THREE POSSIBLE TERRACE FORMS SHOWN IN CROSS SECTION

1: following from the definition of terrace in the text

FIGURE 1.1
Erratum: The bottom line on figure 1.2 should read:

NOTE: UNDERLINED TERMS ARE DESCRIPTIVE OR GENETIC PREFIXES. E.G. CHANCE TERRACES
TERRACE AND TERRACE FRAGMENT ORIGIN BY ALTIMETRIC ANALYSIS

START: TERRACE LOCATED AND MEASURED

NO CHANGE IN LOCALATION

YES

NO CHANGE IN LOCALATION

TERRACE LOCALATION IN DOWNVALLEY GRADIENT REGULAR?

YES: IS TERRACE A 08005-

TERRACE AND TERRACE FRAGMENT ORIGIN BY ALTIMETRIC ANALYSIS

TERRACE LOCALATION IN DOWNVALLEY GRADIENT VALLEY CORRELATION?

NO DELTAS, EROSION OR CROSS VALLEY ISOSTATIC-PAIRED FORMS

YES: IS IT A CROSS VALLEY RELATION?

NO UNPAIRED OR ERODED EQUIVALENTS BETWEEN OI50/SA?

TILTING OF ABOVE CATEGORIES

NO: IS THERE A CROSS VALLEY CORRELATION?

DISCONTINUED PROFiLE

YES: IS THERE A CROSS VALLEY CORRELATION?

NO: IS IT A SIMPLE PROFILE

PREDICT FORM

PREDICT FORM

NO: IS IT A COMPLEX PROFILE

RE-EXPLORE CORRELATION

RE-EXPLORE EVIDENCE

NOTE: UNDERLINED TERMS ARE DESCRIPTIVE OR DESCRIPTIVE PREFIXES E.G. CHANGE TERRACES

FIGURE 12

END RESULT

UNAMBIGUOUS DATA YIELD UNAMBIGUOUS ANSWER: NO
POSSIBLE VARIATIONS IN TERRASIFORM STRATIGRAPHY WITHIN A BEDROCK VALLEY

A. ONE PAIRED TERRACE

B. TWO PAIRED TERRACES

C. THREE PAIRED TERRACES

1. ONE ALLUVIAL FILL

2. TWO ALLUVIAL FILLS

3. THREE ALLUVIAL FILLS

FIGURE 2.1
**TERRACE PROFILE GEOMETRY**

**GRADIENT = OB/OA**

**GOOD CORRELATION**

**POOR CORRELATION - DIFFERENT GRADIENTS**

**POOR CORRELATION - DIFFERENT PROJECTED INTERCEPTS**

**DISTANCE**

**Altitude**

**FIGURE 2.2**

**TERRACE LONG PROFILES IN THE LITERATURE**

**A)**

**B)**

**C)**

**D)**

**E)**

**F)**

**G)**

**H)**

**FIGURE 2.3**
SOME TYPICAL TERRACE CROSS PROFILES

FIGURE 3.1

STREAM GEOMETRY TERMINOLOGY

Wavelength of meanders = $AE = BD \times 2$
Amplitude of meanders = $XY$
Frequency of meanders = $\frac{1}{BD \times 2}$
Width of meander belt = $XY$
Sinuosity index = $\frac{\text{length of channel mid point}}{\text{length of meander belt}}$

1: after Brice (1964) and others
EQUAL DENSITY, DIFFERENT FREQUENCY SPOT HEIGHT LAYOUTS (after Greig-Smith 1964)

Each square represents a terrace fragment

FIGURE 3.3

SOME POSSIBLE HEIGHT LAYOUTS ON A TERRACE FRAGMENT

1) FIXED INTERVAL LINEAR
2) VARYING INTERVAL LINEAR
3) GROUPED
4) RANDOM
5) CLUSTERED
6) RECTANGULAR GRID
7) TRIANGULAR GRID

EACH SQUARE REPRESENTS ONE TERRACE FRAGMENT
EACH DOT REPRESENTS ONE SPOT HEIGHT

FIGURE 3.4
VARIATIONS IN THE LAYOUT OF SPOT HEIGHTS ON A PART OF F 585

- SPOT HEIGHT

--- APPROXIMATE BOUNDARY OF TERRACE FRAGMENT

- P NT 7000 3360
- Q NT 6900 3360
- R NT 6900 3300
- S NT 7000 3300

FIGURE 3.5
A COMPARISON OF TWEED SURFACE PROFILES DERIVED FROM LEVELLING AND ANEROID BAROMETER TRAVERSES

Distance downstream from Kelso

Figure 3.6

A COMPARISON OF TERRACE HEIGHTS OBTAINED WITH A LEVEL AND WITH AN ANEROID BAROMETER

Linear regression line equations

Figure 3.7
RELIEF AND DRAINAGE IN THE TWEED BASIN

FIGURE 4.1
THE SOLID GEOLOGY OF THE TWEED BASIN

- Carboniferous sediments
- Old red sandstone sediments
- Silurian sediments
- Ordovician sediments
- Basaltic and andesitic lavas
- Intrusive igneous rocks
- Granite

FIGURE 4.2

SCALE: 0 5 10 15 20 25 MILES KM. REDUCED FROM THE I.G.S. ONE-INCH MAPS
STRIAE AND ORIENTATED RELIEF IN THE TWEED BASIN

FIGURE 4.3

SCALE
0 4 8 12 Miles
0 5 10 15 Km.

- Striation
- Orientation of a ridge crest

B: Berwick  K: Kelso
C: Coldstream  P: Peebles
G: Galashiels  S: Selkirk
H: Hawick  T: Tweedhopefoot
FIGURE 4.4 GENERALISED DRIFT DISTRIBUTION (after Ragg 1960 and others)
RECORDED ERRATICS IN THE TWEED BASIN

A circle enclosing a symbol indicates a possible source of that material.

FIGURE 4.5
DRIFT AND ROCKHEAD IN THE TALLA AND FRUID VALLEYS

TALLA

FRUID

SCALE:

Horizontal

Vertical

Drift, comprising clay, sand, gravel and boulders.

Rockhead

Bonehole location

FIGURE 4.6

Exact locations of the sections are unknown.
MIRROR IMAGE ROSE DIAGRAMS OF TILL FABRICS FROM A SITE AT BERWICK-ON-TWEED

1. MICRO-FABRIC
2. MICRO-FABRIC
3. MICRO-FABRIC
4. MICRO-FABRIC
5. TOTAL MICRO-FABRIC
6. MACRO-FABRIC

STONES
RADIAL SCALES:

DIAGRAM

--- RIDGE CREST

FIGURE 4.7
ICE FLOW ORIENTATION IN THE TWEED BASIN
AS RECORDED BY STRIAE, ORIENTATED RELIEF
AND ERRATIC TRANSPORT

SCALE:

B: BERWICK  H: HAWICK
C: COLDSTREAM  P: PEEBLES
G: GALASHIELS  T: TWEEDSMUIR

FIGURE 4.8
EXAMPLES OF SEISMIC WAVE VELOCITY/DISTANCE GRAPHS

1. NORMAL GRAPH

2. GRAPH SHOWING DISCONTINUITIES

FIGURE 4.9
MAP SYMBOLS.

The symbols used in figures 5.1, 5.2, 5.3, 6.1, 6.2, 6.3, 7.1 and 7.2 are defined as follows:

- **Terrace or terrace fragment.**
- **Doubtful terrace fragment.**
- **Terrace fragment number (F is occasionally omitted where space is at a premium)**
- **Kame**
- **Meltwater channel (bar at highest point of the channel base).**
- **Channel in the lowest terrace.**
- **Other relevant channels.**
- **Kettle holes**
- **Fan**
- **National Grid Line.**
CLAPPERTON'S TWEED GLACIER 2 STAGE - DRAINAGE HYPOTHESIS

---

Meltwater route
--- Meltwater channel in rock
--- Present drainage line

FIGURE 5.4
A SEISMIC-DERIVED SECTION OF TERRACE FRAGMENT 679

FIGURE 5.5

THE TERRASIFORM DEPOSITS AT FLEURS CASTLE

FIGURE 5.6
DRIFT DEPOSITS UNDER THE RAIL BRIDGE, BERWICK

Each vertical line represents the position of a borehole.
THE MINIMUM POSSIBLE DEPTH OF DRIFT UNDER THE ROYAL TWEED BRIDGE, BERWICK

FIGURE 5.8
THE LOCATION OF KNOWN BOREHOLES AND THE BURIED VALLEY OF THE TWEED IN THE ESTUARINE AREA

--- BV Deepest section of the buried valley

--- Present low-tide course of the Tweed

--- Pre-1850 low-tide course of the Tweed

Exposed wave-cut bench

 Concealed wave-cut bench

Borehole

SCALE : 0 0 1 2 3 4 5 6 Miles to Km.

FIGURE 5.9
SUPPOSED TERRASIFORM DEPOSITS UPSTREAM FROM ST. BOSWELLS BRIDGE

FIGURE 6.4
SUPERFICIAL DEPOSITS UNDER THE PROPOSED LOWOOD BRIDGE, GALASHIELS

FIGURE 6.5
A SEISMIC DERIVED SECTION UNDER FRAGMENT 216

DRIFT, MAINLY SAND AND GRAVEL

BEDROCK

HEIGHT ABOVE O.D.

DISTANCE

FIGURE 7.3
HYPOTHETICAL DIAGRAM ILLUSTRATING THE DESIRABILITY OF USING DIFFERENT PROJECTION PLANES FOR DIFFERENT TERRACES

THE MOST SUITABLE PROJECTION PLANE FOR THE TERRACES MARKED 'A' IS PARALLEL TO THE 400 (ARBITRARY) UNITS CONTOUR WHILE THAT FOR THOSE TERRACES MARKED 'B' IS COINCIDENT WITH THE RIVER COURSE.

SCALE: ARBITRARY

FIGURE 8.1

VALLEY ASYMMETRY AND THE SINUOSITY OF PROJECTION PLANES

... PROJECTION PLANE COURSE DOWN THE CENTRE OF THE LOWER VALLEY
... PROJECTION PLANE COURSE DOWN THE CENTRE OF THE UPPER VALLEY

FIGURE 8.2
HEIGHT PROJECTION INTO A SEMI-CIRCULAR PLANE

FIGURE 8.3

TERRACE GRADIENT VARIATION DUE TO PROJECTION INTO A CURVILINEAR PLANE

FIGURE 8.4
THE LOCATION OF THE LINEAR PROJECTION PLANE

LOCATION OF THE LINEAR PROJECTION PLANE

THE LOCATION OF THE LINEAR PROJECTION PLANES

Figure 8.5
FORESHORTENING BY PROJECTION INTO LINEAR PLANES

Reproduced length of $AB, CB = AB \cos \alpha$
Foreshortening = $AB(1 - \cos \alpha)$

FIGURE 8.7

POSSIBLE PLOTTING AMBIGUITIES AT THE JUNCTION OF LINEAR PROJECTION PLANES

A and B are spot height locations on a terrace adjacent to the river

FIGURE 8.8
PROJECTION PLANE P 2

FIGURE 9.2
PROJECTION PLANE P.8

PROJECTION PLANE P.9

FIGURE 9.4

FIGURE 9.5
PROJECTION PLANES PIO, PI2 & PI3

FIGURE 9.6
PROJECTION PLANES P 19 & P 20

FIGURE 9.12
FIGURE 9.13
FIGURE 9.15
FIGURE 9.16
PROJECTION PLANES P28, P29A & P29B

FIGURE 9.18
FIGURE 9.19

PROJECTION PLANES P30 & P31 (COMBINED)

GORGE

DISTANCE

Miles

Km.

HEIGHT ABOVE O.D.

Feet

Metres
Figure 9.20

Projection Plane P.32

Distance

Height above O.D.

Meters

Feet

NT 7200 to 3500

NT 7300 to 3349

Miles

Km.
FIGURE 9.21
PROJECTION PLANES P36 & P37

FIGURE 9.23
\[ \log_{10} \left| B_2 - B_1 \right| = 1.3485 - 1.952 \log_{10} N_{21} \]

\[ F = 94.259 \quad \text{DEGREES OF FREEDOM} = 59 \]

\[ \text{PROBABILITY} = 7.6897 \times 10^{-14} \]

\[ r = 0.7842 \]

---

\[ \log_{10} \left| A_2 - A_2 \right| = -59887 - 1.0496 \log_{10} N_{21} \]

\[ \text{DEGREES OF FREEDOM} = 59 \]

\[ F = 24.46 \quad \text{PROBABILITY} = 6.472 \times 10^{-6} \]

\[ r = 0.5419 \]

---

\[ \log_{10} \left| B_{\text{max}} - B_{\text{min}} \right| = -90978 - 18485 \log_{10} N_{21} \]

\[ \text{DEGREES OF FREEDOM} = 47 \]

\[ F = 75.75 \]

\[ \text{PROBABILITY} = 2.3193 \times 10^{-11} \]

\[ r = 0.7856 \]

---

N.B. 1 unit on the horizontal axis = 3 feet/mile

**Figure 9.24**

**Figure 9.25**

**Figure 9.26**
\[
\log_{10}|a^B\text{ VARN. IN } B| = 1.6426 - 1.0648 \log_{10} N
\]

DEGREES OF FREEDOM = 226

\[F = 69.603\]

PROBABILITY = 7.1882 \times 10^{-15}

\[r = 0.4852\]

FIGURE 9.27

\[
\log_{10}|a^B\text{ VARN. OF } B_2| = 1.554 - 1.0036 \log_{10} N_2
\]

DEGREES OF FREEDOM = 59

\[F = 16.124\]

PROBABILITY = 1.6999 \times 10^{-4}

\[r = 0.4633\]

FIGURE 9.28

\[
100 - \log_{10}\text{ YARN. OF } B_2 = 100 - \log_{10}\text{ YARN.}
\]

FIGURE 9.29

\[
100 - \log_{10}\text{ YARN. OF } B_2 = 100 - \log_{10}\text{ YARN.}
\]

FIGURE 9.29
HYPOTHETICAL 'EASE OF CHARACTERISATION' CURVE FOR A FLUVIAL TERRACE FRAGMENT

FIGURE 9.30

FIGURE 9.31
THE LONG PROFILE OF THE RIVER TWEED

(Arithmetic scale)

RIVER SURFACE HEIGHTS
RECORDED FLOOD LEVELS

FIGURE 9.32

THE LONG PROFILE OF THE TWEED

(Logarithmic scales)

BEDROCK GEOLOGY

FIGURE 9.33
SEISMIC WAVE VELOCITY HISTOGRAMS

ALL ROCK TYPES

Silurian/Ordovician

Old Red Sandstone

Carboniferous

WAVE VELOCITY × 10^4 (FEET/SECOND)

FIGURE 9.34
TERRACES AND TERRACE FRAGMENTS OF THE TWEED VALLEY

DISTANCE AND PROJECTION PLANE LOCATION

FIGURE 9.35
MELTWATER PHENOMENA IN A PART OF THE LAMMERMUIR HILLS

FIGURE 10.1

THE CUTTING OF THE TWEED GORGES

FIGURE 10.2
TREND SURFACES FITTED TO FRAGMENT 585
(RECTANGULAR GRID LAYOUT)

FIRST ORDER

SECOND ORDER

THIRD ORDER

A: NT 6877 3351
B: NT 6877 3279
C: NT 7029 3279
D: NT 7029 3351

V.I. = 0.5 Feet

FIGURE 11.1
FIRST ORDER PROJECTED TREND SURFACES WITHIN A MEANDERING VALLEY

FIGURE 11.2

PROJECTION OF SECOND OR HIGHER ORDER TREND SURFACES WITHIN AN ASYMMETRICAL MEANDERING VALLEY

FIGURE 11.3
Plate 1: The 'Terra-Scout' portable refraction seismograph set up ready for use.

Plate 2: Sand and gravel containing shells, enclosed in till, Berwick Plantation.

Plate 3: Kames at Mount Pleasant, near Berwick.

Plate 4: Fragment 814 and backing slope.
Plate 5: Fragment 802, Gainslawhill, near Berwick.

Plate 6: Fragment 794 with drumlinised relief in the background. Winfield aerodrome, near Berwick.

Plate 7: Meltwater channel at 907 462, running towards the Tweed.

Plate 8: Section under F 783, Twizel Station.
Plate 9: Terrace fragments around the Till/Tweed junction.

Plate 10: Contorted and faulted sands at 8467 4007, Coldstream.

Plate 11: Kame and Kettle hole at 858 384, Campfield.

Plate 12: View westwards from the Cornhill-Crookham sands over P 721 to Mark.
Plate 17: Till section, containing gravel lens, overlying rock at Mertoun Mill.

Plate 18: Till (dark) overlying gravel (lighter) in section at Newstead.

Plate 19: Ice-contact slope at 5227 5464, near Darnick.

Plate 20: Dead ice hollow at 517 344, near Abbotsford.
Plate 13: View eastwards along the crest of the Wark Kaim.

Plate 14: F 679, looking northeastwards towards Reddon.

Plate 15: Sanded silts and sands under F 607 at 7185 3370, Kelsohaugh.

Plate 16: The Fleurs terraces and Fleurs Castle from the south.
Plate 21: Low level kettle hole and floodplain underneath Rink Farm (4391 3268).

Plate 22: V shaped cross section of the Tweed Valley and low terraces looking westwards towards Fernielee.

Plate 23: P 347, the highest of the Ashiesteel terraces.

Plate 24: Kain Knowe, near Walkerburn, cut by the Peebles - Galashiels road.
Plate 25: Cademuir dry channel, looking westwards.

Plate 26: Terraces in the vicinity of the Tweed/Lyne junction.

Plate 27: F 216, looking up the Tweed valley.

Plate 28: The Sheriffmuir Esker.
Plate 29: Section at 1870 3348 in the Sheriffmuir Esker.

Plate 30: Kanes upvalley from Drumselier Bridge.

Plate 31: A 'barren area' - the floodplains of the Tweed west of Vrse Farm.

Plate 32: Section under F 120, near the Kingledores Burn/ Tweed junction.
Plate 33: F 189 and 191 at Patervan.

Plate 34: Terrace fragments downvalley from Tweedsmuir Bridge.

Plate 35: Part of section 26 at 1012 2477.

Plate 36: Outwash at the mouth of the Fruid Water valley.
Plate 37: Section 27 under the Badentree 'fan'.