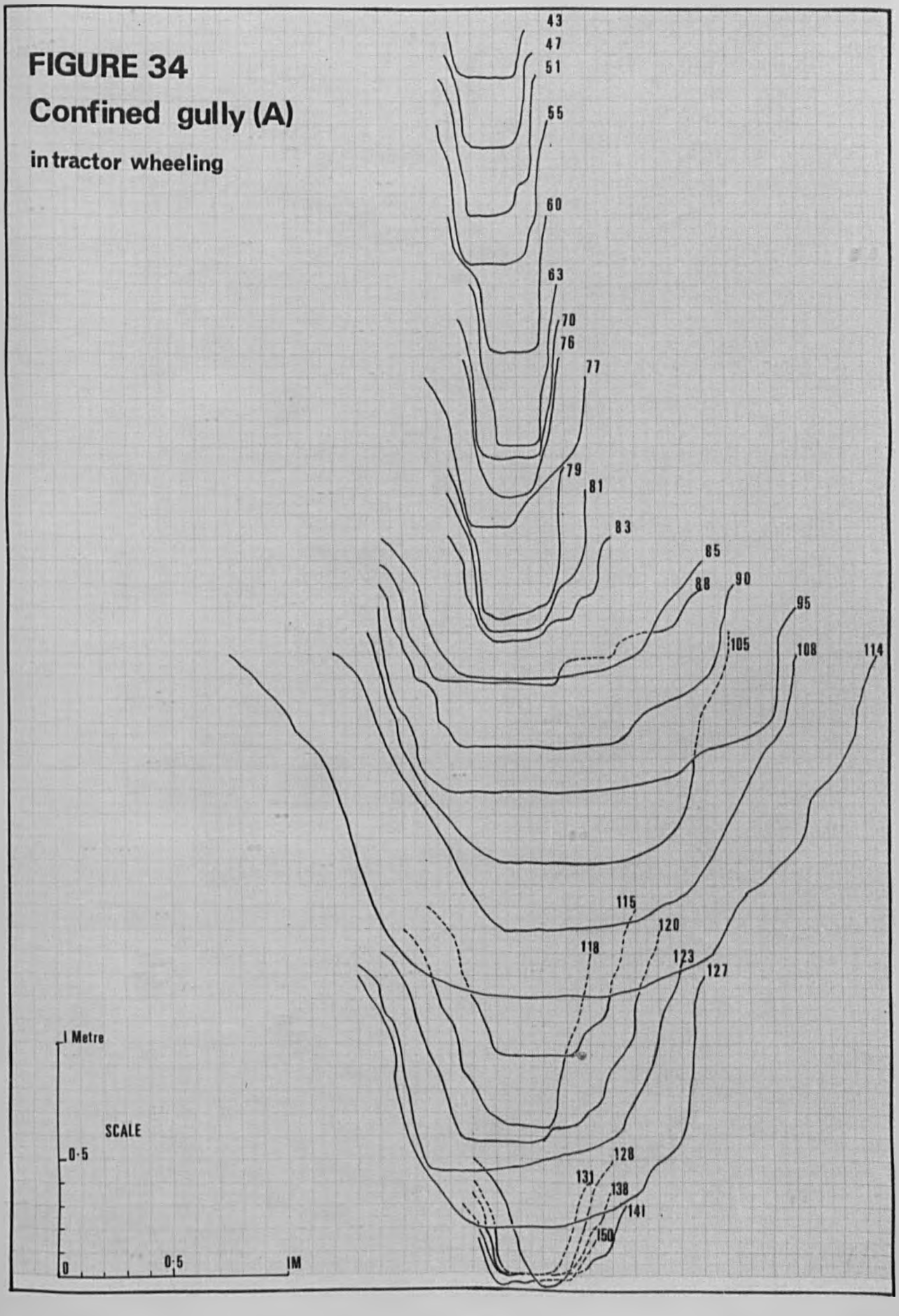


Fig.35.

Fig. 36.

FIGURES 35 AND 36

UNCONFINED GULLY EROSION

Figure 35 shows the middle and upper section of a large confined gully system which is located on Figure 17 (Page 17) between letters e and g. It follows the long axis of a minor re-entrant valley and is fed by a large catchment area which stretches beyond the house seen on the horizon. Figure 36 shows the middle and lower sections of the gully where a change in cross-sectional form from 'U' shape to 'V' shape can be seen marking a transition from incoherent to more coherent (sandy-silty clay) materials. The large base of slope fan in front of the hedgerow had an average depth of material of 0.4 m. Details of upper and middle sections.

SOIL TYPE: Sandy loam.

SOIL SERIES: Newport (deep sandy phase).

SOIL STRUCTURE: Weak.

ORGANIC MATTER CONTENT: 2-2.5%.

RAINFALL: 83 mm in three storms.

RAINFALL RATE: 2.5 to 7.6 mm/hr.

CROP: Prepared for winter barley.

DATE: 25 to 27.9.1976.

LOCATION: Parish of Worfield.

Reference in text: Page 137.

FIGURE 37

CONFINED RILL, INCIPIENT GULLY AND GULLY EROSION occupying a complex set of tractor and implement wheelings. The pattern of wheelings is shown diagrammatically in figure 28 Page 28 A dense pattern of wheelings channelled run-off along 2 - 3° slope which steepens to 9° where a small re-entrant dry valley intersects the main field slope at right angles (left to right in centre of picture). Most of the deepest gullies are associated with wheelings running directly down slope. Some branching is controlled by wheelings which intersect obliquely (from left to right). Run-off from both valley slopes drains into a large unconfined gully in the centre of picture. A deep confined gully can be seen in the foreground cutting through beds of sand and gravel. Large fans coalesce to the right of the picture.

SOIL TYPE: loamy stony sand to stony sandy loam.

SOIL SERIES: Newport (stony phase).

SOIL STRUCTURE: Very weak. ORGANIC MATTER CONTENT: 1.5 - 2.2

RAINFALL: 83 mm in 3 storms.

RAINFALL RATE: 2.5 to 7.6 mm/hr.

CROP: prepared for winter barley.

DATE: 25 - 27.9.1976.

LOCATION: Parish of Worfield (SO 755 963)

Reference in text: Page 138.

COMMENTS: Four erosion episodes have been observed in this field but none as serious as 1976 (1967 - 1976). July 1975 produced a similar pattern of channel developments (in sugar beet) but rainfall associated with thunderstorm only yielded 18.0 mm.

FIGURE 38

CONFINED GULLY EROSION IN TRACTOR WHEELINGS RUNNING ALONG LONG AXIS OF MINOR RE-ENTRANT VALLEY

Two phases of gully development can be identified here: a broad trough-shaped channel which has eroded away most of the Ap horizon to the depth of ploughing (straw stubble from previous crop can be seen resisting on plough sole). Because of the density and resistance of the plough sole, run-off caused extensive lateral corrasion. As the gradient remained constant increased run-off entering the channel from lateral feeders caused headward gully development. Once the severely compacted zone had been breached steep-sided, deep (>1 metre) canyon-like gullies cut into underlying thick colluvium. Note the severely splashed soil surface in the inter-rill and gully areas.

Site details are the same as Figure 37.

Reference in text: Page 140.

FIGURE 39

CONFINED AND UNCONFINED GULLIES FORMED IN SMALL RE-ENTRANT VALLEY ON SOUTH SIDE OF FIELD (shown in Figure 32 Page 32)

The location is shown diagrammatically in Figure 17* and details of the gully in Figures 35 and 36 (Page 34)

The extent of the catchment area for run-off can be visualised. Although tillage lines in the background run obliquely to slope overtopping of run-off took place which reached the farm track (centre left) wheelings and tillage lines running parallel to steepest slope facet. Large base of slope overlapping fans can be seen. The green area is late emergent carrot seedlings which failed to take when planted during the summer drought. Site details similar to Figure 32 (Page 32)

Reference in text: Page 140.

* This photograph is taken from point b on Figure 17 (Page 17)

FIGURE 40

INCIPIENT RILL EROSION AND CONCENTRATED OVERLAND FLOW

on same site as Figure 39 during July storm, 1975. Unconfined rills cut across tillage lines from the right-hand side of photograph. On this occasion rainfall (10.8 mm at an average rate of 2 mm/hr) was much less and the surface was moist from rainfall on preceding day (5.4 mm).

CROP: Sugar beet.

SITE: Data as for Figure 32 (Page 32).

Reference in text: Page 140.

The photograph is taken from point g on Figure 17 (Page 17) facing in a south westerly direction.

FIGURE 41

UNCONFINED RILLS AND INCIPIENT GULLIES cutting across tillage lines running parallel to contour. The channels show a marked development of nick points and plunge pools. In the incipient gullies nick points are found in harder more compact sections of the cultivation pan. A possible explanation for this recurring pattern may be found in the differential loading of the down slope tractor wheel as successive passes are made across the field parallel to the contour. Evidence of a thin initial spread of surface washed material (approx. 5 cm.) which obliterates tillage lines can be seen where the slope angle begins to reduce. In the foreground more concentrated flow from three channels has led to the excavation of a broad trough-like gully in colluvium.

LITHOLOGY: Sandy over Triassic Sandstone (Upper Mottled).

SOIL TYPE: Sandy loam.

SOIL SERIES: Bridgnorth.

SOIL STRUCTURE: Weak crumb to sub-angular blocky.

SOIL ORGANIC MATTER CONTENT: 2.8 to 3.5.%

RAINFALL: Thunderstorm; estimated 16 mm in 9 hours.

RATE: Approx. 1.7 mm/hr.

SLOPE: 8 - 9° ASPECT: N.N.E. ELEVATION: 68.6 m - 114 m.

CROP: Sugar beet newly sown.

DATE: April 1965.

LOCATION: Parish of Bonningale (SJ 823 026)

Reference in text page 141.

COMMENTS: Four other erosion episodes have been recorded here all of which have been less severe and all associated with up and down slope cultivations.

FIGURE 42

UNCONFINED GULLY EROSION

Channel excavating 60 cm. of weathered upper mottled sandstone.

Details as for Figure 41.

Reference in text: Page 141.

FIGURE 43

UNCONFINED INCIPIENT GULLYING AND GULLY EROSION

Channels cut across tillage lines which run parallel to contour.

LITHOLOGY: Sandy over Triassic Sandstone.

SOIL TYPE: Loamy sand to sandy loam.

SOIL SERIES: Bridgnorth, Newport.

SOIL STRUCTURE: Weak.

SOIL ORGANIC MATTER CONTENT: 1.9 to 3.4.%

RAINFALL: 10.6 mm in 3.7 hrs.

RATE: 2.8 mm/hr.

SLOPE: Upper convex 9 - 10°. Lower concave-straight 4 - 5.°

ASPECT: S.S.E.

ELEVATION: 92 m - 106 m.

CROP: Sown to winter barley.

DATE: 11 November 1969.

LOCATION: Parish of Quatford SO 903 755.

REFERENCE: in text. Page 141.

COMMENTS: Three erosion episodes have been observed in this 8.9 hectare field - incipient to rill erosion.

FIGURE 44

UNCONFINED TROUGH-LIKE INCIPIENT GULLIES

The rapid removal of the Ap horizon has been facilitated by the presence of a rotovated surface (Ap horizon) resting on a compact impermeable cultivation pan at approximately 20 cm. Here run-off has begun to cut a meandering shallow channel into the pan surface and channel formation becomes progressively deeper down slope (1 metre plus) producing a well defined canyon-like gully. Note the severely splashed and elutriated field surface with trains of sand occupying the micro-furrows of tillage lines.

LITHOLOGY: Sandy drift derived from glaciofluvial deposits overlying Triassic sandstones.

SOIL TYPE: Loamy coarse sand to stony sandy loam.

SOIL SERIES: Rudge.

SOIL STRUCTURE: Weak crumb.

SOIL ORGANIC CONTENT: 2.0 - 2.3%.

RAINFALL: 83 mm.

RATE: 2.5 - 7.6 mm/hr.

SLOPE: 3° (straight).

ASPECT: South.

ELEVATION: 91-106 metres.

CROP: Sown to winter barley.

DATE: 25-27.9.76.

LOCATION: Parish of Claverley SO 773 935.

Reference in text: Page 142. Metre rule as scale.

COMMENTS: Three other erosion episodes recorded on this 5.80 hectare field within the survey period; two of confined rilling and one of incipient rilling.

FIGURE 45

LARGE OVERLAPPING FANS OF ERODED SOIL

Position indicated diagrammatically on Figure 17 (point c). Page 17.

Partially buried hedge line* acts as trap for medium to fine sand although second set of large fans occur in meadow below hedge. Depth of fans varied from 10 cm to 30 cm. Calculations of volume and weight taken on average depth of material = 20 cm. Length of fan at hedge line = 122 m; average width = 20 metres which is equal to 2440 m^2 or 488 m^3 (2440 m^2 x 0.2 m). Bulk density for coarse textured surface soils is usually in range 1.3 to 1.8 (Miller et al 1965). Assuming an average figure for soil bulk density of 1.55 approximately 756 tonnes of soil were deposited in this section alone. The very stony surface in the foreground is part river terrace deposits (No.1 Terrace, Severn Valley).

Site data as for Figure 32 (Page 32)

Reference in text: Page 143.

* See Figure 33 Page 32 for downslope view of hedgeline.

46

47

48

FIGURES 46. 47. 48

ACCELERATED CONCENTRATED RUN-OFF DURING A PASSAGE OF STORM

Run-off continuing on a 7.84 hectare field after passage of main storm. Cultivation lines run obliquely to contour on main slope except on field margin where wheelings run down slope and receive run-off from numerous confined rill channels. A large fan of coarse to medium sand was deposited against hedge line and cut into by braided stream channels. At the mid-storm stage temporary ponding of run-off took place against hedge (see Figure 47). As flow through meshed fencing in former gateway became choked with run-off debris.

Average depth of deposited material = 12.5 cm.

Dimensions of fan 30 x 26 m = 780 m^2 = 97.5 m^3.

Assuming a soil bulk density of 1.55, about 151 tonnes of soil were deposited or approx. 19.3 tonnes of soil eroded per hectare (7.84 hectare field).

LITHOLOGY: Sandy drift over sandy clay till over Triassic sandstones.

SOIL TYPE: Sandy loam.

SOIL SERIES: Newport and Salwick.

SOIL STRUCTURE: Crumb to sub-angular blocky.

SOIL ORGANIC MATTER: 2.8 - 3.9%.

SLOPE: 4^{o} (straight).

ASPECT: W.N.W.

ELEVATION: 82 m - 89 m.

RAINFALL: 2.4 mm/hr.

RAINFALL RATE: 2.4 mm/hr.

CROP: Preparation for winter wheat.

LOCATION: Parish of Worfield SO 726 973.

DATE: 28 September 1976.

Reference in text: Page 144.

FIGURE 49

UNCONCENTRATED SURFACE WASH

Temporary ponding of run-off took place against hedgerow backed by raised road. Overtopping of detention storage water in hollows and tillage lines (running parallel to contour) transported splashed soil materials which were deposited as a veneer of silty clay as ponded water subsided. The retention of this fine grade material within the field boundary is in marked contrast to the high rate of loss experienced in the previous example (Figures 46-48).

LITHOLOGY: Sandy drift over sandy clay loam till.

SOIL TYPES: Fine sandy loam to loam.

SOIL STRUCTURE: Weak crumb.

SOIL ORGANIC MATTER: 2.3-2.9.

SLOPE: 3-4^{o} straight.

ASPECT: N.N.W.

ELEVATION: 84 m.

RAINFALL: 22 mm in 1.8 hrs.

RAINFALL RATE: 12.2 mm/hr.

CROP: Young sugar beet.

DATE: 25.5.68.

LOCATION: Parish of Stockton SO 722 997.

Reference in text: Page 145.

COMMENTS: This thunderstorm yielded fairly intensive rainfall for just under two hours at average rate of 12.2 mm/hr and 17 mm in 48 mins, which on compacted soil yielded rapid run-off. The short-lived nature of this storm reduced the possible risk of more serious rilling and gully erosion.

FIGURE 50

DELTAIC GROWTH OF ERODED SOIL INTO TEMPORARY PONDED RUN-OFF

More concentrated run-off in the form of flash flooding occurred along the axis of a natural declivity in the field described in Figure 49. This more energised flow scoured a very broad shallow channel which transported large quantities of coarser sediment building out a series of deltas into the temporary ponded run-off. An estimated 6 tons of soil was deposited in the delta illustrated here

(7.6 m x 5 m = 38 m^2 x 0.1 m = 3.8 m^3

3.8 m^3 x 1.55 = 5.9 tonnes

Details as for Figure 49.

Reference in text: Page 145.

FIGURE 51

DELTAIC GROWTH OF ERODED SOIL INTO FLOODED STREAM

Deposition of second line of fans as deltas in flooded stream course. Details as for Figure 45 (Page 43). Once again coarse fraction remains as fans and deltas while fine fraction is carried off in suspension in flooded stream.

Reference in text: Page 146.

Position of photograph - See Figure 17 (Page 17) point h.

52

53

FIGURES 52 AND 53

LARGE SINGLE FAN OVERSPILLING INTO COUNTRY LANE

Fan size 27 x 23 m = 621 m^2 x 0.22 = 136.62 m^3 x 1.55 = 212 tonnes of eroded soil. An estimated 130 tonnes partially blocked the lane.

LITHOLOGY: Sandy drift and colluvium over upper mottled sandstone.

SOIL TYPE: Sandy loam.

SOIL SERIES: Bridgnorth.

SOIL STRUCTURE: Weak.

SOIL ORGANIC MATTER: 1.9 - 2.7%.

SLOPE: Upper

Convex 9 - 11°

Lower 3 - 4°

ASPECT: N.W.

ELEVATION: 61 m.

RAINFALL:

RAINFALL RATE:

CROP: Potatoes.

DATE: 11- 16 November 1969.

LOCATION: Parish of Claverley SO 789 938

REFERENCE in text: Page 146.

COMMENTS: This 2.70 hectare field has eroded every year during the survey 1967 - 1976 and on a number of occasions twice per annum and on one occasion three times. Confined rill erosion associated with up and down cultivation methods represents the most common form of erosion.

FIGURE 54

DELTAIC GROWTH OF ERODED SOIL INTO SMALL POND

Most of the run-off causing the illustrated confined incipient gullies derived from a 6 hectare field lying behind the hedge line. Run-off ponded against this hedge line on the up field side and overflowed at lowest point following tractor wheelings. This run-off built out a sizeable delta into an existing field pond.

Site data as for Figure 44.

Reference in text: Page 146.

FIGURE 55

CONFINED RILL EROSION

Storm run-off moved down slope along tractor wheelings, excavating shallow rills which deposited small fans of coarse sand at the point where the slope angle decreases. Small amounts of splash derived sediment moved along micro-furrows made by the seed drill. The most efficient rill channels are those occupying wheelings made by a tractor passing in a downhill direction.

LITHOLOGY: Sandy drift overlying Triassic Sandstone (Upper Mottled Sandstone).

SOIL TYPE: Sandy loam - loamy sand.

SOIL SERIES: Newport sandy phase; Wick.

SLOPE: Convex-concave 8 - 11°.

ASPECT: N.N.W.

ELEVATION: 68-84 m.

RAINFALL: 26.9 mm in 12 hours.

RAINFALL RATE: Average = 2.3 mm/hr.

CROP: Prepared for sugar beet.

DATE: 13-14 May 1967.

LOCATION: Parish of Claverley. SO 791 923.

Reference in text: Page 146.

COMMENT: Six erosion episodes have been observed on this field with varying amounts of run-off and sediment reaching the near-by stream (tributary of the River Worfe). All were associated with run-off channelled in tractor and implement wheelings.

56

57

FIGURES 56 AND 57

INCIPIENT CONFINED RILLING AND SEDIMENTATION IN POTATO FURROWS

Potato furrows which run up and down slope provide efficient channels for collecting and discharging run-off water generated during storms. Run-off moves most efficiently along furrows where the soil is compacted by the passage of tractor wheels. The most compacted furrows are those which are traversed by the front and back wheels of the tractor during planting operations (see Figure 57). In addition the potato planter is supported by two smaller wheels which leave rib markings in furrows to the left and right of the tractor wheels. With this type of equipment five furrows are produced in each pass and of these only the centre one avoids compaction by wheelings. In Figure 56 this centre furrow shows no sign of rill development and has approximately one tenth of the sedimentation. Overtopping of ridges by the build up of sediment and rising water levels is common where changes of slope direction occur. Here lateral flow breaches ridges and carries run-off along the long axis of a large depression or minor valley. The severely splashed nature of the ridge tops can be seen by the accumulation of sand and rounded aggregates on the tops of ridges. Data for Figure 56:

SOIL TYPE: Sandy loam.

SOIL SERIES: Newport.

SLOPES: 8-9° convex-concave.

ASPECT: N.N.E.

ELEVATION: 76 m.

RAINFALL: 21.1 mm in 4 hours. RAINFALL RATE: Average = 3 mm/hr.

CROP: Potatoes.

DATE: 3rd May 1969. LOCATION: Parish of Claverley SO 772 947.

Reference in text: Pages 146-147.

FIGURE 58

EROSION OF RIDGE CRESTS RUNNING AT RIGHT ANGLES TO WIND

Strong gusty northerly winds caused blowing on soils which became very dry and 'puffy' after 20 days of continuous drought and overnight frost. In this example tine ridges of 12-15 cm in height run at right angles to the wind. The ridge surface was made up of angular aggregates and stones, 4-6.5 cm in diameter, together with many fragments of decomposing sugar beet from previous crop. The crest zone and margins quickly eroded in the more exposed part of the field and the furrows infilled with saltating sand (centre area in photograph). Variations in relief and the shelter afforded by belts of woodland of varying width running at right angles to the wind produced a complex pattern of airflow which in turn caused increased wind speed over the very exposed parts of the field.

LITHOLOGY: Stony sandy drift over Triassic sandstone.

SOIL TYPE: Loamy sand (stony).

SOIL SERIES: Bridgnorth (stony phase).

SOIL STRUCTURE: Weak crumb.

SOIL ORGANIC MATTER: 3.2%.

SLOPE: 5-6°.

ASPECT: N.N.W.

ELEVATION: 68 m.

WIND DIRECTION: North to N.N.W.

WIND SPEED (MEAN): 26 km/hr, gusting 40 km/hr.

CROP: Arable, fallow.

DATE: 6.3.1968.

LOCATION: Parish of Quatt Malvern SO 759 892.

Reference in text: Page 167.

FIGURE 59

COMMENCEMENT OF A BLOW: WIND BLOWING PARALLEL TO THE DIRECTION OF MICRO-RIDGES

Strong northerly wind funnelling through a minor vale. Very open landscape of low hedges situated along the dip slope of the outcrop of Bunter Pebble Beds (trees at top of photograph mark the line of the escarpment). A seed-drill has produced micro-ridges 5-6 cm high and approximately the same distance apart. The crests are narrow and are made up of angular and sub-angular aggregates 1.5-2.5 cm in diameter with larger clods and stones 3-4.5 cm in diameter. As wind direction was parallel or slightly oblique to ridges deflation of ridge and furrow surfaces took place and down wind saltating and creeping sand infilled the micro-furrows. Here surface roughness was minimal and only the larger clods and stones protruded above the sheet of moving sand. Wind speed ranged from a steady 21.5 kts* to 26.4 kts when small 'dust devils' began to move (centre of photograph) across the more exposed part of the field. At 29-31 kts a much larger area became affected by saltation and surface creep. Most of this material came to rest down wind along a hedge line at right angles to the wind.

LITHOLOGY: Sandy drift over Triassic sandstones and pebble beds.

SOIL TYPE: Sandy stony loam.

SOIL SERIES: Newport (stony phase).

SOIL STRUCTURE: Weak crumb to weak subangular blocky.

SOIL ORGANIC MATTER: 2.2%

SLOPE: 4^{o}. ASPECT: East. ELEVATION: 99 m.

WIND DIRECTION: N. N.N.W. WIND SPEED: (Mean 26 kts, gusting 40 kts).

CROP: Sown to spring barley.

DATE: 6.3.1968. LOCATION: Parish of Worfield (SO 732 933).

Reference in text: Page 167.

* Hand held anemometer. (Casella.)

FIGURE 60

ERODED RIDGES AND INFILLED FURROWS: WIND AT RIGHT ANGLES TO CULTIVATION LINES

Detail of area in the middle distance of Figure 58. Site details as for Figure 58. (Page 52)

The crest area has been virtually flattened with only stones, grit and the occasional beet carcass remaining. Each obstruction has a well defined tail of sand developed leeward which tends to produce an asymmetric infilling of the furrows along the leeward side of each ridge crest.

WIND DIRECTION: Right to left of the photograph.

Reference in text: Page 168.

FIGURE 61

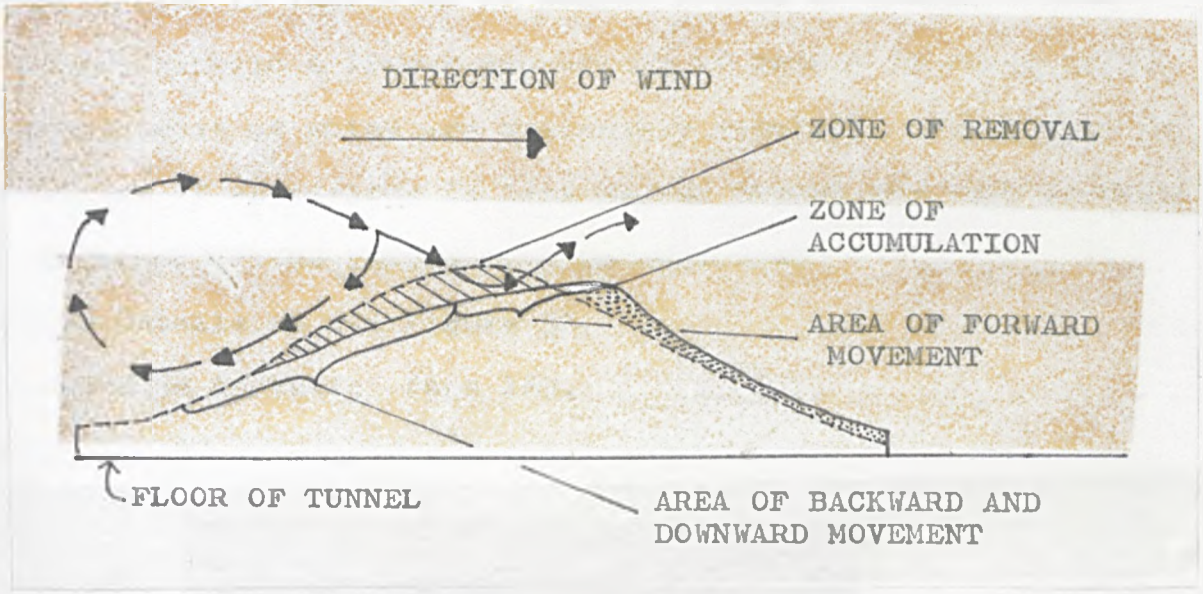


FIGURE 61 CROSS SECTION OF A RIDGE INDICATING ZONES OF SOIL REMOVAL, ACCUMULATION AND DIRECTION OF MOVEMENT WHEN WIND BLOWS AT RIGHT ANGLES TO THE RIDGE.

SOURCE: ARMBRUST ET AL (1964): EFFECTS OF RIDGES ON EROSION OF SOIL BY WIND

Reference in Text Page 168

FIGURE 62

DETAIL OF ERODED RIDGE CRESTS IN MORE SHELTERED PART OF FIELD

Wind at right angles to cultivation lines and direction on photograph is indicated by pencil (right to left). Here crests contain a larger proportion of medium to small aggregates, most of which are noticeably rounded. Deposition in the lee of aggregates is less marked though the same asymmetric infilling of the furrows can be detected.

Site details as for Figure 58.

Reference in text; Page 169.

FIGURE 63

DETAIL OF RIDGE CRESTS AND FURROWS

Wind blowing parallel to direction of cultivation lines in field adjacent to Figure 58 (site details the same). In this situation both ridge crest and furrows are deflated and abra ded by wind action. In this example very little remains of the ridge crest which tends to be emphasised more by the development of trails of sand in the lee of aggregates and stones. The material in the furrows tends to be swept up the sides of former ridges leaving a chevron like pattern (pointing up wind). The furrow surface is covered with coarse sand and small fragments of grit. Any larger fragments or aggregates have lee-side trails of sand which run obliquely towards the limbs of the ridges.

Wind direction from right to left on picture.

Reference in text: Page 169.

FIGURE 64

RIPPLES IN WIND BLOWN SOIL

Miniature lines developing behind turf residue, down wind of severely deflated field surface.

Field surface prepared for spring barley and here the pattern of micro-ridge and furrows is obliterated by drifted sand.

Site details as for Figures 65 and 66. (Pages 59, 60)

Wind direction from right to left.

Reference in text: Page 169.

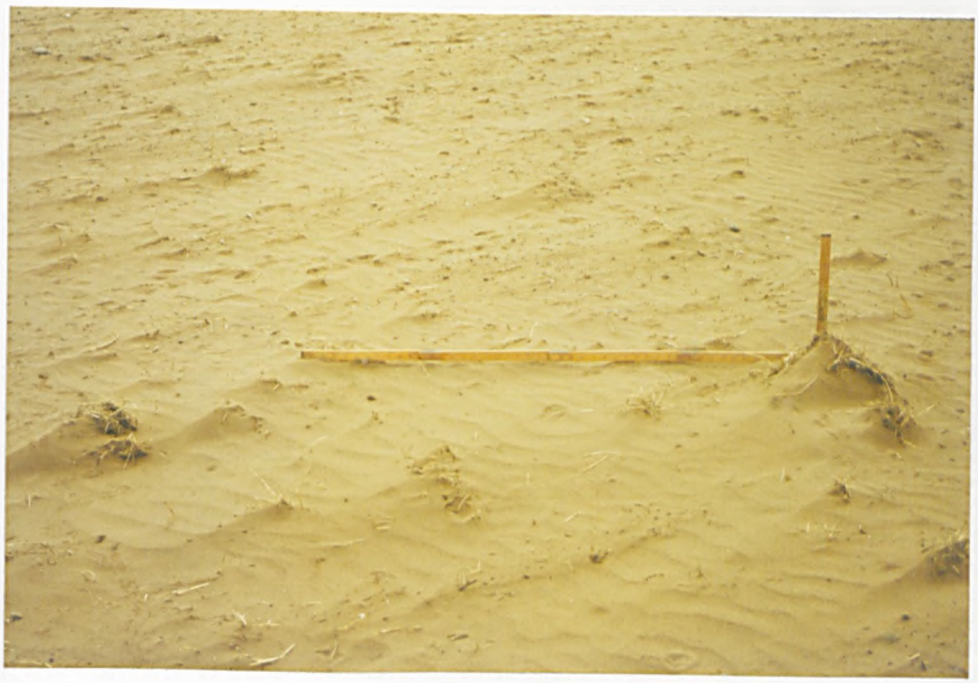


FIGURE 65

SURFACE CREEP AND SALTATION AFFECTING LARGE EXPOSED FIELDS

Strong to gale force north to north west winds produced turbulent conditions which adversely affected many exposed field surfaces after a prolonged dry spell (absolute drought of 20 days 14 February to 4 March 1968). Wind speed increased locally with gusts of over 40 kts where ridges and steep sided valleys caused wind funnelling. In this example the largest field of 12 hectares had been enlarged from three former fields and this produced a much greater wind fetch causing extensive erosion over three-quarters of the area during this blow. The degree of exposure and the limited surface roughness over much of the field caused widespread soil movement down wind, a large proportion of which was deposited against the hedgerow (see Figure 66 Page 60).

LITHOLOGY: Sandy drift over Triassic Sandstone.

SOIL TYPE: Loamy sand.

SOIL SERIES: Newport and Bridgnorth (sandy phase).

SOIL STRUCTURE: Weak crumb to single grain.

SOIL ORGANIC MATTER: 1.7%.

SLOPE: 2 - 3°.

ASPECT: Variable, for main slope East.

ELEVATION: 53 m.

WIND DIRECTION: North west.

WINDSPEED: (Mean 28 kts/hr gusting to 42 kts).

CROP: Spring barley (not emerged).

DATE: 6.3.1968.

LOCATION: Parish of Quatford SO 752 904.

Reference in text: Page 173.

FIGURE 66

DRIFTED SOIL AGAINST HEDGEROW

A tall hedgerow with a large number of trees acts as a major wind break here and causes a rapid build-up of fine to medium sand. The depth of deposited material was 30 cm in a zone 2 - 3 metres wide extending from the hedge and decreasing up wind. Wind direction from right to left.

Site details as for Figure 65 (Page 59)

Reference in text: Page 173.

FIGURE 67

UNCONFINED GULLY EROSION ON BROWN CLEE HILL, SOUTH SHROPSHIRE

Large unconfined gullies affecting bracken clad slopes (304-457 m) on the south summit of Brown Clee Hill in soils of the Liberty complex which comprise Liberty, Eardiston, Bromyard and Woodlands series (Mackney and Burnham 1966). This is unenclosed land and the large flocks of sheep which graze these slopes have tended to increase the risk of run-off and erosion in this area. There is some evidence to suggest that during the Napoleonic Wars hill farming in this area reached its peak of development and improvement. Since then overstocking has led to a steady decline in pastures and increased erosion. In recent years there has been renewed effort to improve the quality of hill grazings by reseeding but there remains the threat of continued erosion through overstocking.

Reference in text: Page 184.

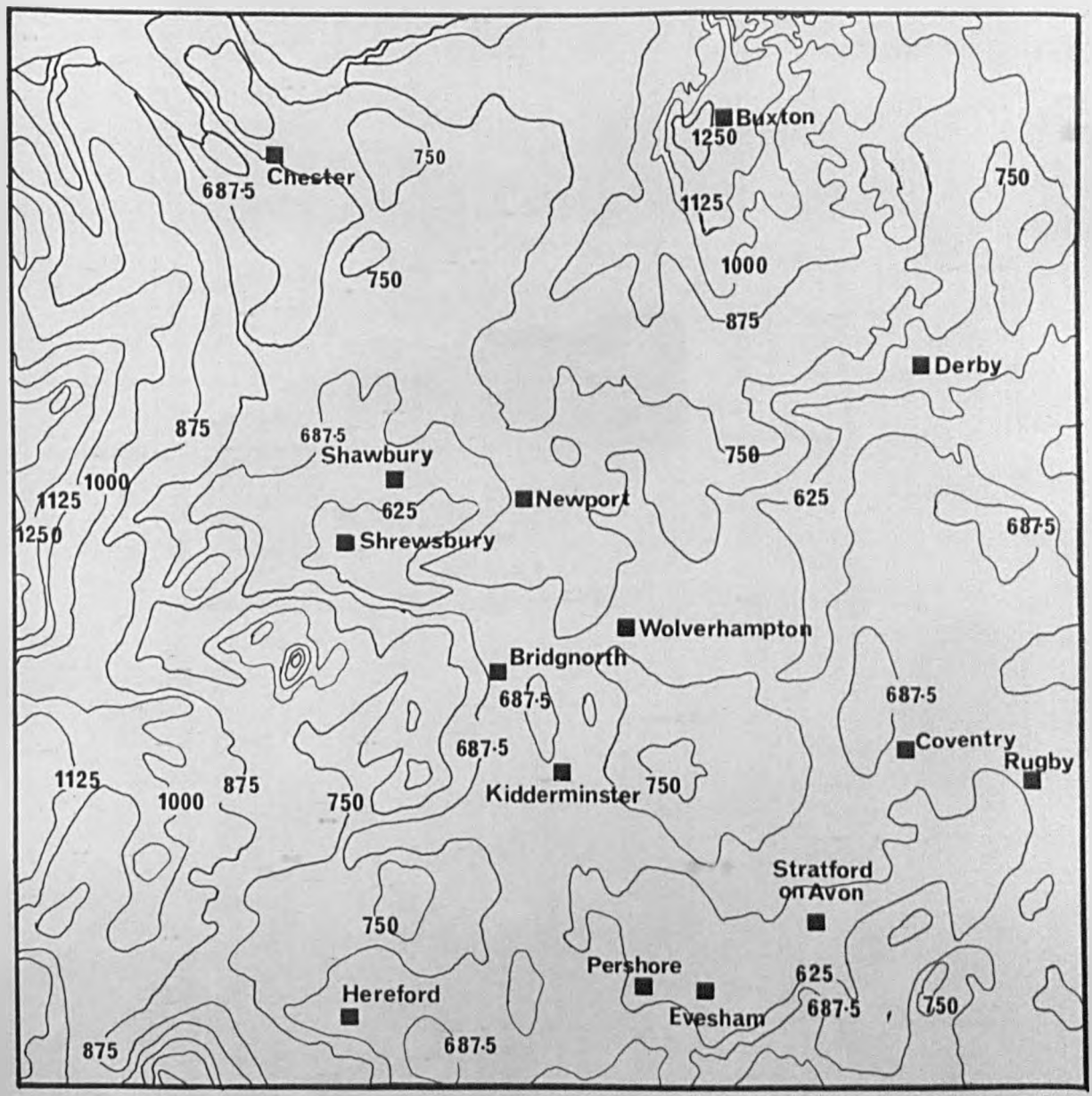


Figure 69 Rainfall: West Midlands

FIGURE 70

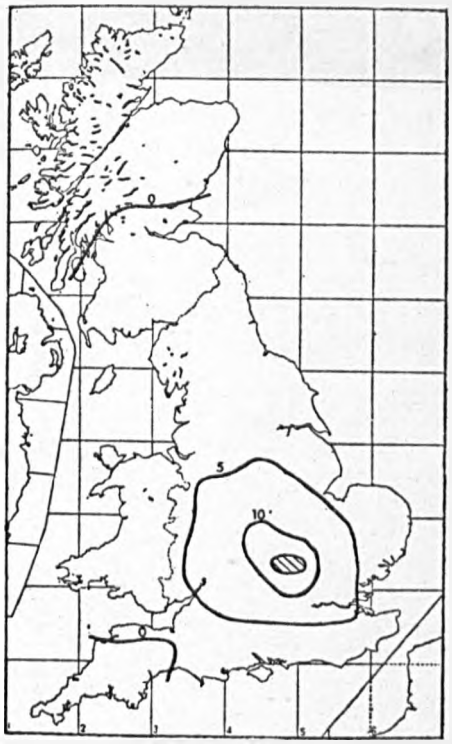


Fig. 1. May

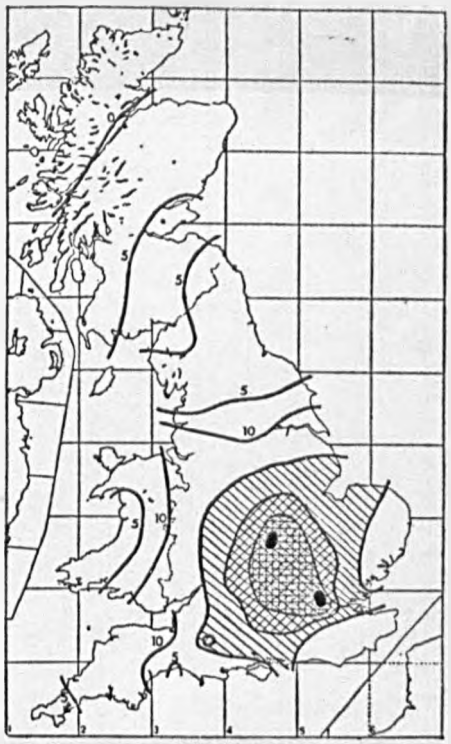


Fig. 2. June

Total number of days of severe or widespread thunderstorms in 20 years (1930 to 39 and 1948 to 57). Isopleths at 5-day intervals, ■ > 30 days

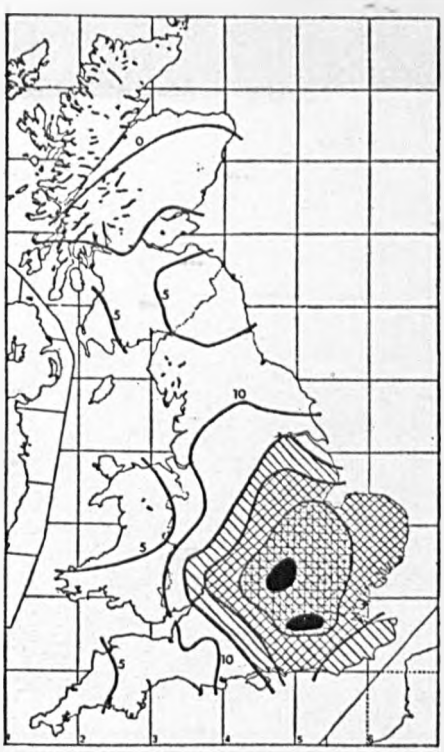


Fig. 3. July

Fig. 4. August

Total number of days of severe or widespread thunderstorms in 20 years (1930 to 39 and 1948 to 57). Isopleths at 5-day intervals, ■ > 30 days

SOURCE: Crossley A.f.,Lofthouse N. (1964).

Reference in text: Page 207

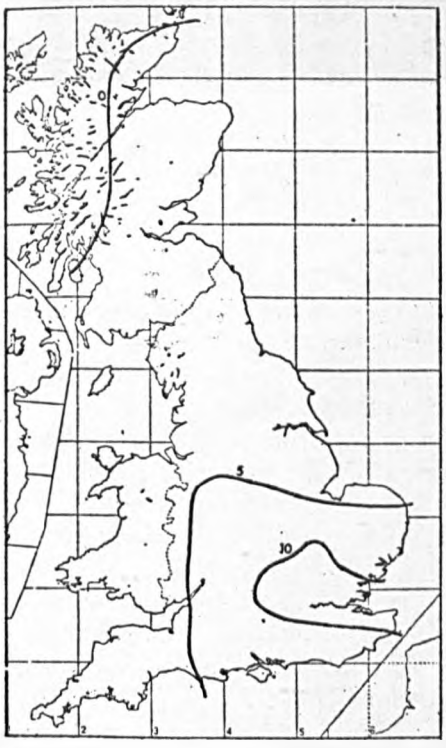


Fig. 5. September. Total number of days of severe or widespread thunderstorms in 20 years (1930 to 39 and 1948 to 57)

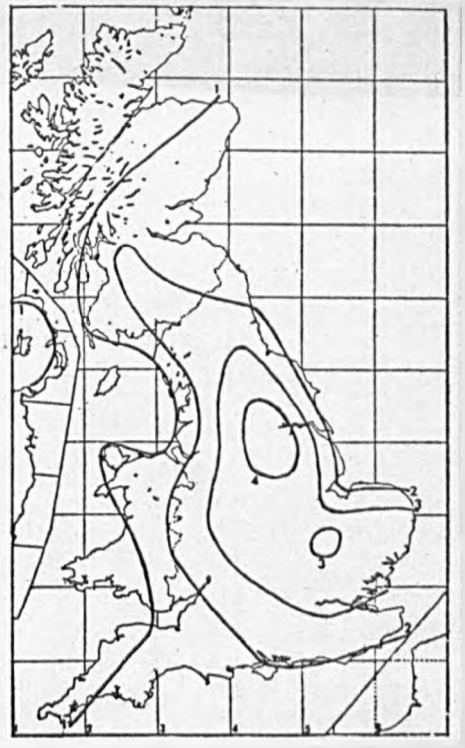
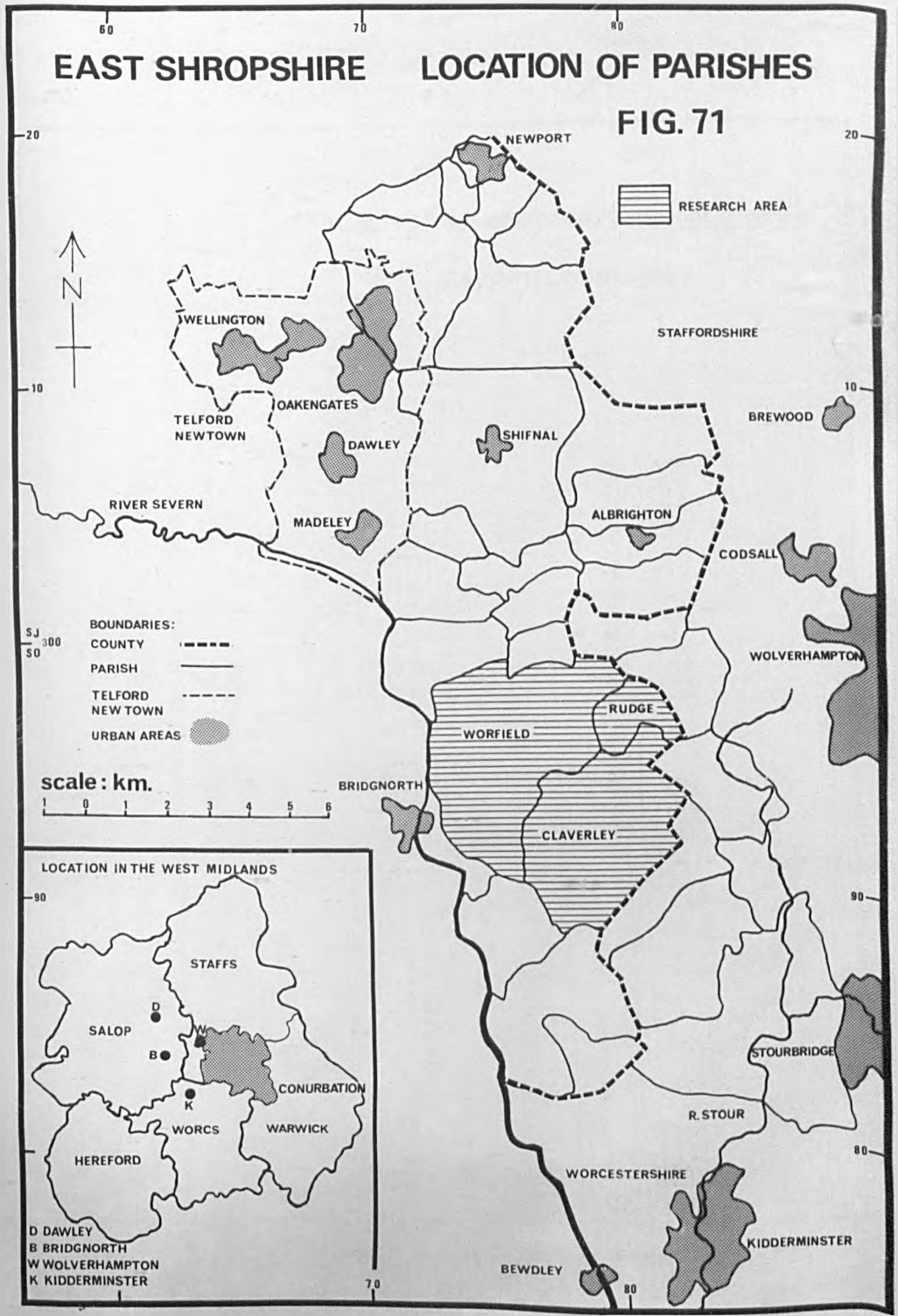
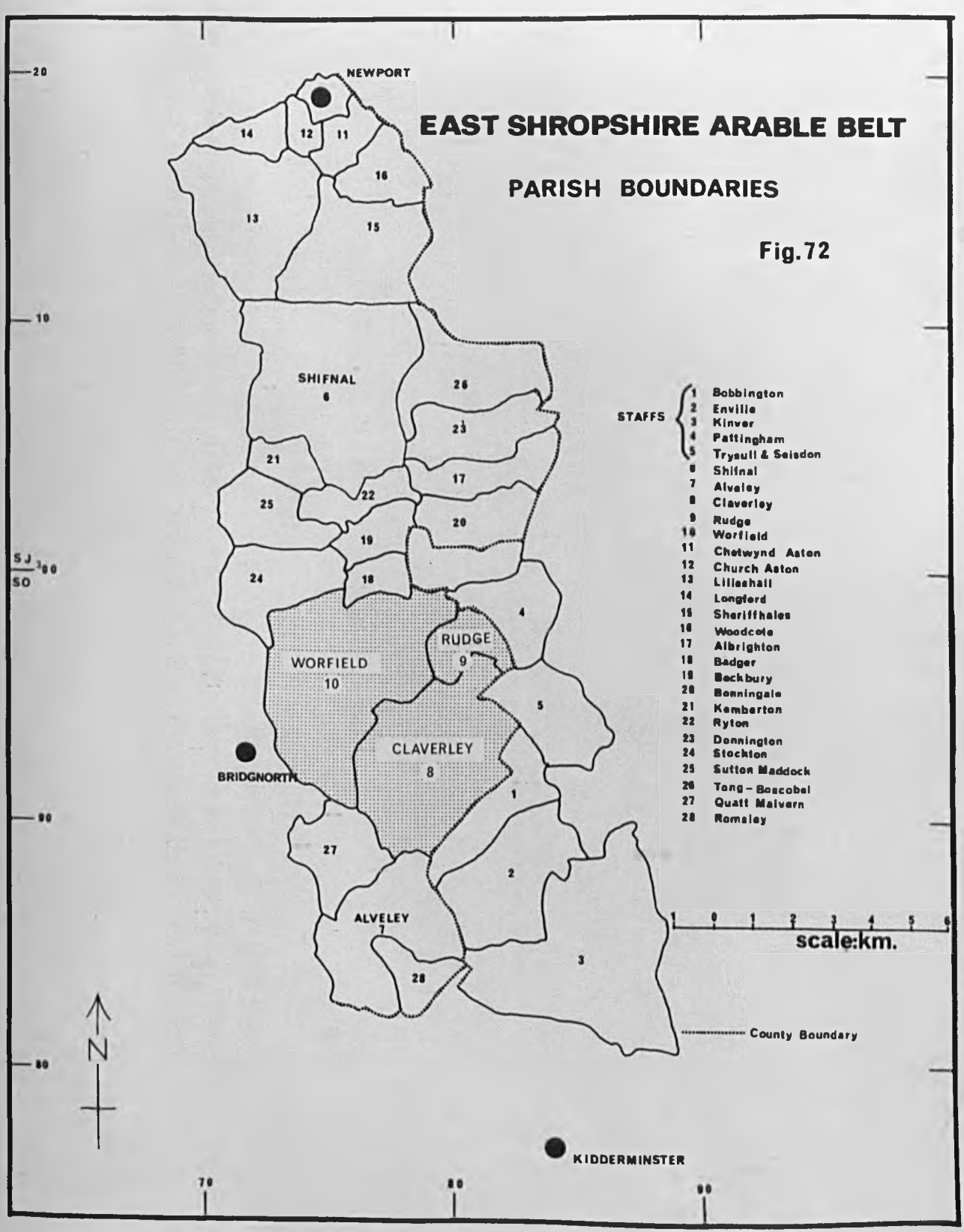


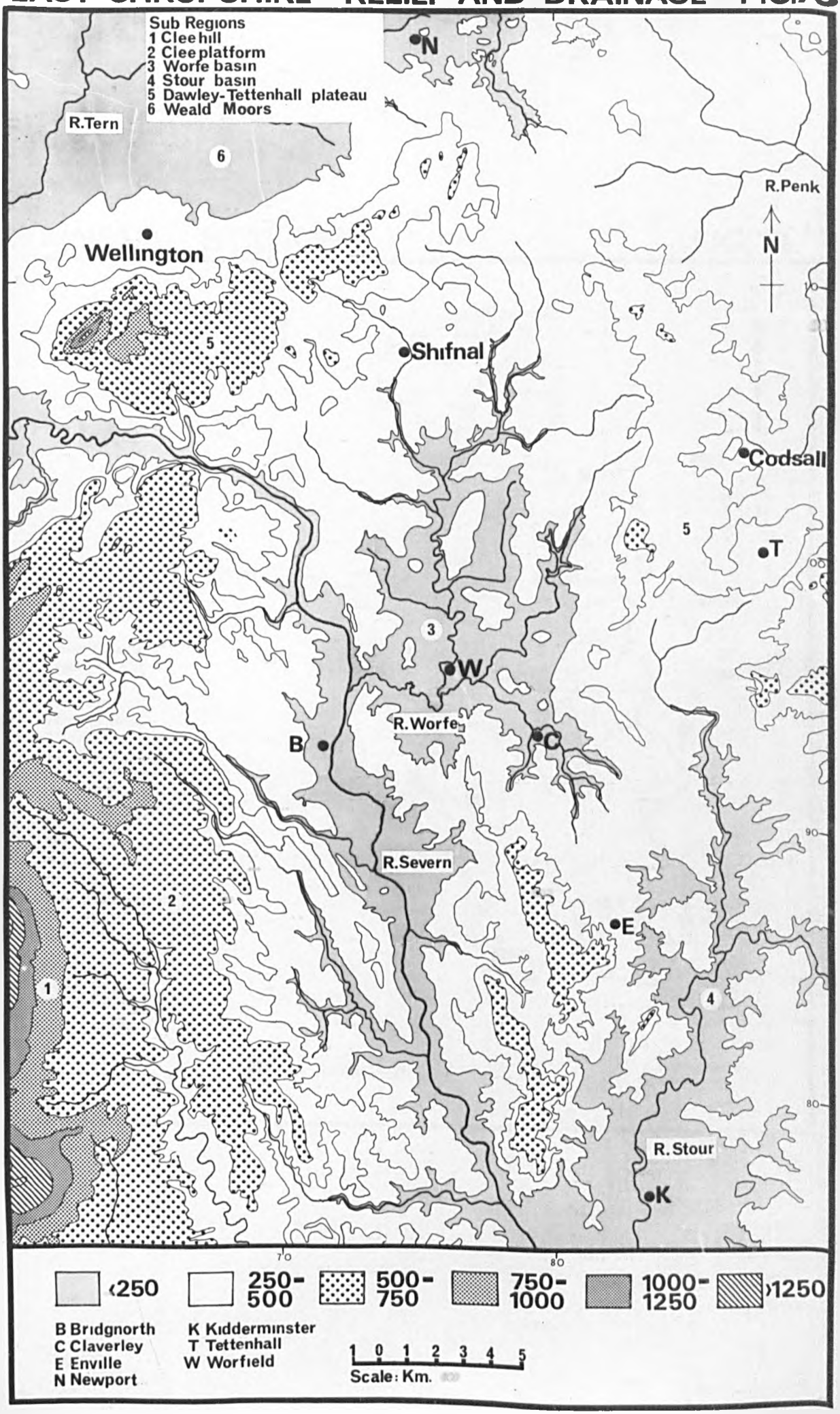
Fig. 6. July. Average number of days of thunder per year in 20 years (1930 to 39 and 1948 to 57)

Reference in text: Page 207


EAST SHROPSHIRE LOCATION OF PARISHES
FIG. 71
RESEARCH AREA
NEWPORT
WELLINGTON
STAFFORDSHIRE
OAKENGATES
TELFORD
NEWTOWN
DAWLEY
SHIFNAL
BREWOOD
RIVER SEVERN
MADELEY
ALBRIGHTON
CODSALL
WOLVERHAMPTON
BOUNDARIES:
COUNTY
PARISH
TELFORD NEW TOWN
URBAN AREAS
SJ
SO
300
RUDGE
WORFIELD
BRIDGNORTH
CLAVERLEY
scale : km.
1 0 1 2 3 4 5 6
LOCATION IN THE WEST MIDLANDS
STAFFS
SALOP
D
W
B
K
CONURBATION
WORCS
WARWICK
HEREFORD
D DAWLEY
B BRIDGNORTH
W WOLVERHAMPTON
K KIDDERMINSTER
STOURBRIDGE
R. STOUR
WORCESTERSHIRE
KIDDERMINSTER
BEWDLEY
60
70
80
20
10
90


EAST SHROPSHIRE ARABLE BELT
PARISH BOUNDARIES
Fig.72
NEWPORT
SHIFNAL
6
WORFIELD
10
RUDGE
9
CLAVERLEY
8
ALVELEY
7
BRIDGNORTH
KIDDERMINSTER
STAFFS
1 Bobbington
2 Enville
3 Kinver
4 Pattingham
5 Trysull & Seisdon
6 Shifnal
7 Alveley
8 Claverley
9 Rudge
10 Worfield
11 Chetwynd Aston
12 Church Aston
13 Lilleshall
14 Longford
15 Sheriffhales
16 Woodcote
17 Albrighton
18 Badger
19 Beckbury
20 Bonningale
21 Kemberton
22 Ryton
23 Donnington
24 Stockton
25 Sutton Maddock
26 Tong - Boscobel
27 Quatt Malvern
28 Romsley
scale:km.
County Boundary
N
SJ
SO

EAST SHROPSHIRE RELIEF AND DRAINAGE FIG.73



RAINFALL STATIONS

FIG. 74

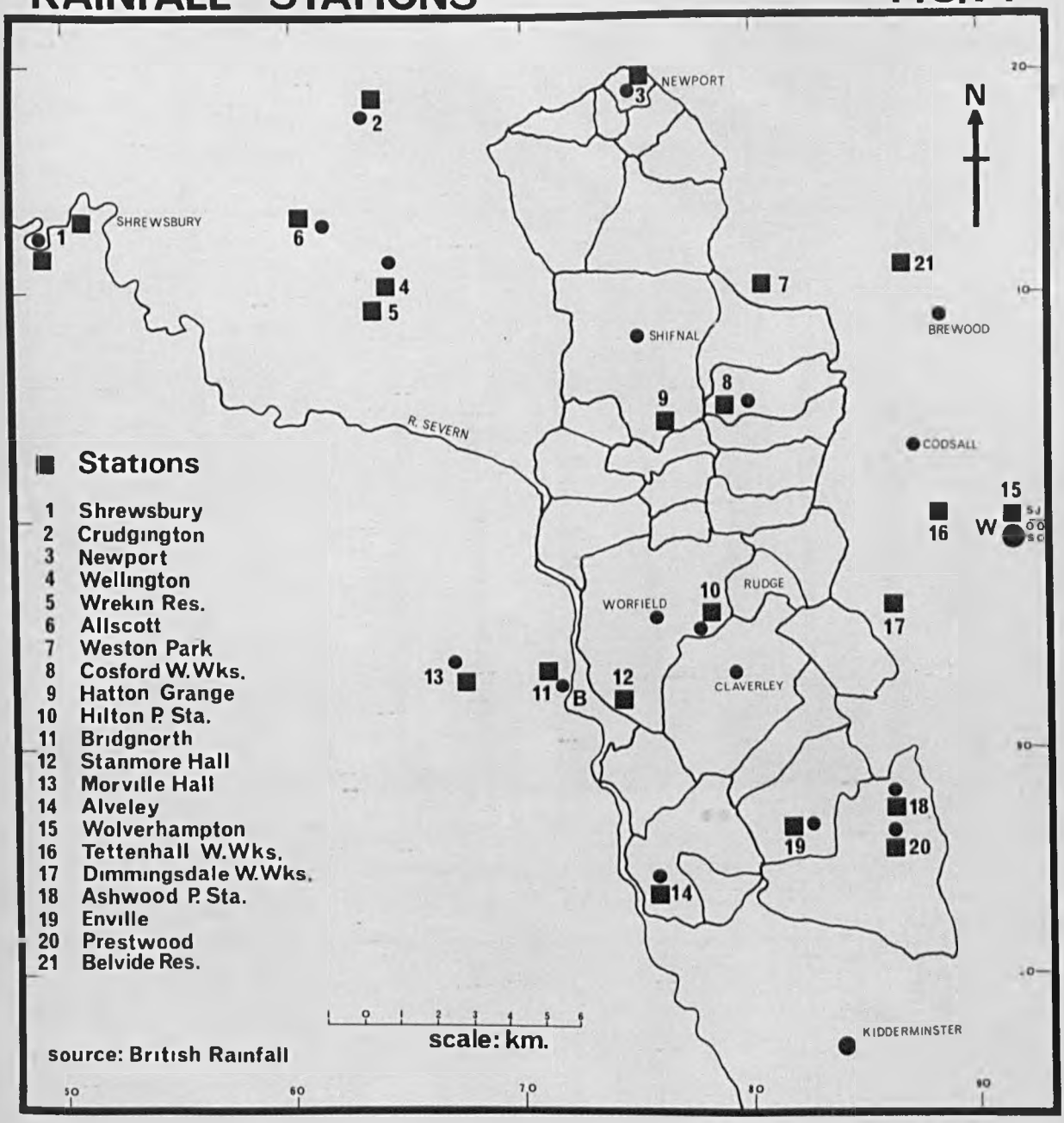


Figure 75

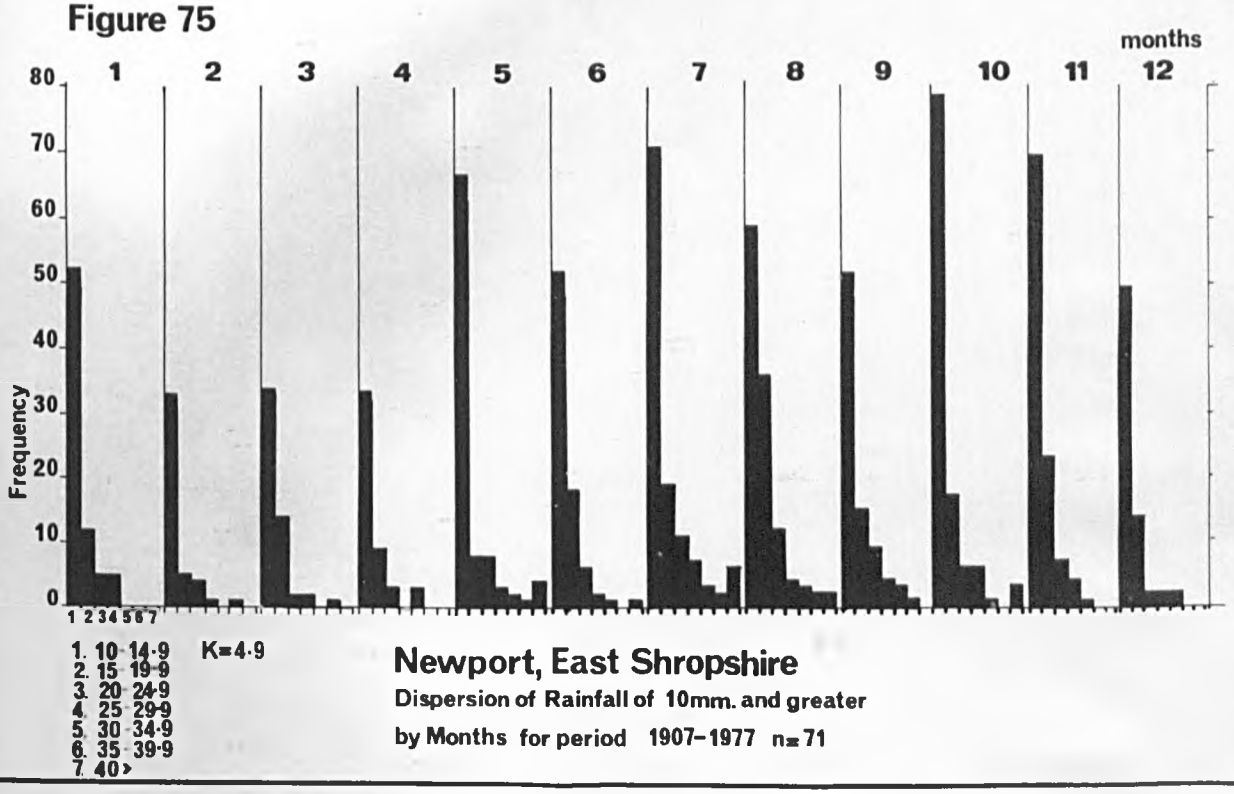

months
1 2 3 4 5 6 7 8 9 10 11 12
80
70
60
50
40
30
20
10
0
Frequency
1 2 3 4 5 6 7
1. 10-14·9
2. 15-19·9
3. 20-24·9
4. 25-29·9
5. 30-34·9
6. 35-39·9
7. 40>
K=4·9
Newport, East Shropshire
Dispersion of Rainfall of 10mm. and greater
by Months for period 1907-1977 n=71

Figure 76

Agricultural Land Classification Key

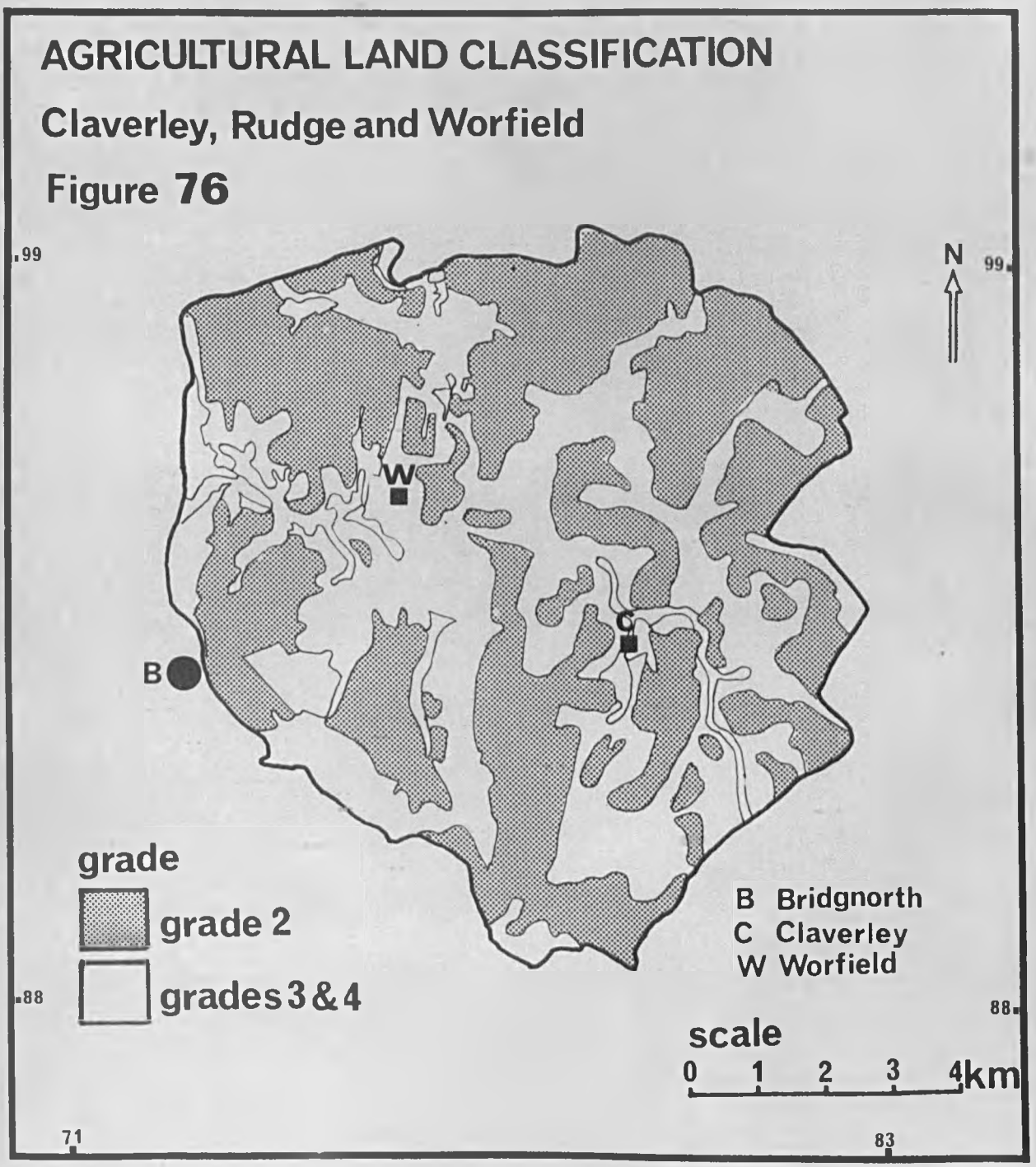
Of the five Land Classification grades only three are recognised in this part of the Sheet.

Grade 2 Land with some minor limitations which exclude it from Grade 1.
Soil limitations: texture, depth or drainage.
Site restrictions: exposure or slope.

Grade 3 Land with moderate limitations due to soil, relief, climate or some combination of these factors which restricts the choice of crops, timing of cultivations or level of yield. Soil defects may be of structure, texture, drainage, depth, stoniness or water holding capacity.

Grade 4 Land with severe limitations due to adverse soil, relief or climate or a combination of these. Adverse soil characteristics include unsuitable texture and structure, wetness, shallow depth, stoniness or low water-holding capacity. Relief and climatic restrictions may include steep slope, short growing season.

Source: Agricultural Land Classification of England and Wales M.A.A.F. (1967)


AGRICULTURAL LAND CLASSIFICATION
Claverley, Rudge and Worfield
Figure 76
99
N
99
W
C
B
grade
grade 2
grades 3 & 4
B Bridgnorth
C Claverley
W Worfield
88
88
scale
0 1 2 3 4km
71
83

Land Use Capability Classification Key (continued)

Class and Subclass	Map Units	Limitations
3ws/1	Disturbed soils at Halfpenny Green (820910) and New Barn (787955) Hodnet Gatacre Clifton	Seasonal wetness caused by impermeable horizons above 50 cm in the profile. Minor limitation of slight droughtiness.
4w/1	Undifferentiated alluvial soils Undifferentiated organic soils	Seasonal wetness caused by high groundwater and occasional damaging floods.
5g/1	Disturbed soils at Blackhills Plantation(838920) Steep phases	Steep slopes preclude normal cultivations

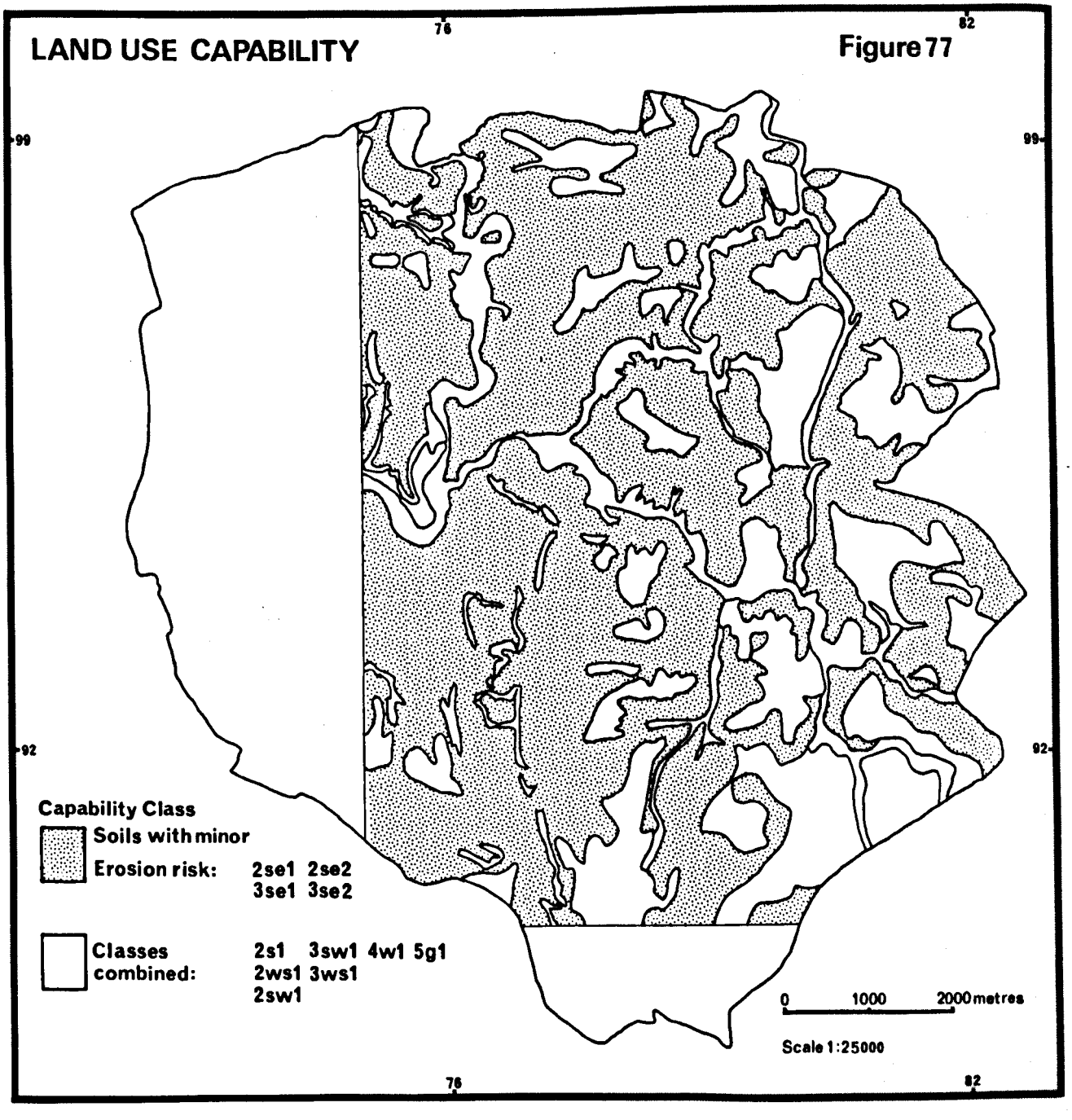
Source: Hollis: Soils in Salop 1 Page 156

Land Use Capability Classification Key

Class and Subclass	Map Units	Limitations
2se/1	Wick Arrow	Very slightly droughty with a minor risk of erosion.
2s/1	Salwick (deep sandy loam phase)	Slightly droughty.
2ws/1	Quorndon Blackwood	Seasonal wetness caused by fluctuating groundwater. Minor risk of topsoil slaking and capping.
2se/2	Bromsgrove Newport (loamy phase) Newport (sandy phase) Ollerton Rudge Ebstree	Slightly droughty with a minor risk of erosion and/ or capping of the topsoil.
2sw/1	Dunnington Heath Clifton (deep sandy loam phase) Salwick	Slightly droughty with slight seasonal wetness caused by impermeable horizons below 50 cm depth in the profile.
3se/1	Shifnal Bromsgrove (shallow phase) Bridgnorth Bridgnorth (shallow phase) Crannymoor Delamere	Moderately droughty with a minor risk of erosion and/ or surface capping.
3se/2	Disturbed soils at Trysull (847940) and Seisdon Common (828937) Newport (stony phase) Newport (stony loamy phase) Bromsgrove (stony phase) Bridgnorth (stony phase)	Slightly to moderately droughty, with moderately stony topsoils. Minor risk of erosion and/or surface capping.
3sw/1	Lilleshall	Moderately droughty with slight seasonal wetness caused by an impermeable subsoil.

Source: Hollis: Soils in Salop 1 Page 155

70. (1). continued.


LAND USE CAPABILITY
Figure 77
76
82
99
92
Capability Class
Soils with minor
Erosion risk:
2se1 2se2
3se1 3se2
Classes
combined:
2s1 3sw1 4w1 5g1
2ws1 3ws1
2sw1
0 1000 2000 metres
Scale 1:25000

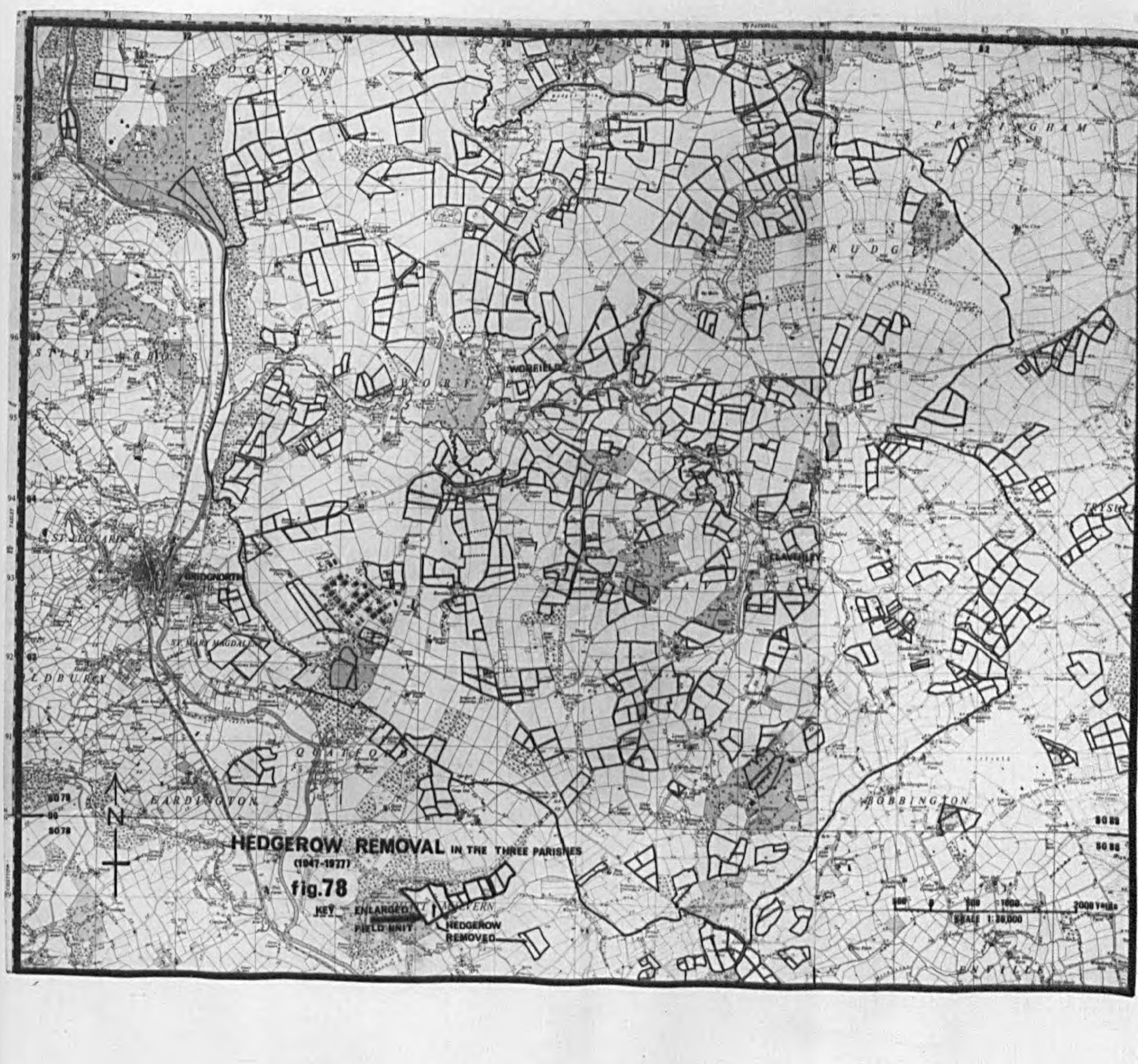

HEDGEROW REMOVAL IN THE THREE PARISHES
(1947-1977)
fig.78
KEY
ENLARGED FIELD UNIT
HEDGEROW REMOVED
SCALE 1:20,000
WORFIELD
BRIDGNORTH
CLAVERLEY
BOBBINGTON
PATTINGHAM

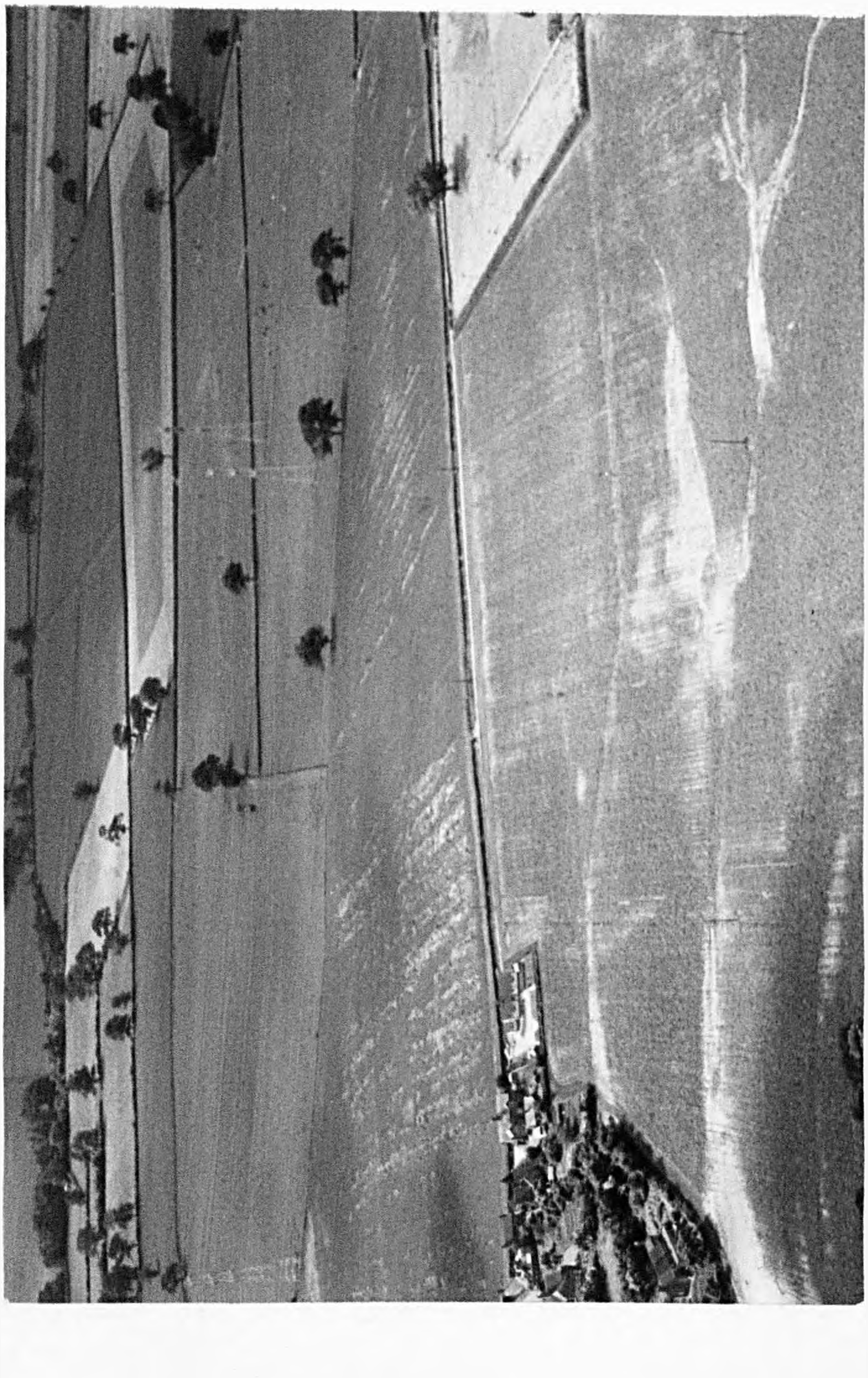
FIGURE 79

VERTICAL AIRPHOTOGRAPH SHOWING GULLY EROSION AND AREAS OF SEDIMENTATION

The large gully system seen on Figure 80 is located at point A Old field boundaries can also be identified. Areas of erosion and sedimentation can be observed at points B and C Here run-off from severely compacted winter barley was channelled along tractor wheelings in the winter barley (complex pattern of old wheelings during seed drilling with marked sinkage and more recent ones associated with crop spraying). This run-off badly eroded potato ridges in adjoining section of field (downslope). Run-off crossed compacted pathway of new sewage line into second field of potatoes. Copious run-off from the large field of winter barley came off main slope 5^{o} into field of sugar beet (point A

For site details see Figure 80 Page

Reference in text: Page 226.



73

FIGURE 80

OBLIQUE AIRPHOTOGRAPH SHOWING GULLY EROSION AND SEDIMENTATION IN SUGAR BEET

This oblique shows clearly the areas affected by erosion and the principal areas of deposition. It also shows the effects of run-off generated within the field which was mainly in the form of unconcentrated surface wash and incipient rill erosion. Most of the damage has been caused by flash flooding and where this has become concentrated, by gully erosion. Spraying operations which postdate this erosion episode can be seen where wheelings cross areas of sediment. This sortie was specially flown by the Royal Air Force Helicopter Training School at Shawbury.

LITHOLOGY: Loamy drift over sandy clay till.

SOIL TYPE: Loam to sandy clay loam.

SOIL SERIES: Cottam/Flint.

SOIL STRUCTURE: Crumb to weak sub-angular blocky.

SOIL ORGANIC MATTER: 4.1%.

SLOPE AND ASPECT: Variable. Maximum 5°. N.W., N. and S.

ELEVATION: 84 m.

RAINFALL: 42 mm in 16.8 hours.

RAINFALL RATE: 2.5 mm/hr - but locally estimated at 7 mm/hr.

CROP: Sugar beet.

DATE: 25.5.1968.

LOCATION: Parish of Sutton Maddock SJ 718 023.

See also Figure 81 (Page 74) for detail of one area of sedimentation.

Reference in text: Page 224.

FIGURE 81

SOIL EROSION DAMAGE BY RUN-OFF AND PONDING

The remains of a large temporary pool of run-off water held up by a raised section of main road which bisects the main axis of this miniature valley feature. Large quantities of silt and fine sand together with clay and organic matter were deposited in this pool. Run-off from the valley sides formed small deltas into the pool. Remarkably little damage was done to the sugar beet plants except where run-off was concentrated. The photograph was taken three days after the storm.

Site details as for Figure 80.

Reference in text: Page 226.

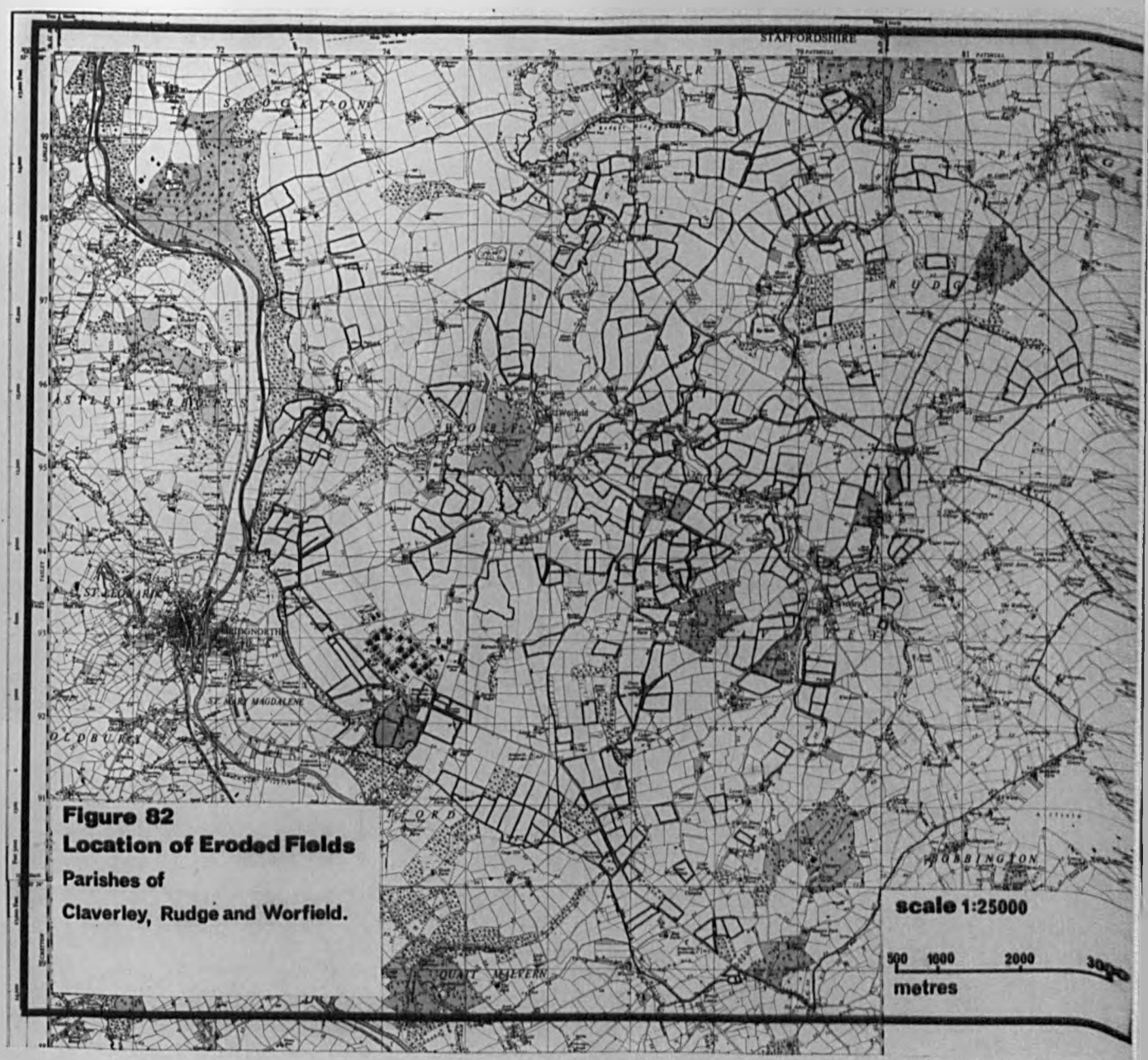
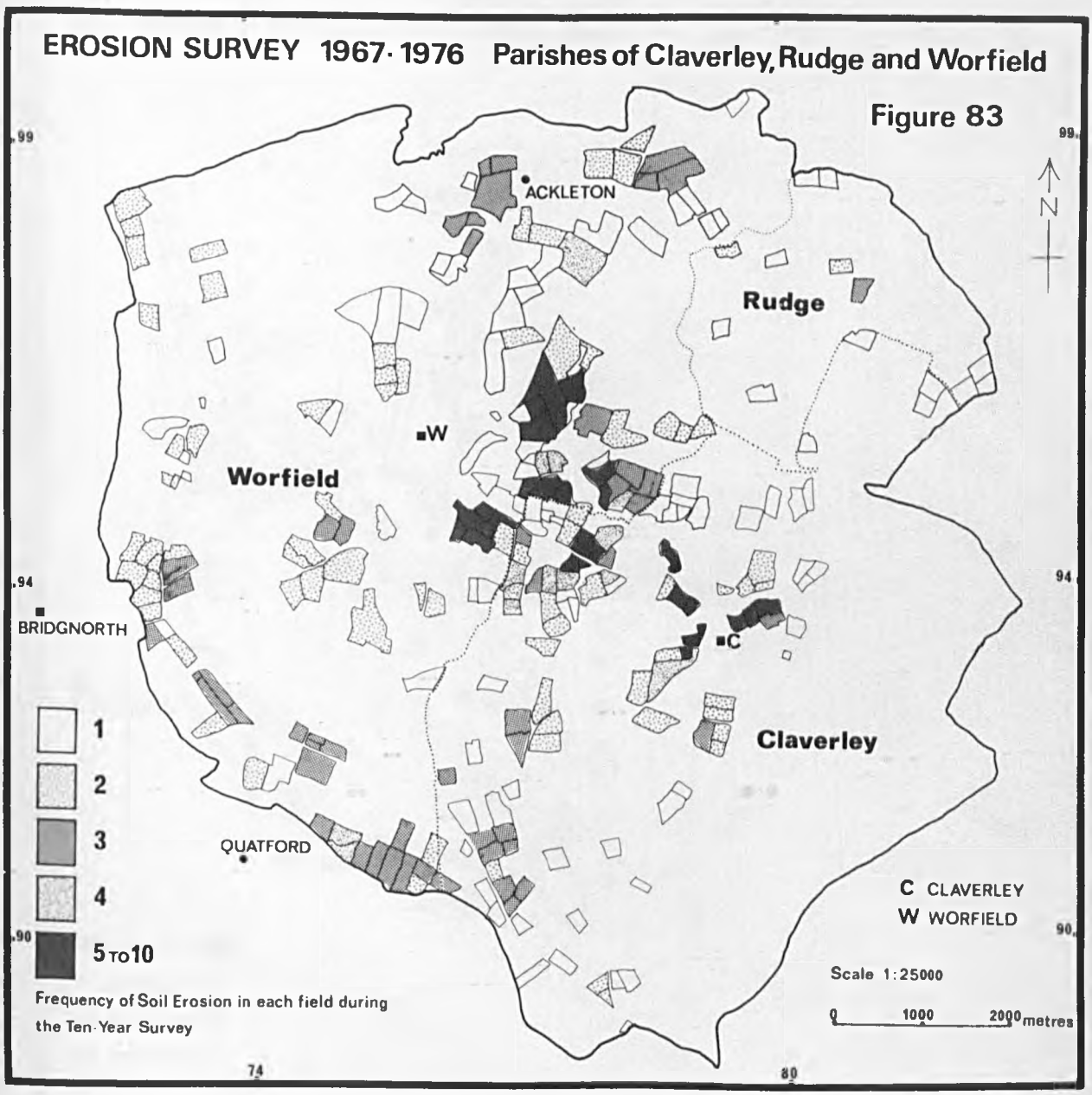


Figure 82
Location of Eroded Fields
Parishes of
Claverley, Rudge and Worfield.


EROSION SURVEY 1967-1976 Parishes of Claverley, Rudge and Worfield
Figure 83
99
99
ACKLETON
N
Rudge
W
Worfield
94
94
BRIDGNORTH
C
1
2
3
4
5 TO 10
Claverley
QUATFORD
C CLAVERLEY
W WORFIELD
90
90
Scale 1:25000
0 1000 2000 metres
Frequency of Soil Erosion in each field during the Ten-Year Survey
74
80

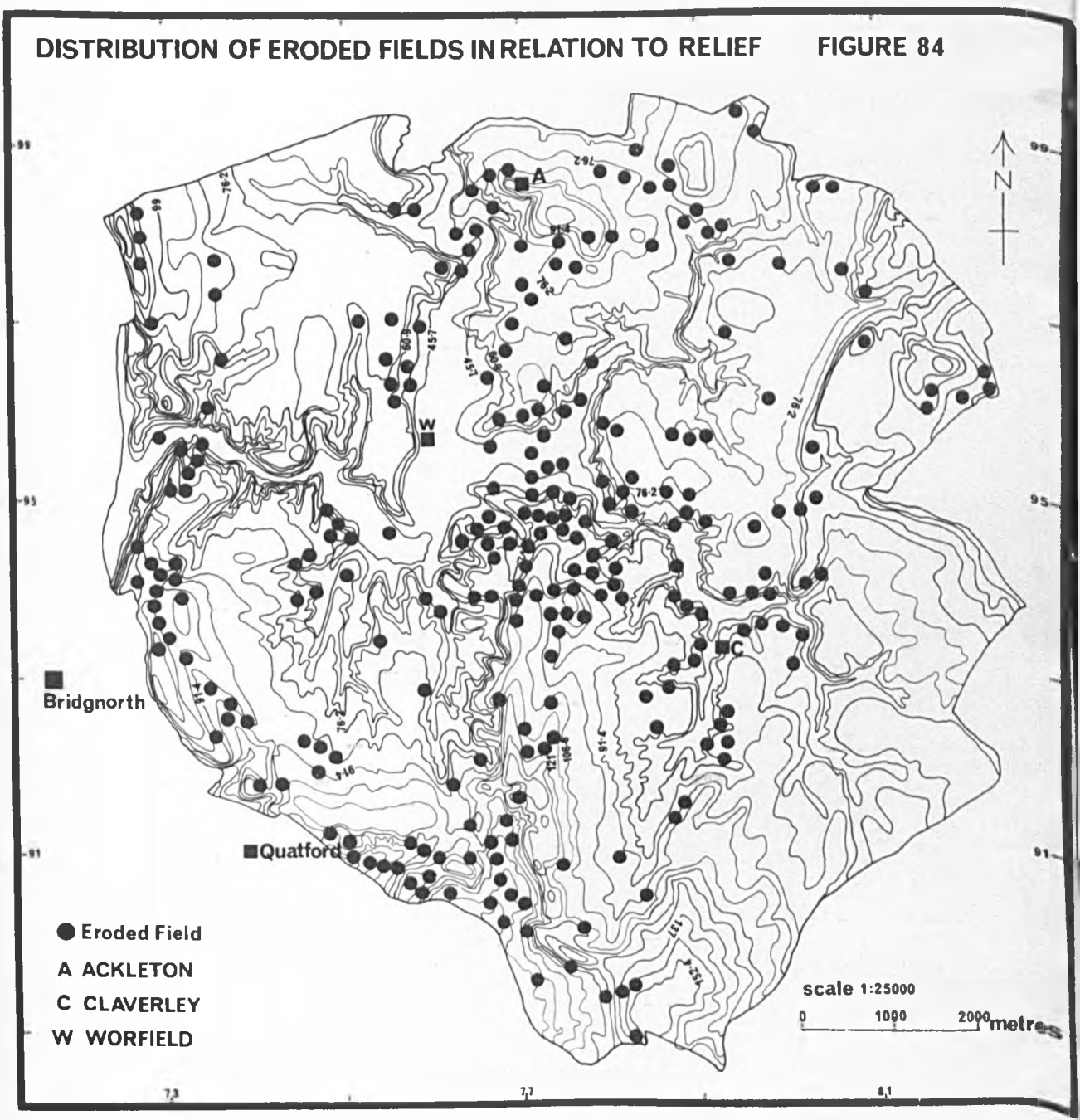
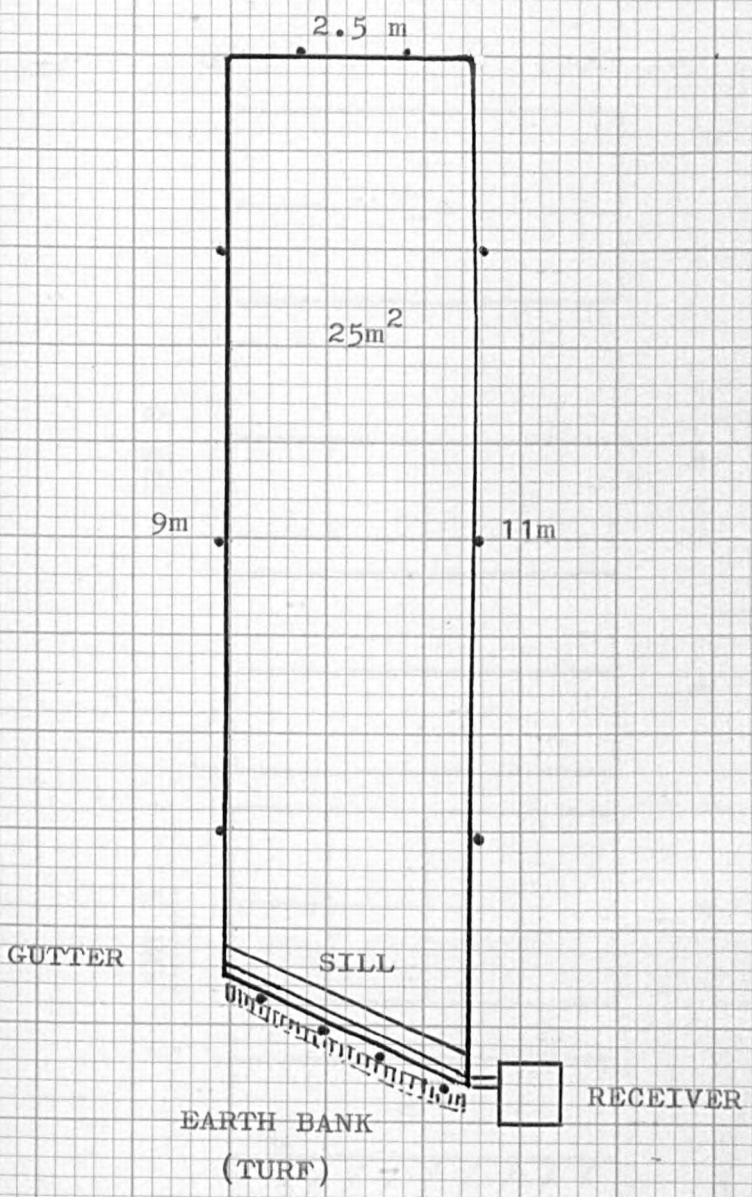

DISTRIBUTION OF ERODED FIELDS IN RELATION TO RELIEF
FIGURE 84
A
W
C
Bridgnorth
Quatford
N
Eroded Field
A ACKLETON
C CLAVERLEY
W WORFIELD
scale 1:25000
0
1000
2000 metres

FIGURE 85.



BLOCK 1

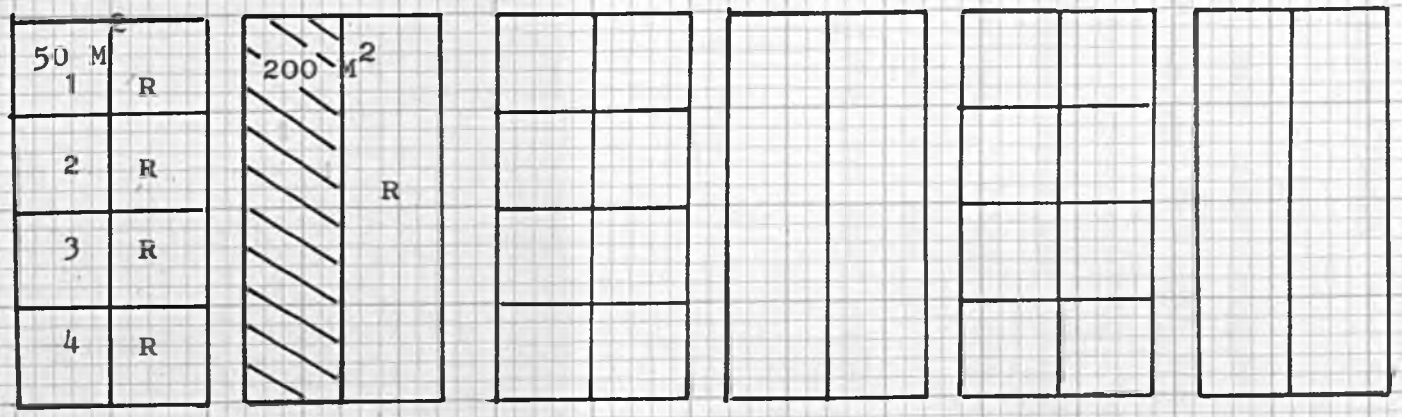
SET A

SET B

SET C

W

E



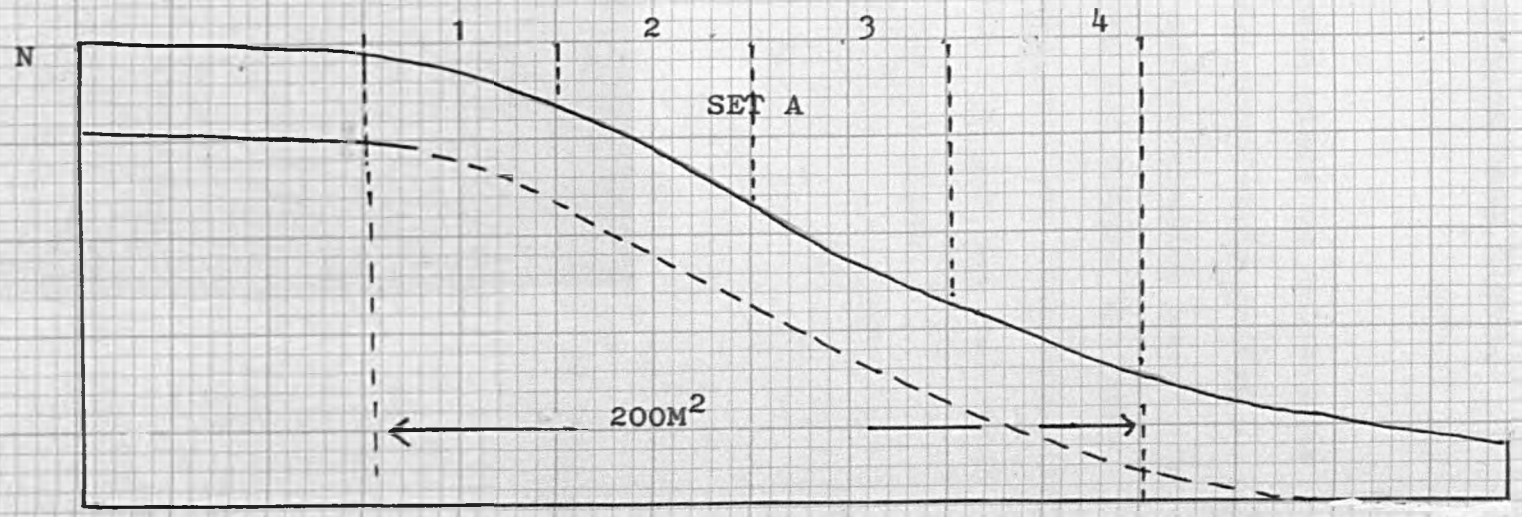


Figure 87

'Badland' topography: Severe active erosion near Nimes, Languedoc, southern France

In this example deep dissection has taken place on calcareous shale and mudstone and the soil has been completely eroded away. There was clear evidence that active erosion was taking place higher up-slope where trees and bushes had been recently undermined. Large fans of sediment had been deposited in an adjacent vineyard and concentrated run-off had excavated small gullies along the main slope of the vineyard.

Reference in text Page 290.

Figure 88

Confined rill erosion in vineyard near Sommieres, Languedoc, southern France

Confined rill erosion in tractor wheelings after short-lived thunderstorm (yield unknown). Erosion in the vineyard from previous storms was extensive and was predominantly of the unconfined rill and incipient gully type.

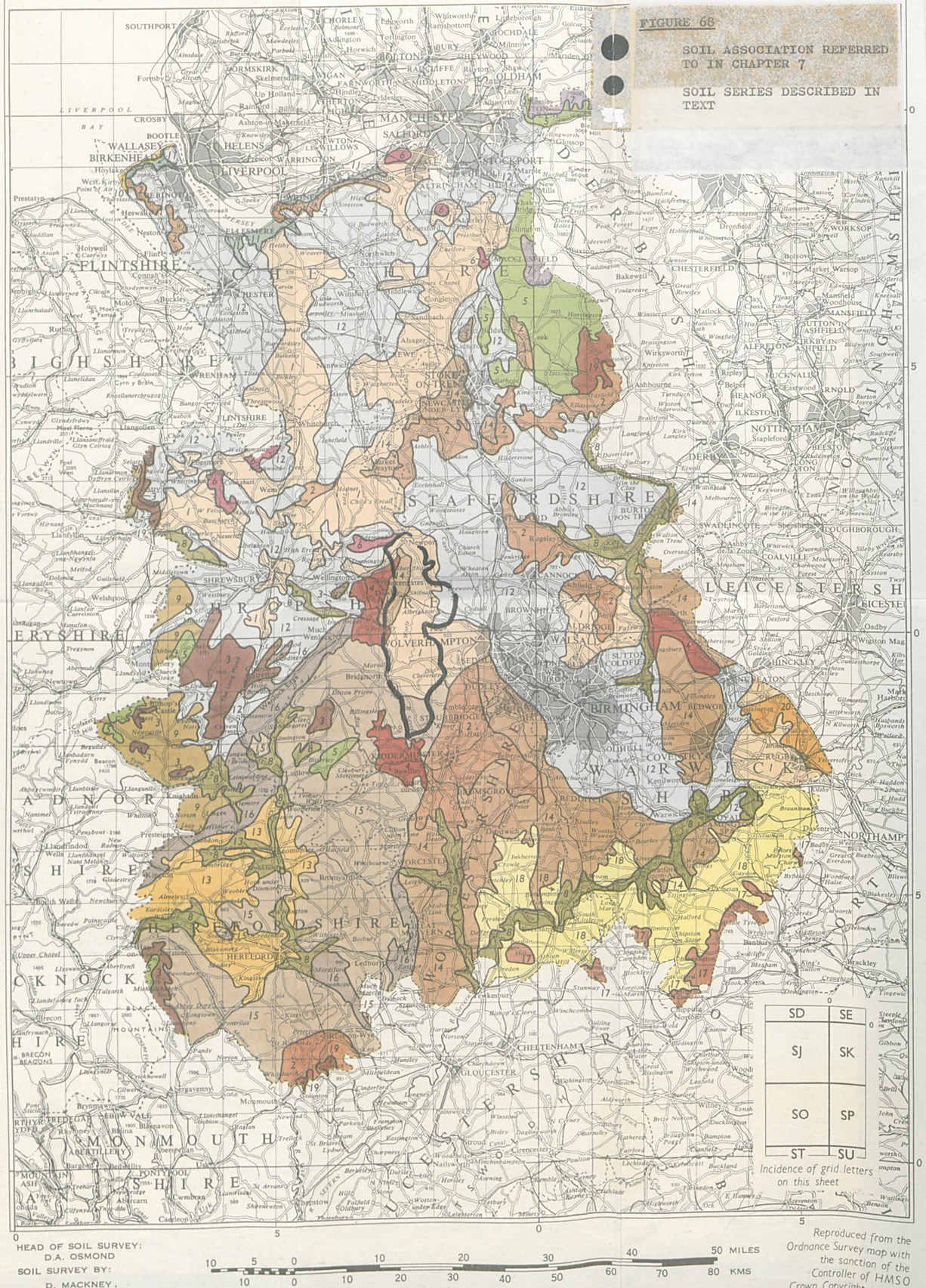
Slope approximately: 6^{o}.

Soil type: Brown calcimorphic, moderately stony and shallow < 35 cm.

Reference in text: 290.

SOIL SURVEY OF ENGLAND AND WALES

SOIL ASSOCIATIONS OF THE WEST MIDLANDS



HEAD OF SOIL SURVEY:
D.A. OSMOND

SOIL SURVEY BY:
D. MACKNEY,
P. BURNHAM, 1963

10 5 0 10 20 30 40 50 MILES
10 0 10 20 30 40 50 60 70 80 KMS

EXPLANATION OF MAPPING UNITS

BASE CONTENT OF PARENT MATERIAL	RELIEF	GEOLOGY		SOIL ASSOCIATIONS: MAJOR SOIL GROUPS AND SUB-GROUPS	TYPICAL SOIL SERIES OR COMPLEXES	SOIL PROPERTIES: NATURAL DRAINAGE	SOIL PROPERTIES: TEXTURE
LOW	Gently undulating or hummocky; mostly below 400 feet	Glacial sands and gravels derived from Triassic rocks; in West Salop from Palaeozoic rocks; in East Warwickshire from Jurassic and Cretaceous rocks; boulder clay subordinate	1	ACID BROWN SOILS	NEWPORT	Free	Loamy sand
				PODZOLS	CRANNYMOOR	Excessive	Sand
				GLEY PODZOLS	NONE NAMED	Imperfect	
				SURFACE-WATER GLEY SOILS	WEM	Poor	Sandy loam over clay
	Hills and ridges; mostly 300-600 feet	Trias and Devonian sandstones	2	ACID BROWN SOILS	BRIDGNORTH, ROSS	Free	Loamy sand
				PODZOLS AND PODZOLIZED ACID BROWN SOILS	CRANNYMOOR	Excessive	Sand
	Plateaux and Scarps; mostly over 800 feet	Pre-Cambrian and Palaeozoic sandstones, hard siltstones and igneous rocks	3	ACID BROWN SOILS	BATCH COMPLEX	Free	Loam or silt loam
				PODZOLIZED ACID BROWN SOILS	PORTWAY COMPLEX	Free	Sandy loam
				PEATY GLEYED PODZOLS		Imperfect	Loam
	Plateaux and valleys; 300-600 feet	Coal Measures sandstones and shales	4	ACID BROWN SOILS	NONE NAMED	Free	Sandy loam
				SURFACE-WATER GLEY SOILS		Poor	Sandy loam over clay
	Plateaux and valleys; mostly over 800 feet	Carboniferous and Lower Palaeozoic shales and local drifts	5	SURFACE-WATER GLEY SOILS	NONE NAMED	Poor and very poor	Clay
				SURFACE-WATER PEATY GLEY SOILS			Peat over clay
				PEATY GLEYED PODZOLS		Imperfect	Clay loam
	Depressions; below 400 feet	Recent peat	6	PEAT SOILS { RAISED MOSS, FEN PEAT	NONE NAMED	Very poor	Peat
				PEATY SOILS { PEATY LOAM			Peaty loam
	Plateaux tops; mostly over 1200 feet	Recent peat	7	PEAT SOILS (BLANKET BOG)	NONE NAMED	Very poor	Peat
				SURFACE-WATER PEATY GLEY SOILS			Peat over clay
MEDIUM	Flood plains and low terraces; below 400 feet	Recent alluvium	8	ACID BROWN SOILS	WICK	Free	Loamy sand
				GROUND-WATER GLEY SOILS	FLADBURY, CONWAY	Poor	Silty clay or clay
				BROWN WARP SOILS	WYRE	Free	
	Plateaux and valleys; 600-1400 feet	Silurian shales	9	ACID BROWN SOILS	MUNSLOW	Free	Silt loam
	Coastal dunes; below 50 feet	Recent blown sand	10	REGOSOLS	DUNE SAND	Excessive	Sand
				GROUND-WATER GLEY SOILS	LINKS SAND	Poor	
	Estuarine and coastal flats; below 50 feet	Recent alluvium (sometimes with peat bands)	11	GROUND-WATER GLEY SOILS	NONE NAMED	Poor	Clay
				BROWN WARP SOILS		Free or imperfect	Fine sandy loam
HIGH (Often slightly calcareous)	Gently undulating; mostly below 500 feet	Reddish brown or brown till derived from Triassic rocks; in West Salop from Palaeozoic rocks; sands and gravels subordinate	12	SURFACE-WATER GLEY SOILS	SALOP	Poor	Loam over clay
				LEACHED BROWN SOILS WITH GLEYING	COTTAM	Imperfect	
				ACID BROWN SOILS	NEWPORT	Free	Loamy sand
	Gently undulating; below 500 feet	Reddish brown till; mainly derived from Devonian rocks, with some Lower Palaeozoic material	13	LEACHED BROWN SOILS SOMETIMES WITH GLEYING	WOOTTON	Free and imperfect	Loam or silt loam over silty clay loam
	Plateaux and valleys; 100-700 feet	Upper Coal Measures and Keuper marl with sandstone bands and locally, thin drift	14	LEACHED BROWN SOILS SOMETIMES WITH GLEYING	WORCESTER, LILLESHALL	Free and imperfect	Silt loam over silty clay
				ACID BROWN SOILS SOMETIMES WITH SUBSOIL GLEYING	SHIFNAL	Free	Sandy loam
					DUNNINGTON HEATH	Free and imperfect	Sandy loam over silty clay
	Plateaux and valleys; mostly 200-800 feet	Devonian marl with fine grained sandstone bands and, very locally, thin drift	15	LEACHED BROWN SOILS SOMETIMES WITH GLEYING	BROMYARD	Free	Silt loam over silty clay loam
					MIDDLETON	Imperfect	
				ACID BROWN SOILS	EARDISTON	Free	Fine sandy loam
	Scarp and vale; 400-1000 feet	Silurian siltstones, limestones and shales	16	ACID BROWN SOILS	MUNSLOW	Free	Silt loam
				LEACHED BROWN SOILS OFTEN WITH GLEYING	WILDERHOPE, YELD		Silt loam over silty clay loam
					STANWAY	Imperfect	
	Scarps and plateaux; 300-700 feet	Jurassic ironstones, limestones and silty shales	17	FERRITIC BROWN EARTHS	BANBURY	Free	Clay loam
				BROWN CALCAREOUS SOILS	SHERBORNE		Silty clay loam
				SURFACE-WATER GLEY SOILS	LONG LOAD, MILCOMBE	Poor	Silty clay loam over silty clay
VERY HIGH (Highly calcareous)	Gently undulating; below 400 feet	Lower Lias clay and, locally, thin drift	18	BROWN CALCAREOUS SOILS WITH GLEYING	EVESHAM	Imperfect	Clay
				SURFACE-WATER GLEY SOILS	CHARLTON BANK	Poor	
	Plateaux and valleys; mostly 800-1200 feet	Carboniferous limestone	19	LEACHED BROWN SOILS	NONE NAMED	Free	Silt loam over silty clay loam
	Low plateaux and valleys; mostly below 450 feet	Greyish brown or brown till derived mainly from Jurassic rocks; includes chalky and locally Triassic material	20	LEACHED BROWN SOILS WITH GLEYING	NONE NAMED	Imperfect	Silty clay loam over clay
				SURFACE-WATER GLEY SOILS		Poor	

Henry Burt & Son Ltd, Mill Street, Bedford

Price 5/- net.