Some aspects of the geomorphology of the Durham coast

Westgate, W. A.

SOME ASPECTS OF THE GEOMORPHOLOGY OF THE DURHAM COAST

W.A. Westgate, B.Sc.

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FIG. 1.

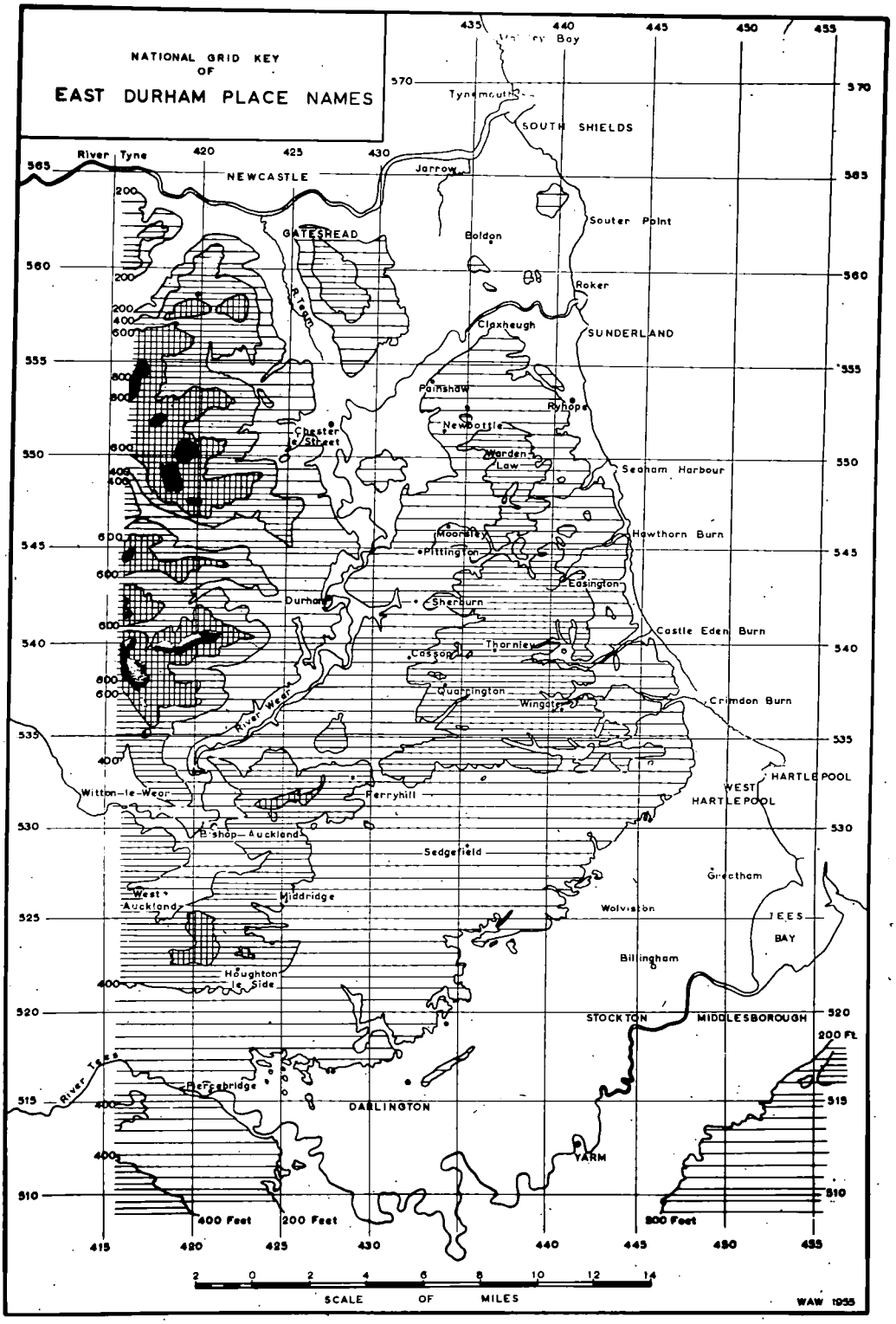
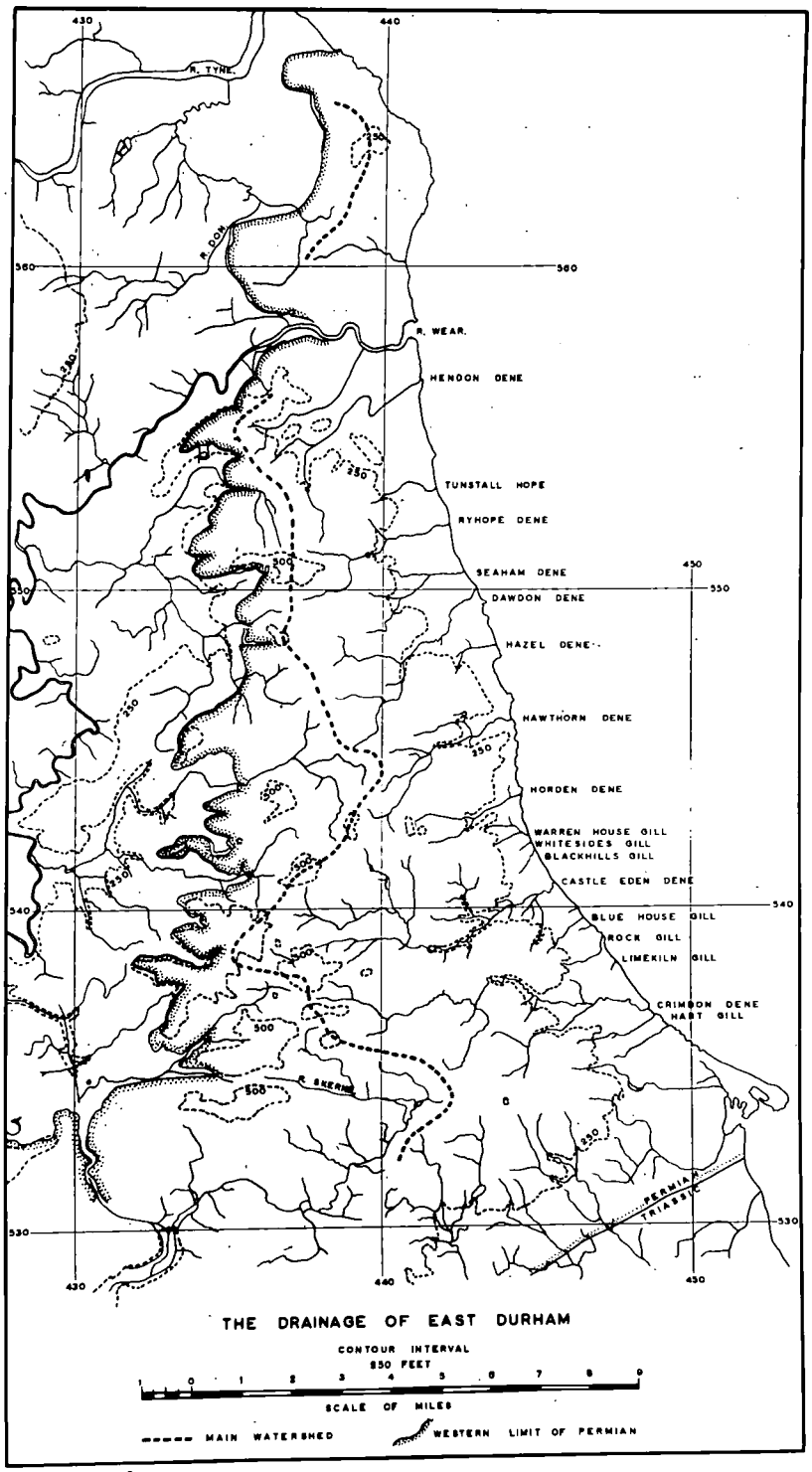

NATIONAL GRID KEY
OF
EAST DURHAM PLACE NAMES
River Tyne
NEWCASTLE
GATESHEAD
Jarrow
Boldon
Tynemouth
SOUTH SHIELDS
Souter Point
Roker
SUNDERLAND
Claxheugh
R. Team
Palmshaw
Ryhope
Newbottle
Chester-le-Street
Warden Law
Seaham Harbour
Moorsley
Hawthorn Burn
Pittington
Easington
Durham
Sherburn
Castle Eden Burn
Thornley
Cassop
Quarrington
Wingate
Crimdon Burn
River Wear
HARTLEPOOL
WEST HARTLEPOOL
Witton-le-Wear
Ferryhill
Bishop Auckland
Sedgefield
Greatham
West Auckland
Middridge
Wolviston
TEES BAY
Billingham
Houghton-le-Side
STOCKTON
MIDDLESBOROUGH
River Tees
Darlington
YARM
400 Feet
200 Feet
200 Ft.
SCALE OF MILES
WAW 1935

FIG. 2.


430
440
R. TYNE.
R. DON
560
R. WEAR.
HENDON DENE
TUNSTALL HOPE
RYHOPE DENE
SEAHAM DENE
450
550
DAWDON DENE
HAZEL DENE
HAWTHORN DENE
HORDEN DENE
WARREN HOUSE GILL
WHITESIDES GILL
BLACKHILLS GILL
CASTLE EDEN DENE
540
BLUE HOUSE GILL
ROCK GILL
LIMEKILN GILL
CRIMDON DENE
HART GILL
R. SWERNE
PERMIAN
TRIASSIC
530
430
440
450
THE DRAINAGE OF EAST DURHAM
CONTOUR INTERVAL
250 FEET
1 0 1 2 3 4 5 6 7 8 9
SCALE OF MILES
MAIN WATERSHED
WESTERN LIMIT OF PERMIAN

ALTIMETRIC FREQUENCY CURVES. EAST DURHAM

BASED ON THE HIGHEST POINTS PER SQUARE KM.

(A) 20 foot Grouping
(B) 40 foot Grouping
(C) 60 foot Grouping

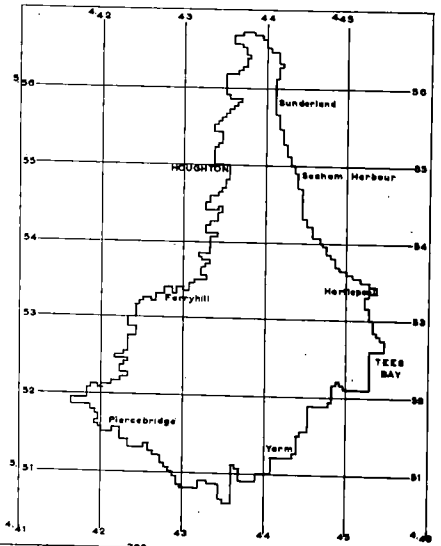
BASED ON THE HIGHEST POINTS PER 1/4 SQUARE KM.

(D) 20 foot Grouping
(E) 40 foot Grouping
(F) 60 foot Grouping

BASED ON THE HIGHEST POINTS PER 4 SQUARE KMS.

(G) 20 foot Grouping
(H) 40 foot Grouping

BASED ON O.S. ONE INCH MAPS, NEW POPULAR EDITION.



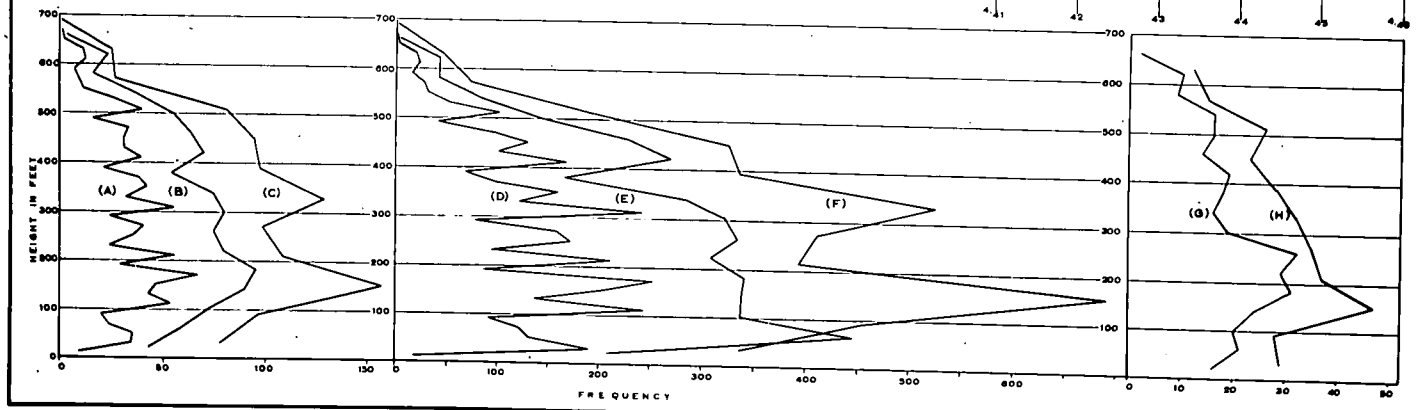


FIG. 3.

FIG. 4.

Generalised Contours. East Durham.

~~~ BASED ON HIGHEST POINTS PER 4 SQUARE KMS.

- - - - BASED ON HIGHEST POINTS PER 16 SQUARE KMS.

CONTOUR INTERVAL 100 FEET.

2 0 2 4 6 8 10 12 14

SCALE OF MILES

BASED ON O.S. ONE INCH MAPS, POPULAR EDITION.

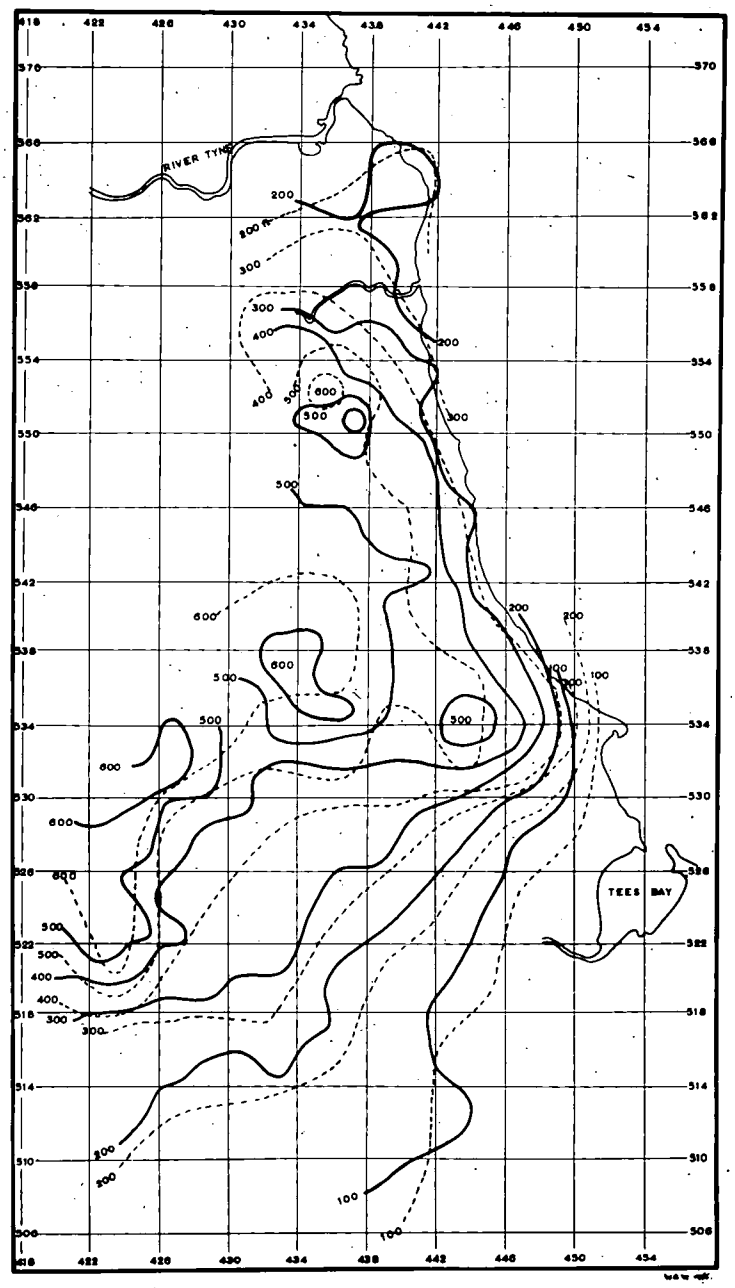

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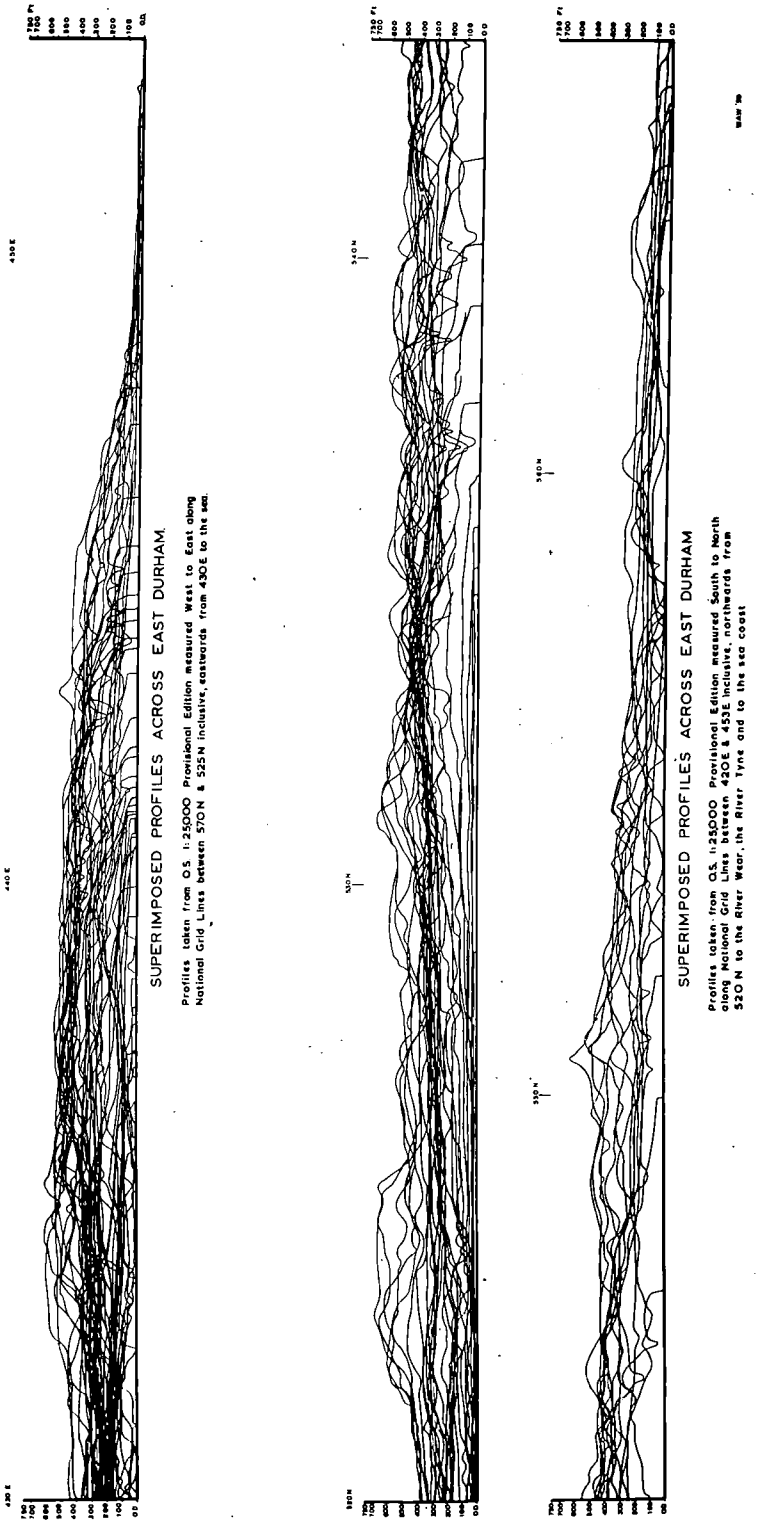
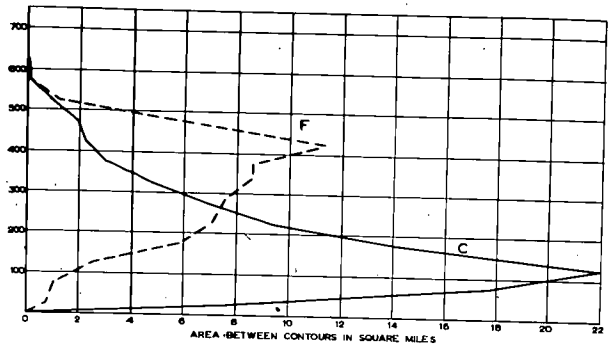
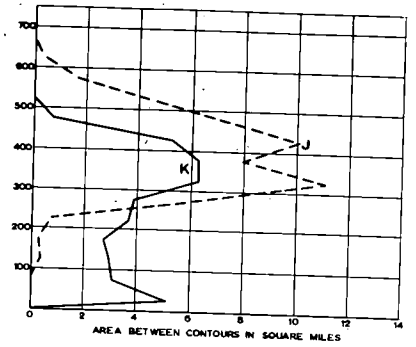
FIG. 5.

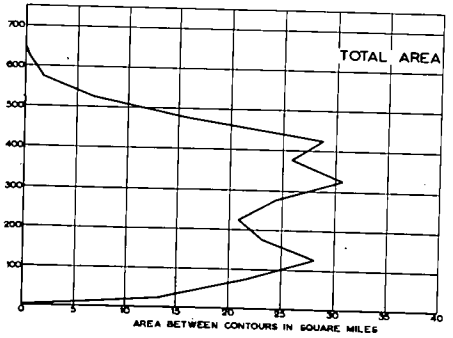

SUPERIMPOSED PROFILES ACROSS EAST DURHAM.
Profiles taken from O.S. 1:25000 Provisional Edition measured West to East along National Grid Lines between 570 N & 525 N inclusive, eastwards from 430 E to the sea.
SUPERIMPOSED PROFILES ACROSS EAST DURHAM
Profiles taken from O.S. 1:25000 Provisional Edition measured South to North along National Grid Lines between 420 E & 453 E inclusive, northwards from 520 N to the River Wear, the River Tyne and to the sea coast

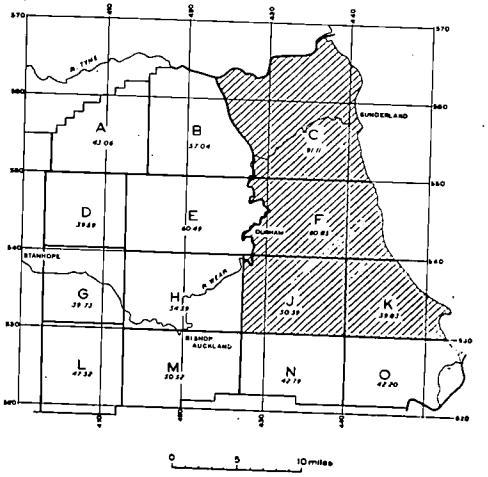




AREA-HEIGHT CURVES OF EAST DURHAM

EXCLUDING THE TEES LOWLANDS





KEY TO AREAS MEASURED

WITH AREAS IN SQUARE MILES

DHM '55

FIG. 6.

FIG. 7.

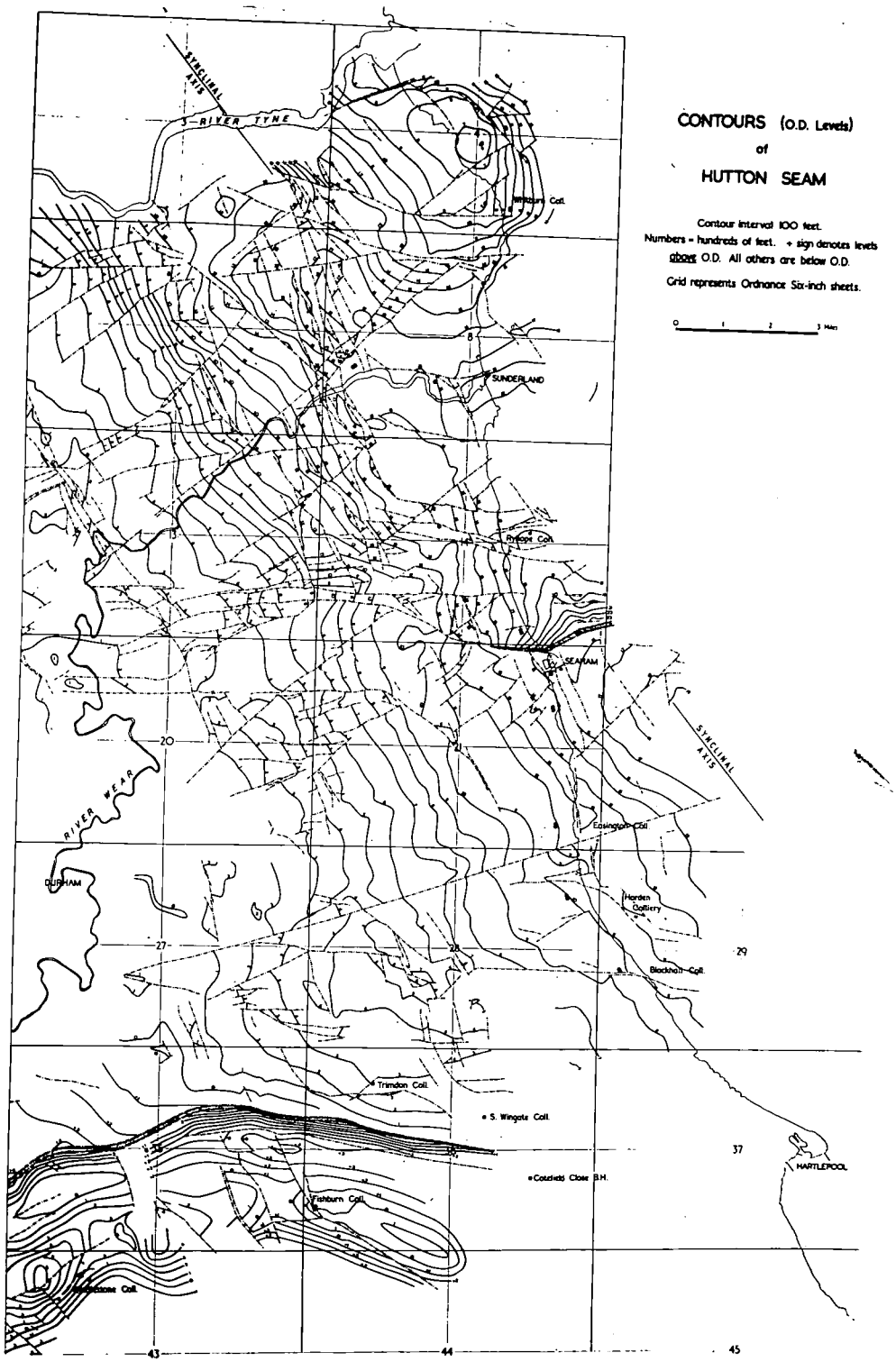
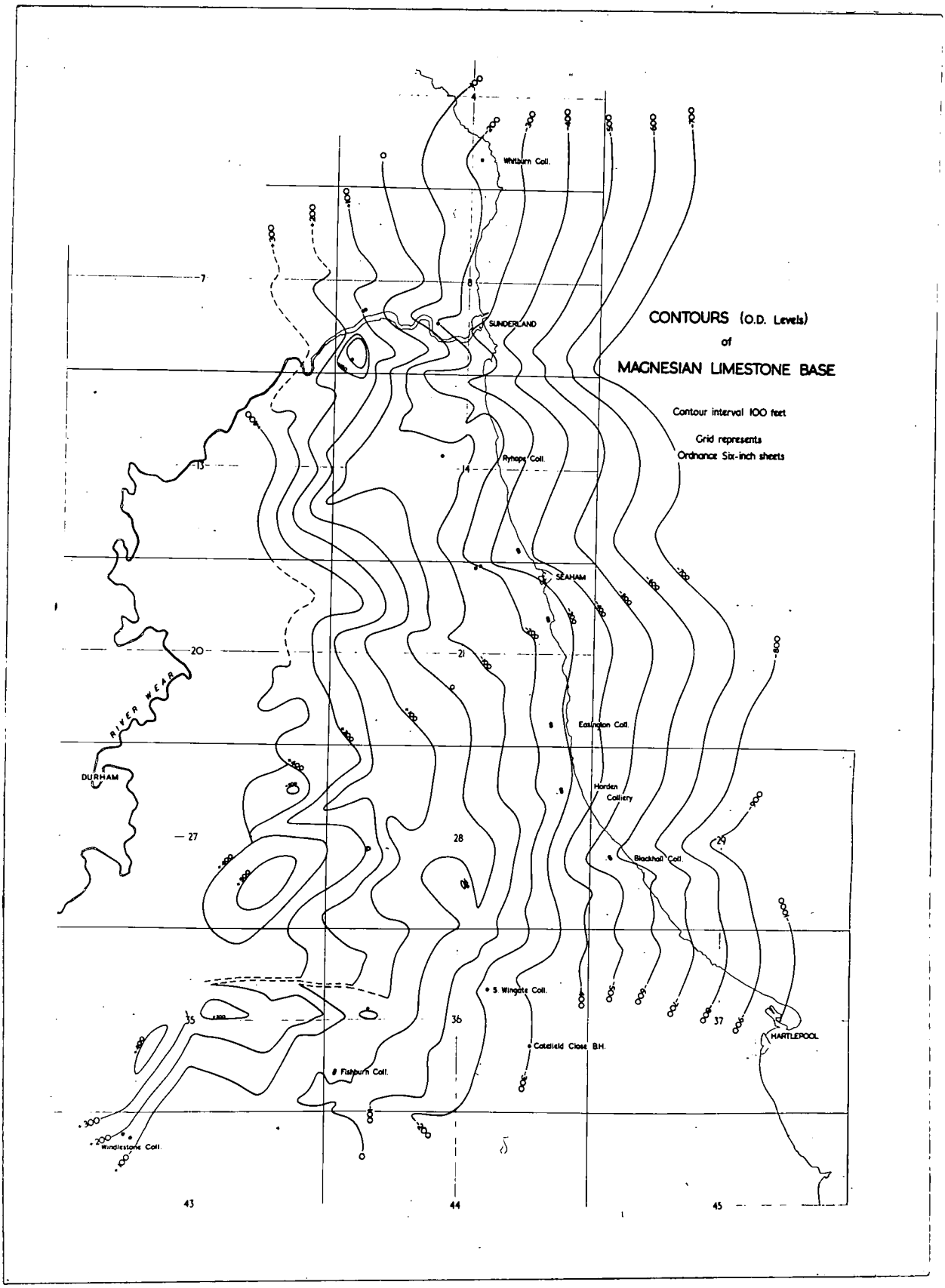
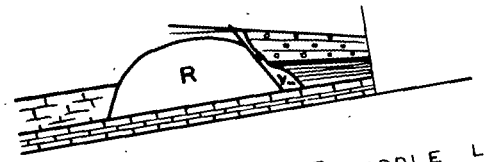

CONTOURS (O.D. Levels)
of
HUTTON SEAM
Contour interval 100 feet.
Numbers = hundreds of feet. + sign denotes levels above O.D. All others are below O.D.
Grid represents Ordnance Six-inch sheets.
SYNCLINAL AXIS
RIVER TYNE
Whitburn Coll.
SUNDERLAND
Ryhope Coll.
SEAHAM
SYNCLINAL AXIS
RIVER WEAR
DURHAM
Easington Coll.
Horden Colliery
Blackhall Coll.
Trimdon Coll.
S. Wingate Coll.
Coxhoe Close B.H.
Fishburn Coll.
HARTLEPOOL
8
20
21
27
28
29
37
43
44
45

FIG. 8.


CONTOURS (O.D. Levels)
of
MAGNESIAN LIMESTONE BASE
Contour interval 100 feet
Grid represents
Ordnance Six-inch sheets
Whitburn Coll.
SUNDERLAND
Ryhope Coll.
SEAHAM
Easington Coll.
Horden Colliery
Blackhall Coll.
S. Wingate Coll.
Castlefield Close B.H.
Fishburn Coll.
Windlestone Coll.
HARTLEPOOL
DURHAM
RIVER WEAR
7
8
13
14
20
21
27
28
29
35
36
37
43
44
45

IDEAL SECTIONS THROUGH THE DURHAM PERMIAN.

(A).



(B).

INTERBEDDED FOSSILIFEROUS BRECCIA.

R BRYOZOA REEF.

MIDDLE LIMEST. FOSSILIFEROUS.

LOWER LIMESTONE.

MIDDLE LIMESTONE. UNFOSSILIFEROUS.

FLEXIBLE LIMESTONE.

UPPER LIMESTONE. CONCRETIONARY.

MIDDLE DOLOMITE. FOSSILIFEROUS.

LOWER DOLOMITE.

MARL SLATE.

YELLOW SANDS.

COAL MEASURES

R BRYOZOA REEF.

MIDDLE LIMESTONE. UNFOSSILIFEROUS.

UPPER LIMESTONE. CONCRETIONARY.

ROKER OOLITE.

FIG. 10.

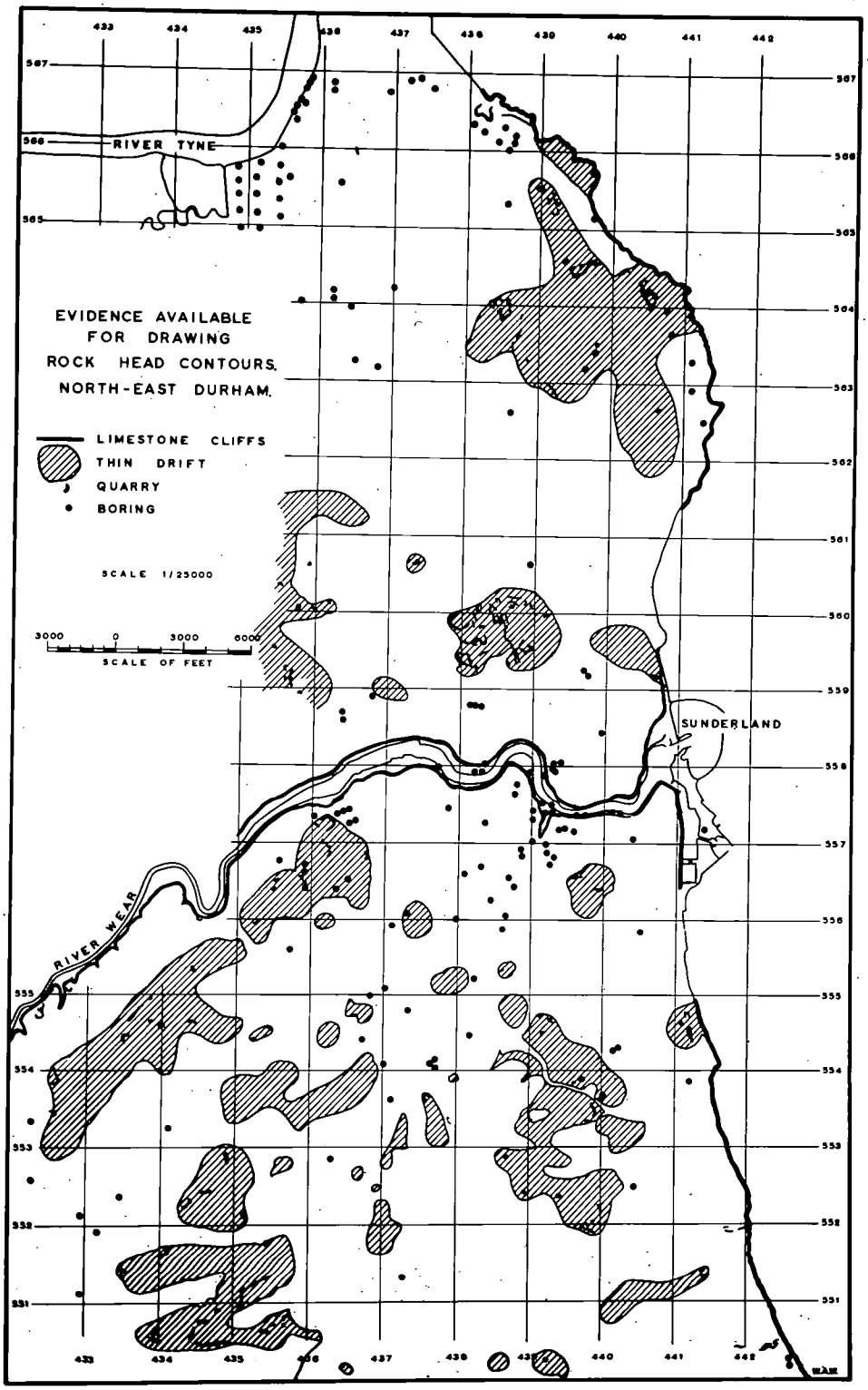

RIVER TYNE
EVIDENCE AVAILABLE
FOR DRAWING
ROCK HEAD CONTOURS.
NORTH-EAST DURHAM.
LIMESTONE CLIFFS
THIN DRIFT
QUARRY
BORING
SCALE 1/25000
3000 0 3000 6000
SCALE OF FEET
SUNDERLAND
RIVER WEAR

FIG. 11.

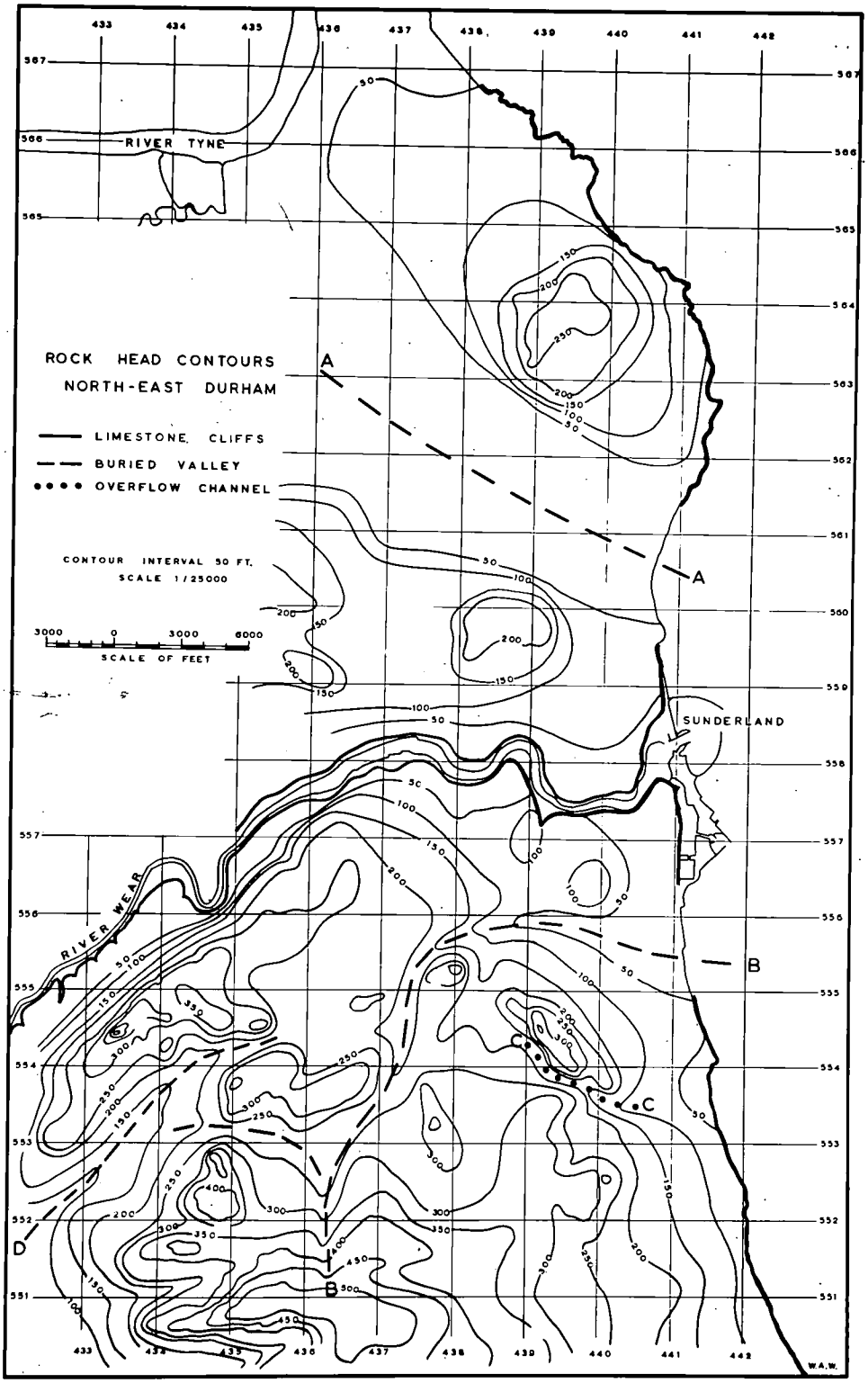

ROCK HEAD CONTOURS
NORTH-EAST DURHAM
LIMESTONE CLIFFS
BURIED VALLEY
OVERFLOW CHANNEL
CONTOUR INTERVAL 50 FT.
SCALE 1/25000
3000 0 3000 6000
SCALE OF FEET
RIVER TYNE
RIVER WEAR
SUNDERLAND
A
B
C
D
W.A.W.

FIG. 12.

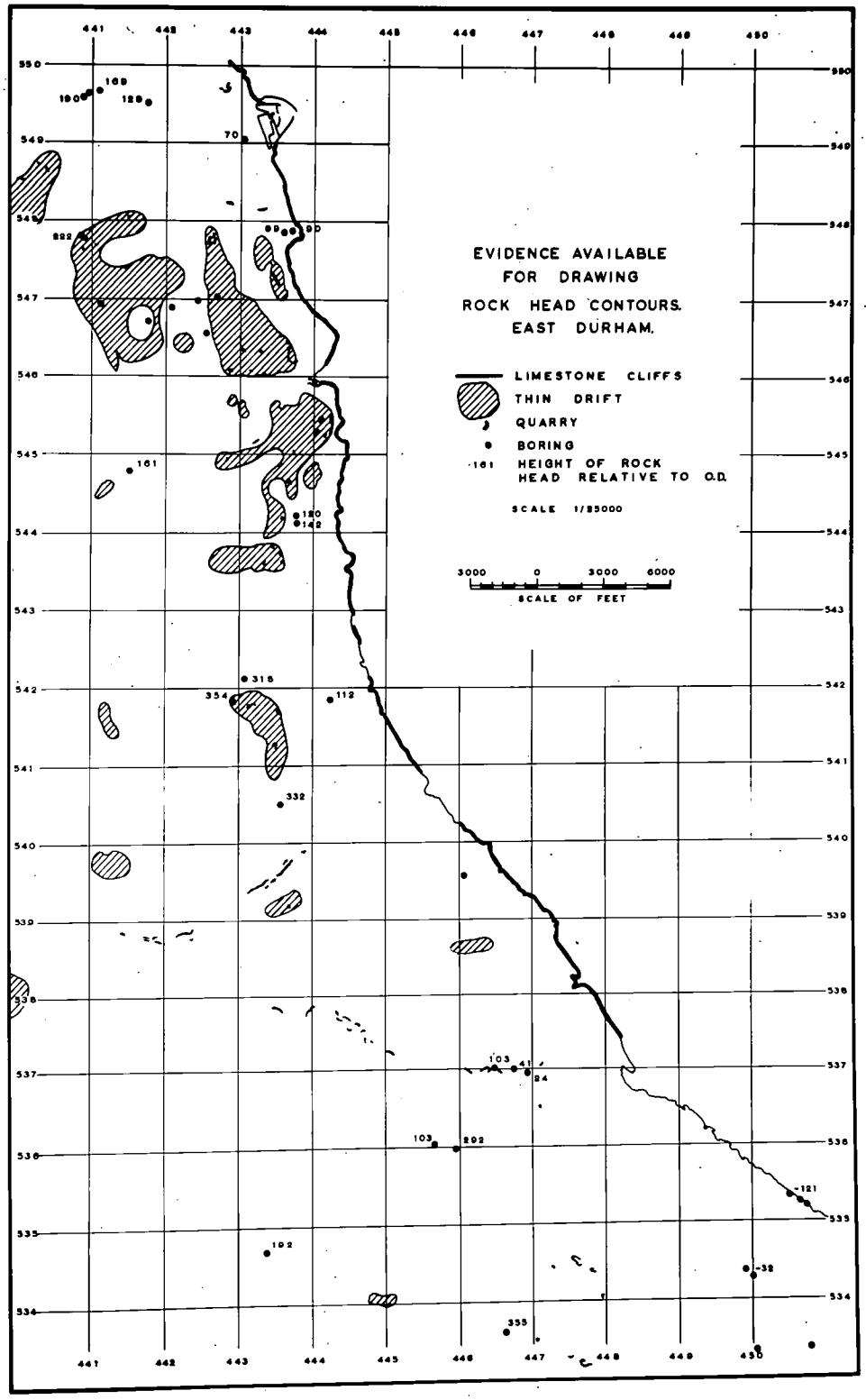
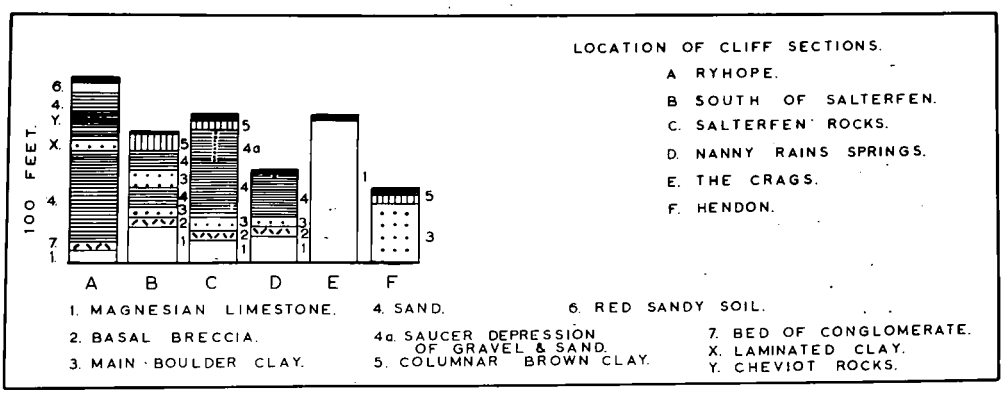

EVIDENCE AVAILABLE
FOR DRAWING
ROCK HEAD CONTOURS.
EAST DURHAM.
LIMESTONE CLIFFS
THIN DRIFT
QUARRY
BORING
-161 HEIGHT OF ROCK HEAD RELATIVE TO O.D.
SCALE 1/25000
3000 0 3000 6000
SCALE OF FEET

FIG. 13.



CLIFF SECTIONS IN NORTH DURHAM.

FIG. 14

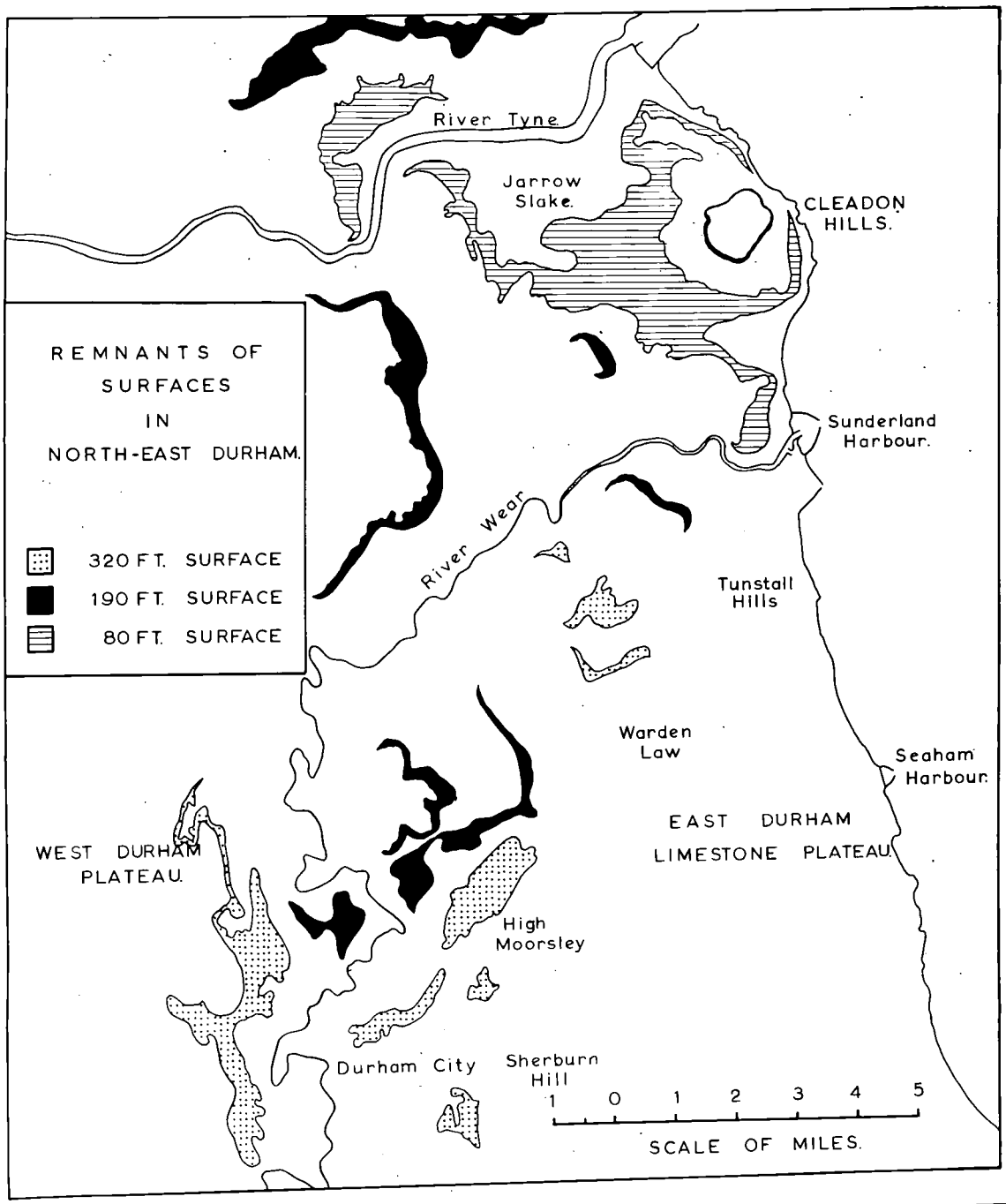

River Tyne
Jarrow Slake
CLEADON HILLS
Sunderland Harbour
River Wear
Tunstall Hills
Warden Law
Seaham Harbour
EAST DURHAM LIMESTONE PLATEAU
WEST DURHAM PLATEAU
High Moorsley
Durham City
Sherburn Hill
REMNANTS OF SURFACES IN NORTH-EAST DURHAM.
320 FT. SURFACE
190 FT. SURFACE
80 FT. SURFACE
1 0 1 2 3 4 5
SCALE OF MILES.

FIG. 15

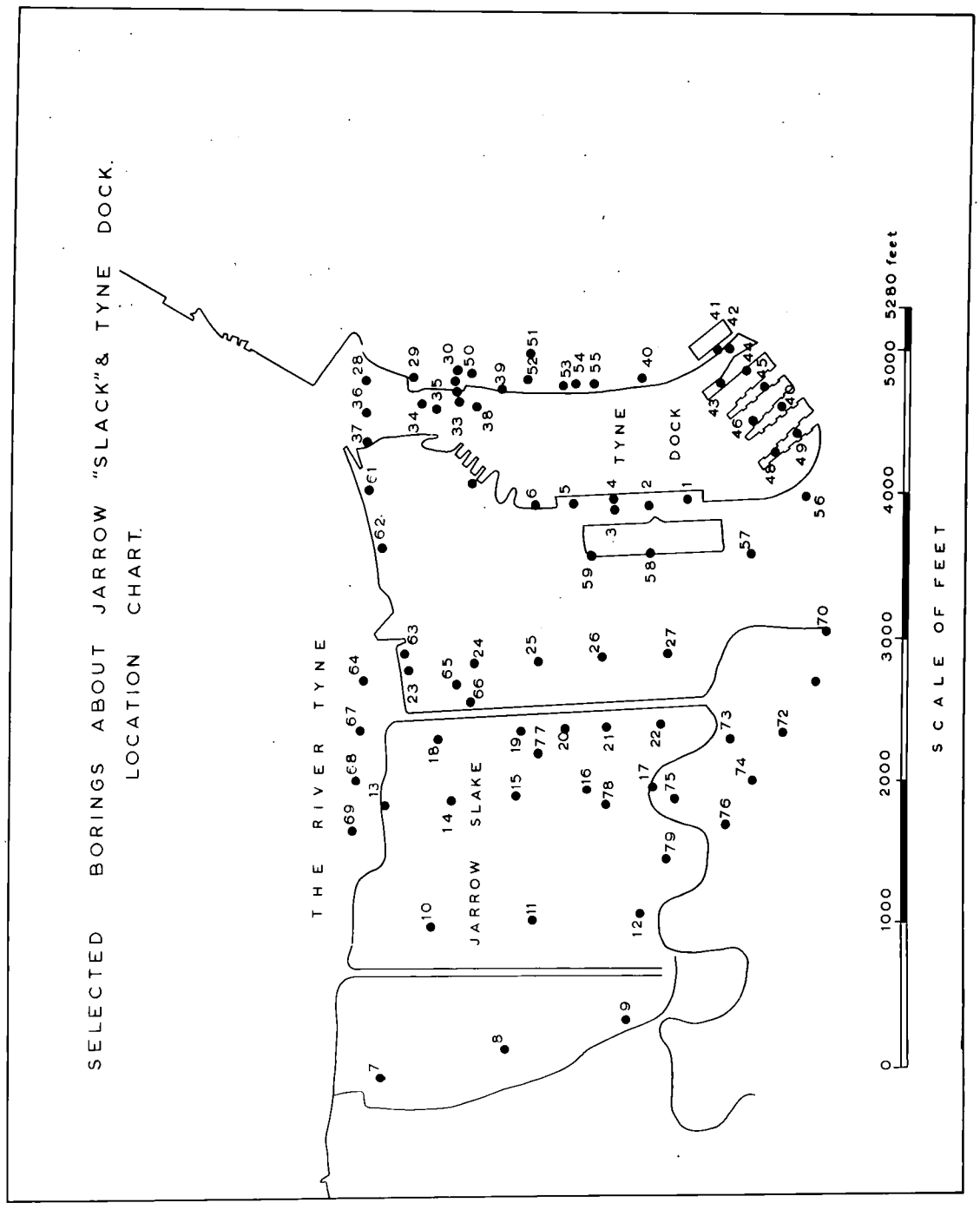
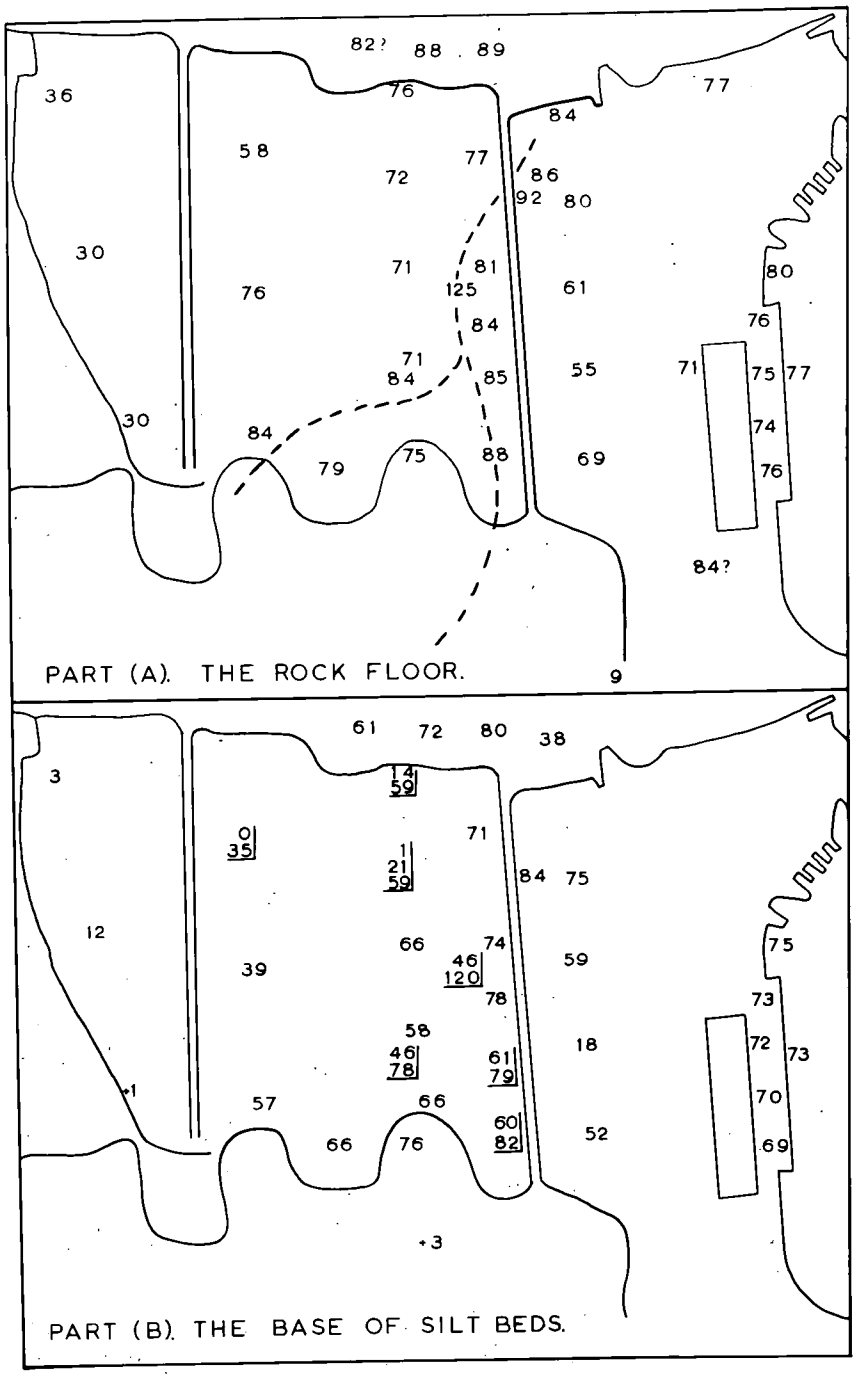

SELECTED BORINGS ABOUT JARROW "SLACK" & TYNE DOCK.
LOCATION CHART.
THE RIVER TYNE
JARROW SLAKE
TYNE DOCK
SCALE OF FEET
0
1000
2000
3000
4000
5000 5280 feet

FIG. 16



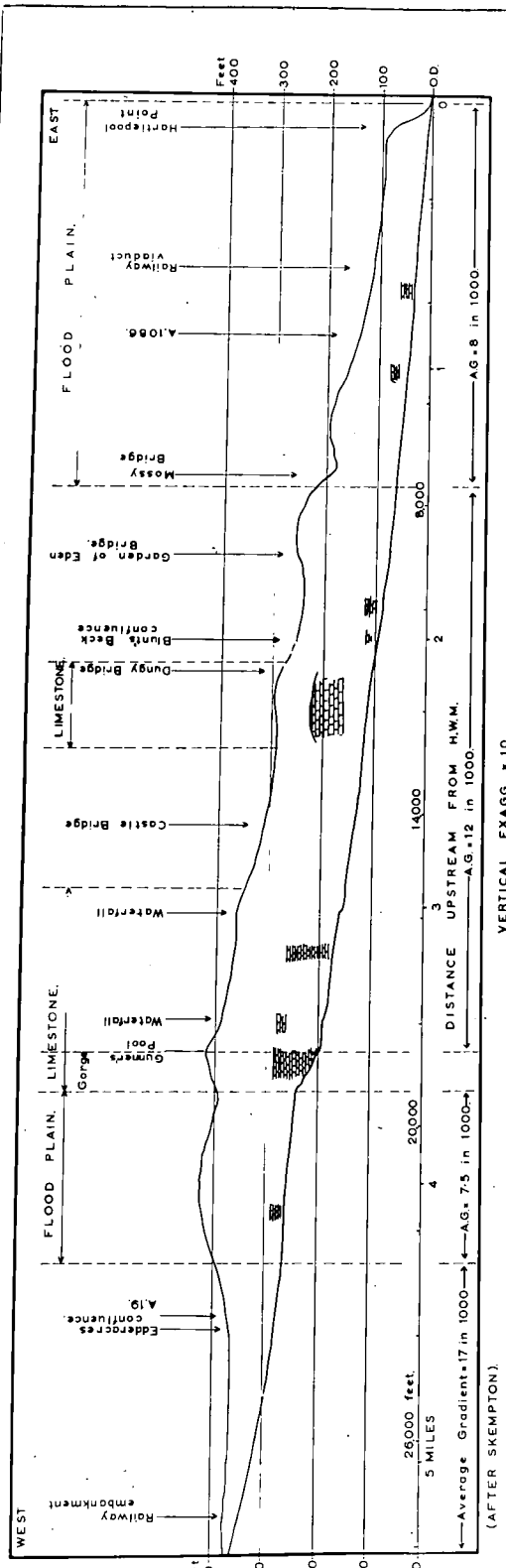
JARROW SLAKE DETAILS.

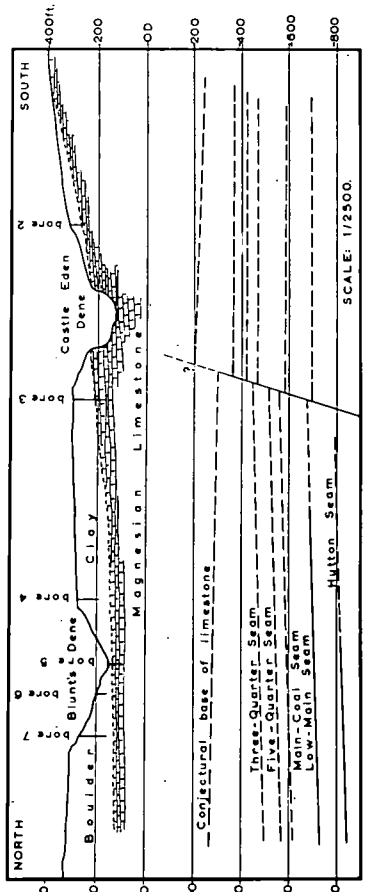
Depths below O.D.

Scale of feet.

0 1000 2000 3000 4000

FIG. 18


WEST
EAST
Feet
400
300
200
100
OD
FLOOD PLAIN.
LIMESTONE.
Railway embankment
Eddercrets confluence
A.19.
Gorge
Gunnerg Pool
Waterfall
Waterfall
Castle Bridge
LIMESTONE.
Dungy Bridge
Blunts Beck confluence
Garden of Eden Bridge.
Mossy Bridge
A.1066.
Railway Viaduct
Hartlepool Point
FLOOD PLAIN.
5 MILES
26000 feet.
20000
14000
8000
0
1
2
3
4
DISTANCE UPSTREAM FROM H.W.M.
Average Gradient=17 in 1000
A.G.= 7.5 in 1000
A.G.=12 in 1000
A.G.=8 in 1000
VERTICAL EXAGG. x 10
LONGITUDINAL PROFILE OF CASTLE EDEN BURN.
(AFTER SKEMPTON).


NORTH
SOUTH
400ft.
200
0D
-200
-400
-600
-800
ft.400
bore 7
bore 8
bore 9
bore 4
bore 3
bore 2
bore 1
Boulder Clay
Blunt's Dene
Castle Eden Dene
Magnesian Limestone
Conjectural base of Limestone
Three-Quarter Seam
Five-Quarter Seam
Main-Coal Seam
Low-Main Seam
Hutton Seam
SCALE: 1/2500.
GEOLOGICAL SECTION.

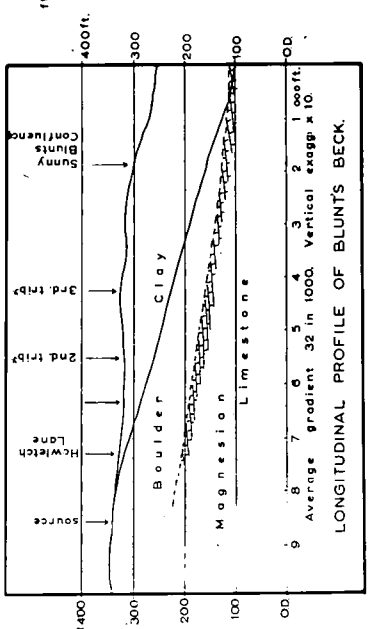

400ft.
300
200
100
0D
ft.400
source
Hewletch Lane
2nd. trib?
3rd. trib?
Sunny Blunts Confluence
Boulder Clay
Magnesian Limestone
Average gradient 32 in 1000.
Vertical exagg. x 10.
1 000ft.
LONGITUDINAL PROFILE OF BLUNTS BECK.

FIG. 19

FIG. 20.

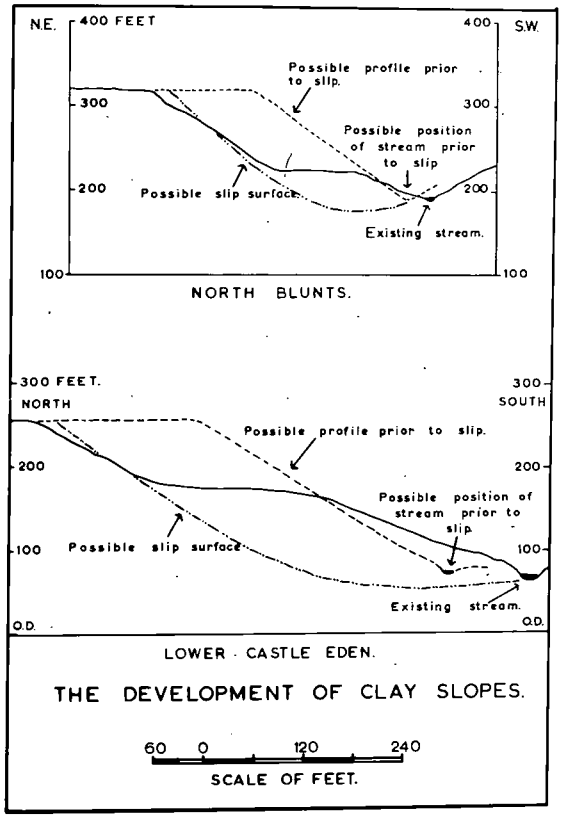
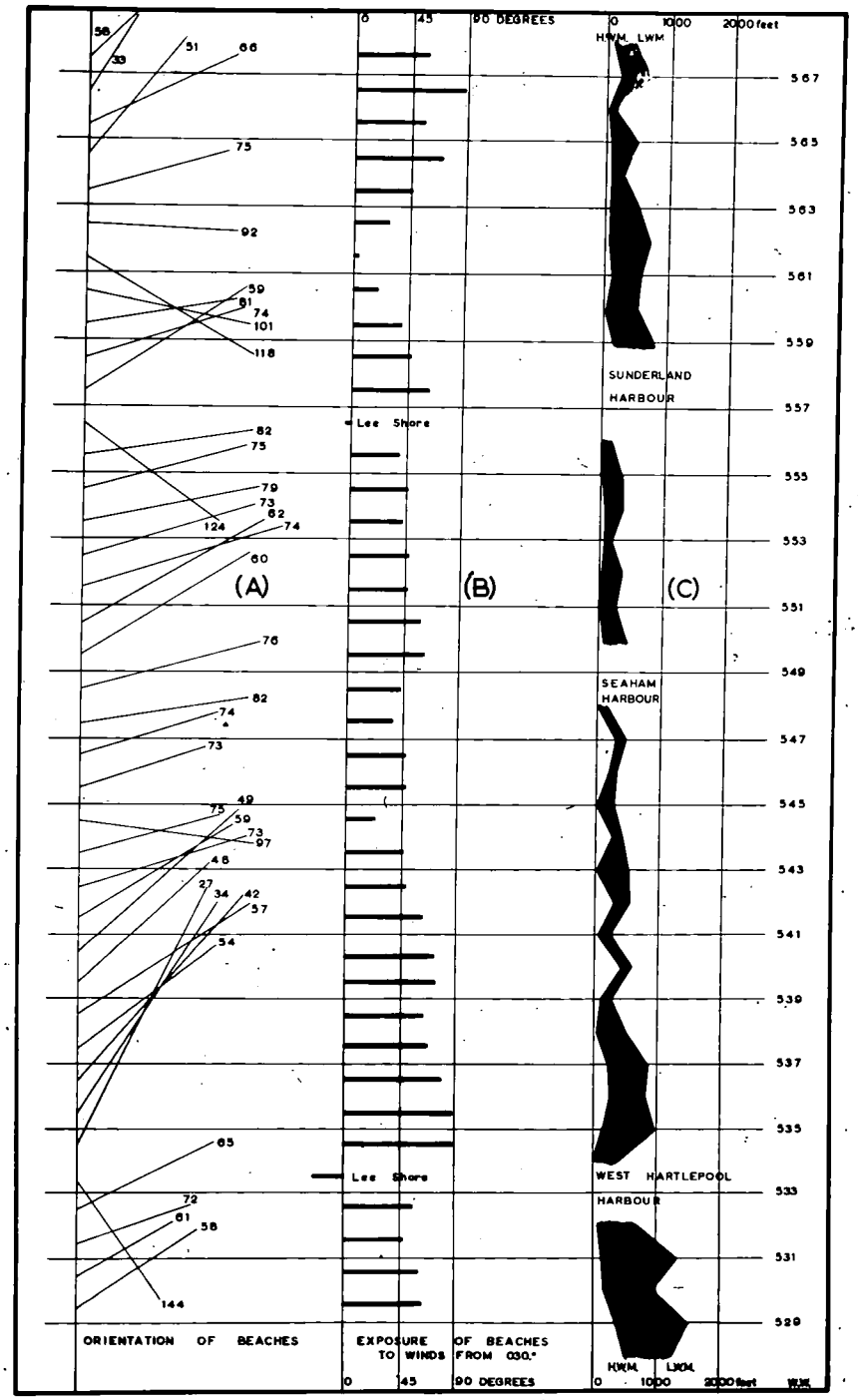

N.E.
400 FEET
400
S.W.
Possible profile prior to slip.
300
300
Possible position of stream prior to slip
200
Possible slip surface.
200
Existing stream.
100
100
NORTH BLUNTS.
300 FEET.
NORTH
300
SOUTH
Possible profile prior to slip.
200
200
Possible position of stream prior to slip.
100
Possible slip surface.
100
Existing stream.
O.D.
O.D.
LOWER · CASTLE EDEN.
THE DEVELOPMENT OF CLAY SLOPES.
60 0 120 240
SCALE OF FEET.

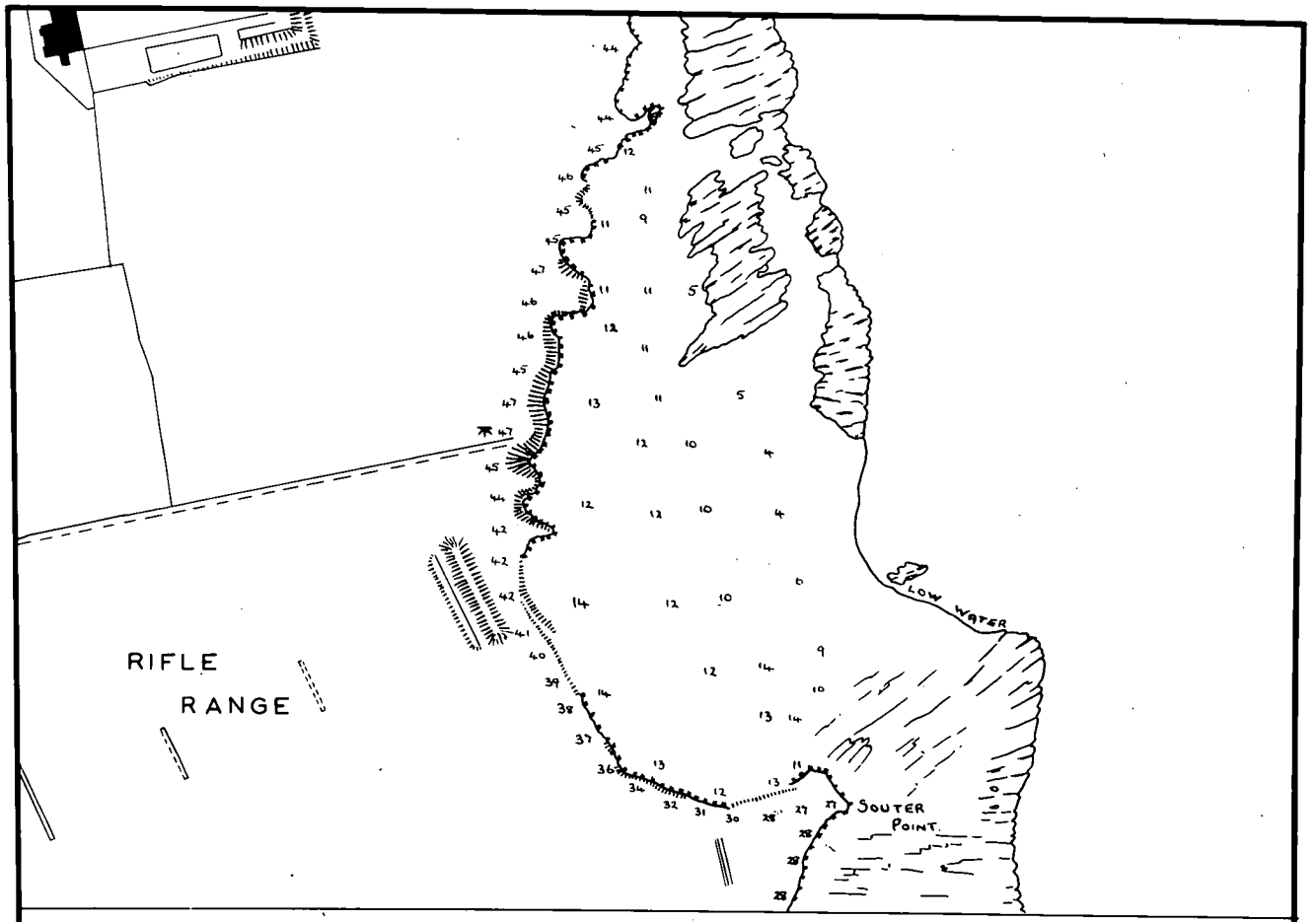
FIG 21

FIG. 22

DIAGRAMS OF THE DURHAM COAST

PARTS A·B· AND C.



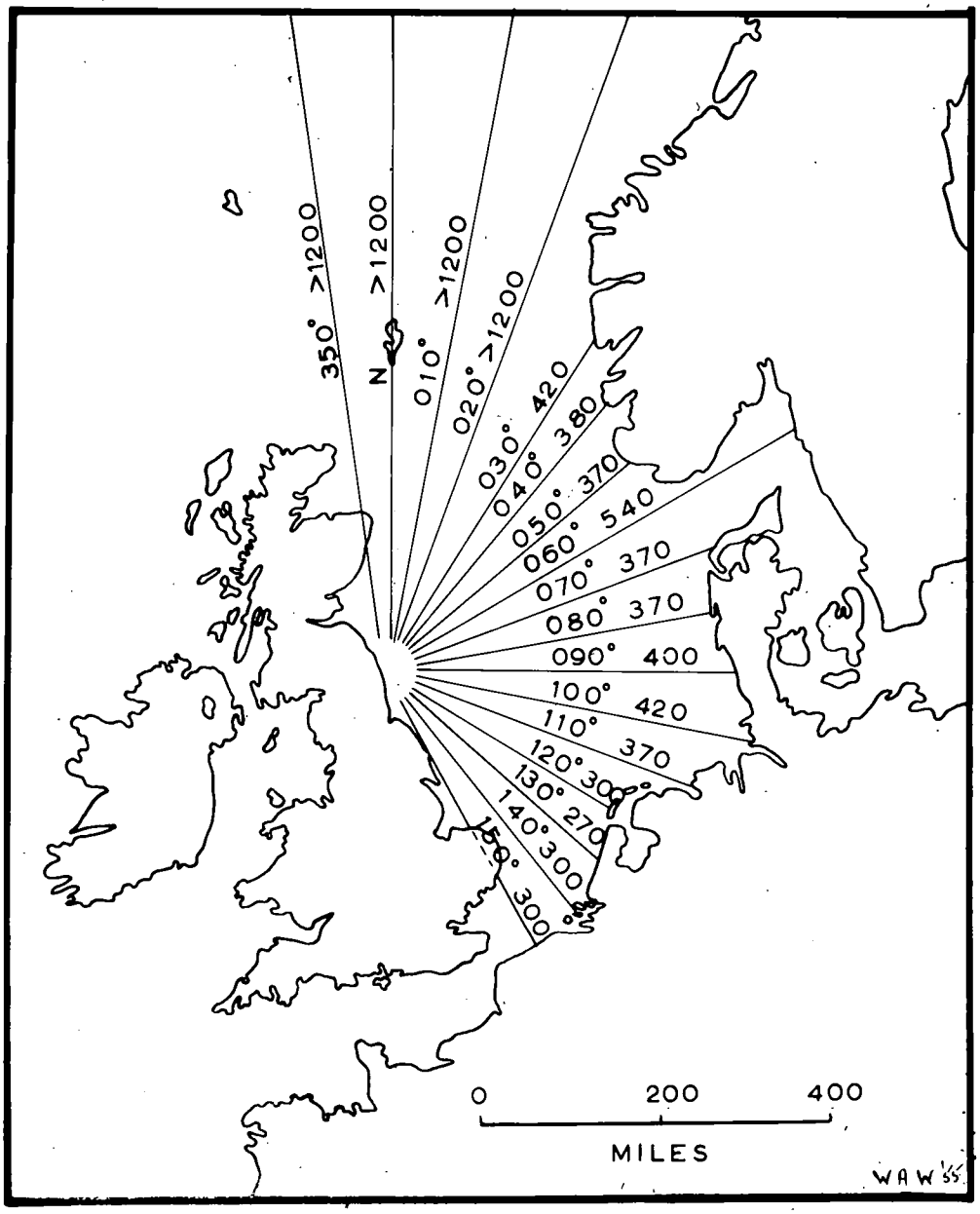


SOUTER POINT 1954.

MEAN HIGH WATER SPRING TIDE AT SUNDERLAND – 15·5 feet. DATUM – 7·3 O.D.

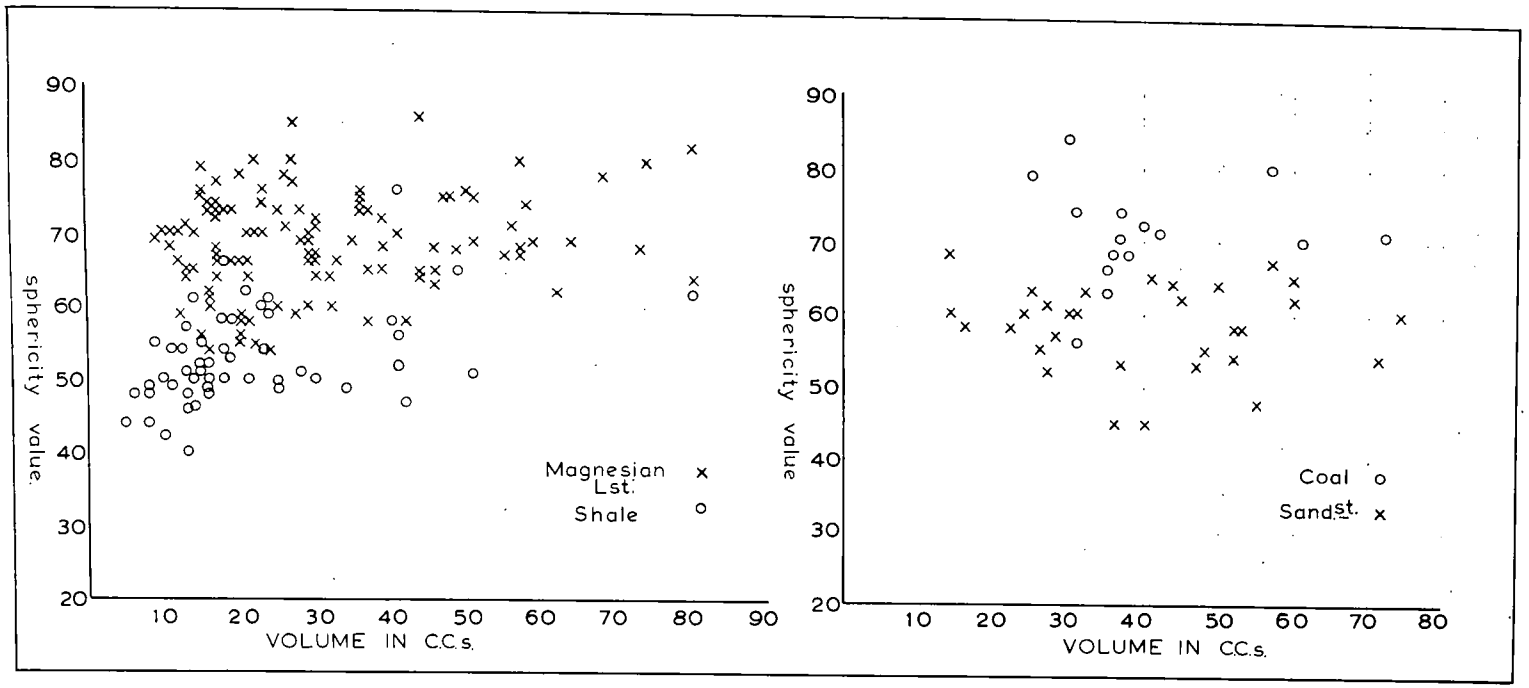
FIG. 23

FIG. 24



THE EXPOSURE OF NORTH EAST ENGLAND

SHOWING FETCH IN MILES



SPHERICITY ANALYSIS OF SHINGLE

FIG. 25

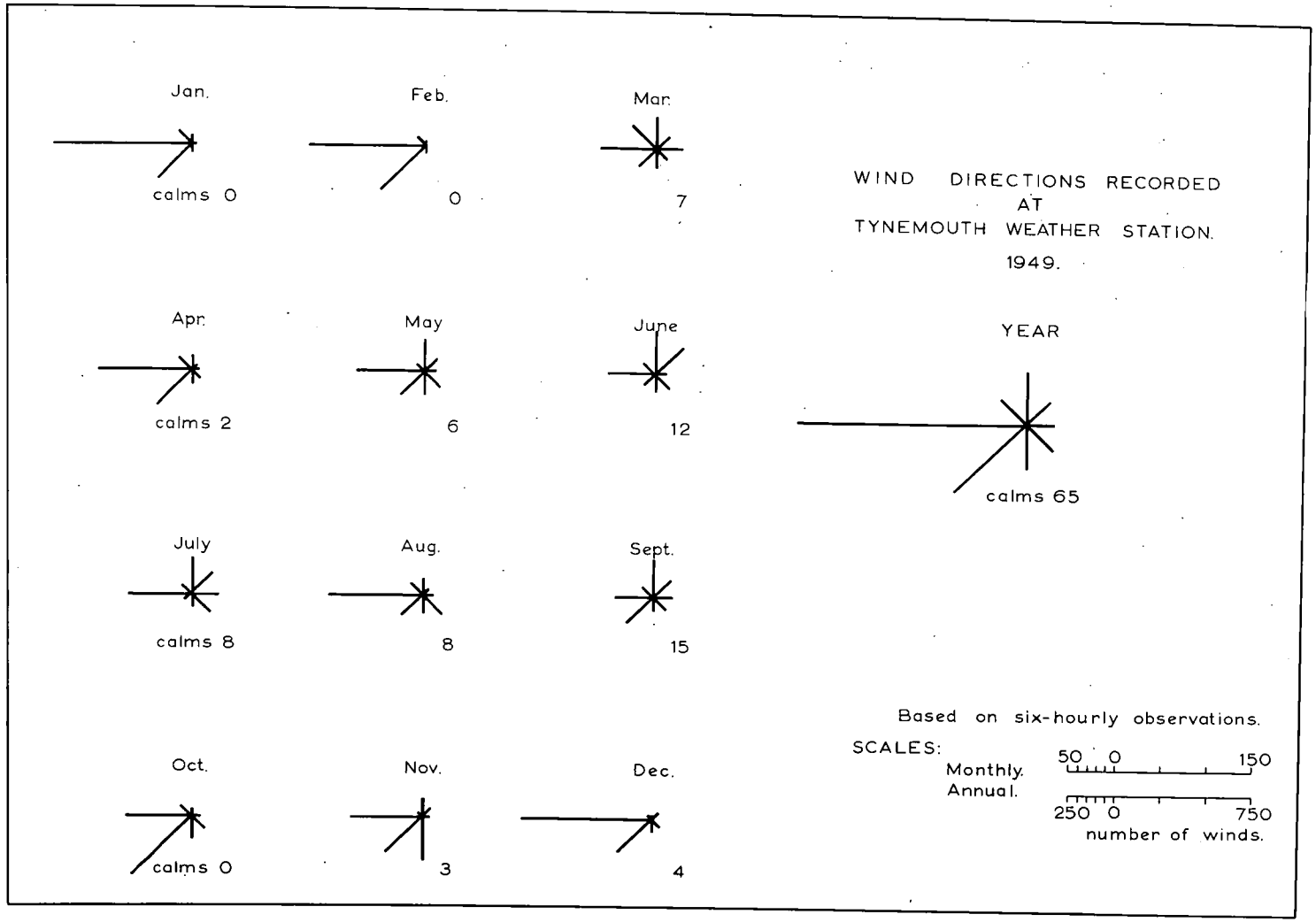

Jan.
calms 0
Feb.
0
Mar.
7
WIND DIRECTIONS RECORDED AT TYNEMOUTH WEATHER STATION. 1949.
Apr.
calms 2
May
6
June
12
YEAR
calms 65
July
calms 8
Aug.
8
Sept.
15
Based on six-hourly observations.
SCALES:
Monthly. 50 0 150
Annual. 250 0 750
number of winds.
Oct.
calms 0
Nov.
3
Dec.
4

FIG. 26

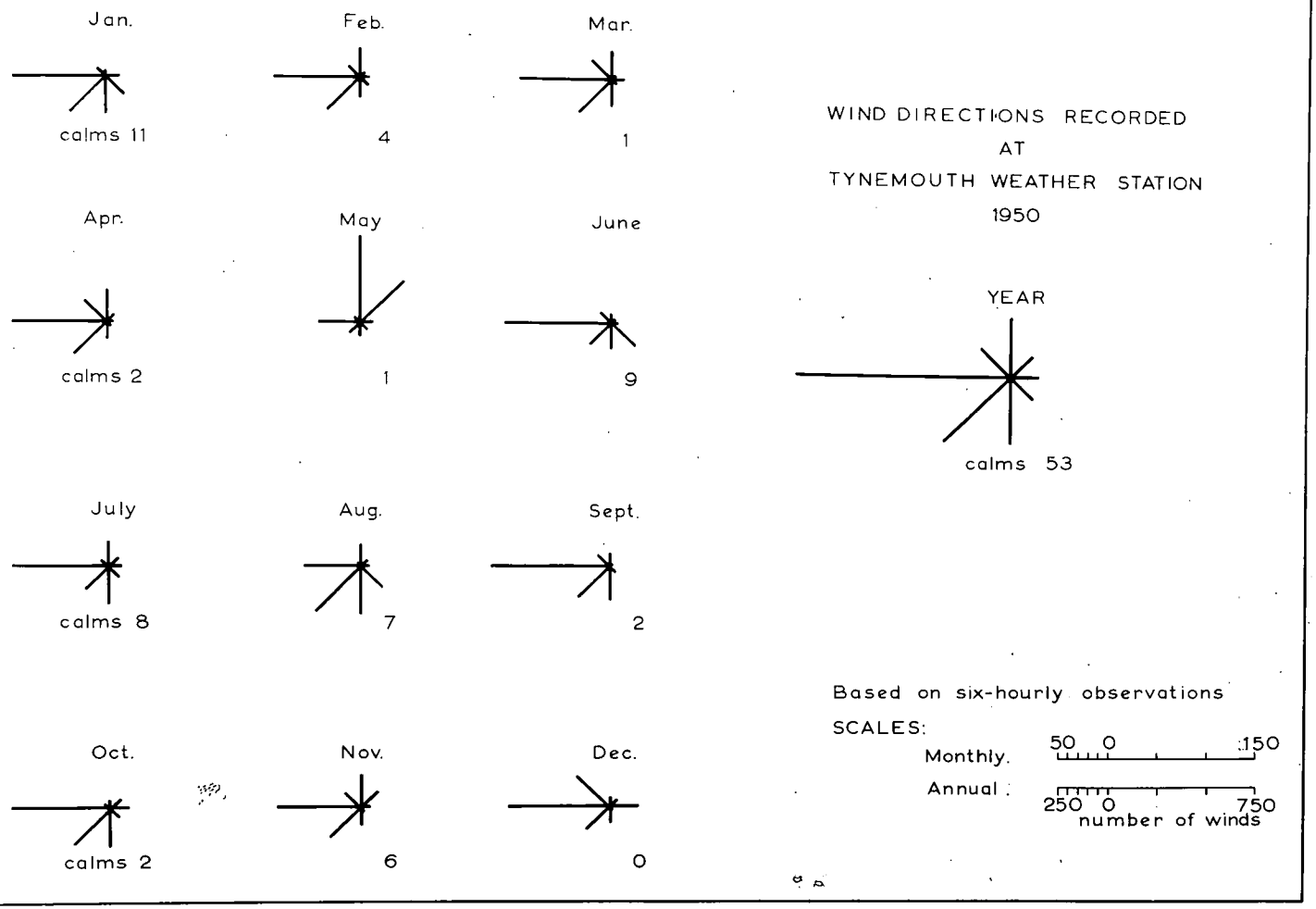

Jan.
calms 11
Feb.
4
Mar.
1
Apr.
calms 2
May
1
June
9
July
calms 8
Aug.
7
Sept.
2
Oct.
calms 2
Nov.
6
Dec.
0
WIND DIRECTIONS RECORDED
AT
TYNEMOUTH WEATHER STATION
1950
YEAR
calms 53
Based on six-hourly observations
SCALES:
Monthly.
50 0 150
Annual.
250 0 750
number of winds

FIG. 27

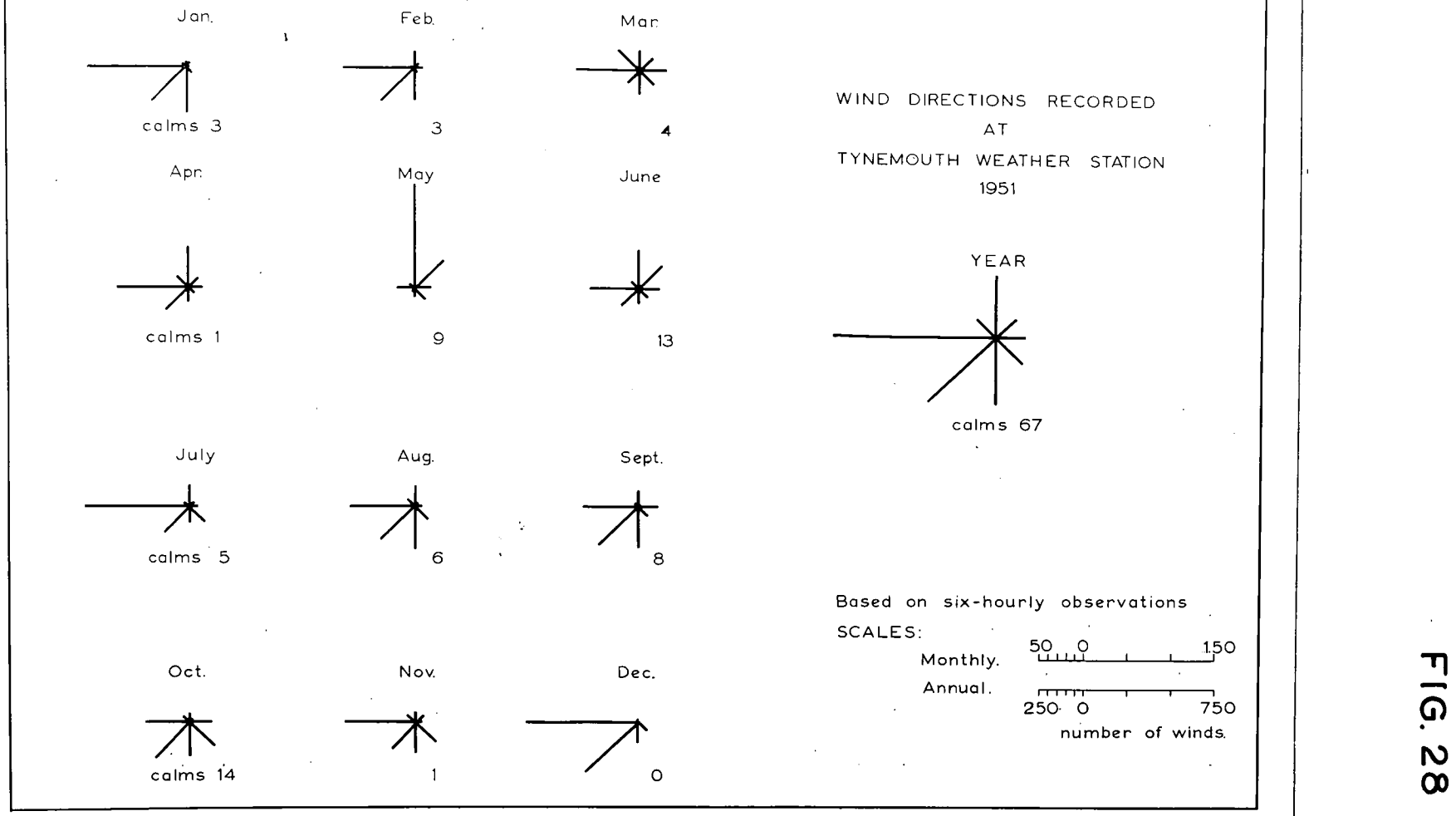

Jan.
calms 3
Feb.
3
Mar.
4
Apr.
calms 1
May
9
June
13
July
calms 5
Aug.
6
Sept.
8
Oct.
calms 14
Nov.
1
Dec.
0
WIND DIRECTIONS RECORDED
AT
TYNEMOUTH WEATHER STATION
1951
YEAR
calms 67
Based on six-hourly observations
SCALES:
Monthly.
50 0 150
Annual.
250 0 750
number of winds.

FIG. 28

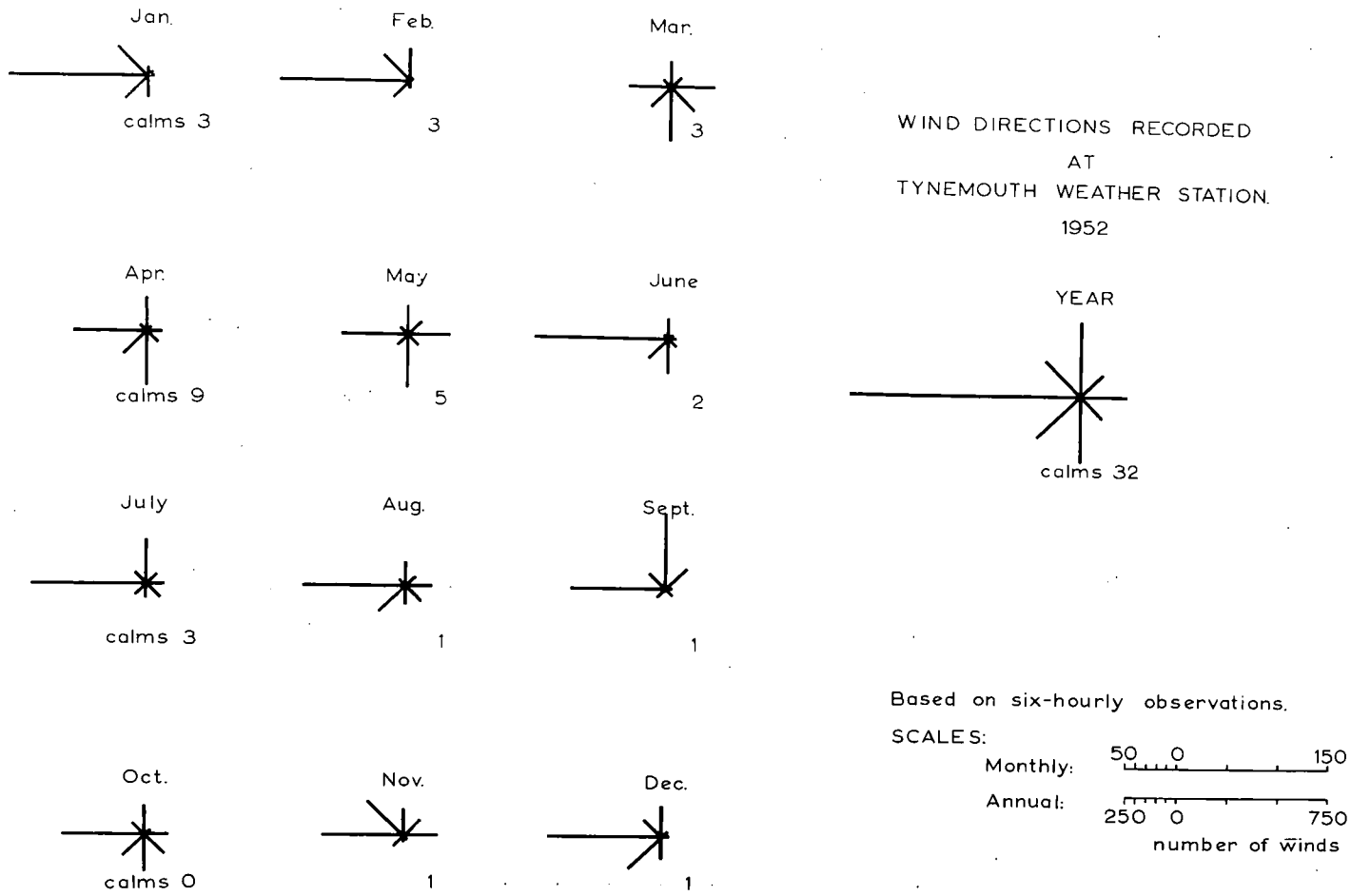

Jan.
calms 3
Feb.
3
Mar.
3
Apr.
calms 9
May
5
June
2
July
calms 3
Aug.
1
Sept.
1
Oct.
calms 0
Nov.
1
Dec.
1
WIND DIRECTIONS RECORDED
AT
TYNEMOUTH WEATHER STATION.
1952
YEAR
calms 32
Based on six-hourly observations.
SCALES:
Monthly:
50 0 150
Annual:
250 0 750
number of winds

FIG. 29

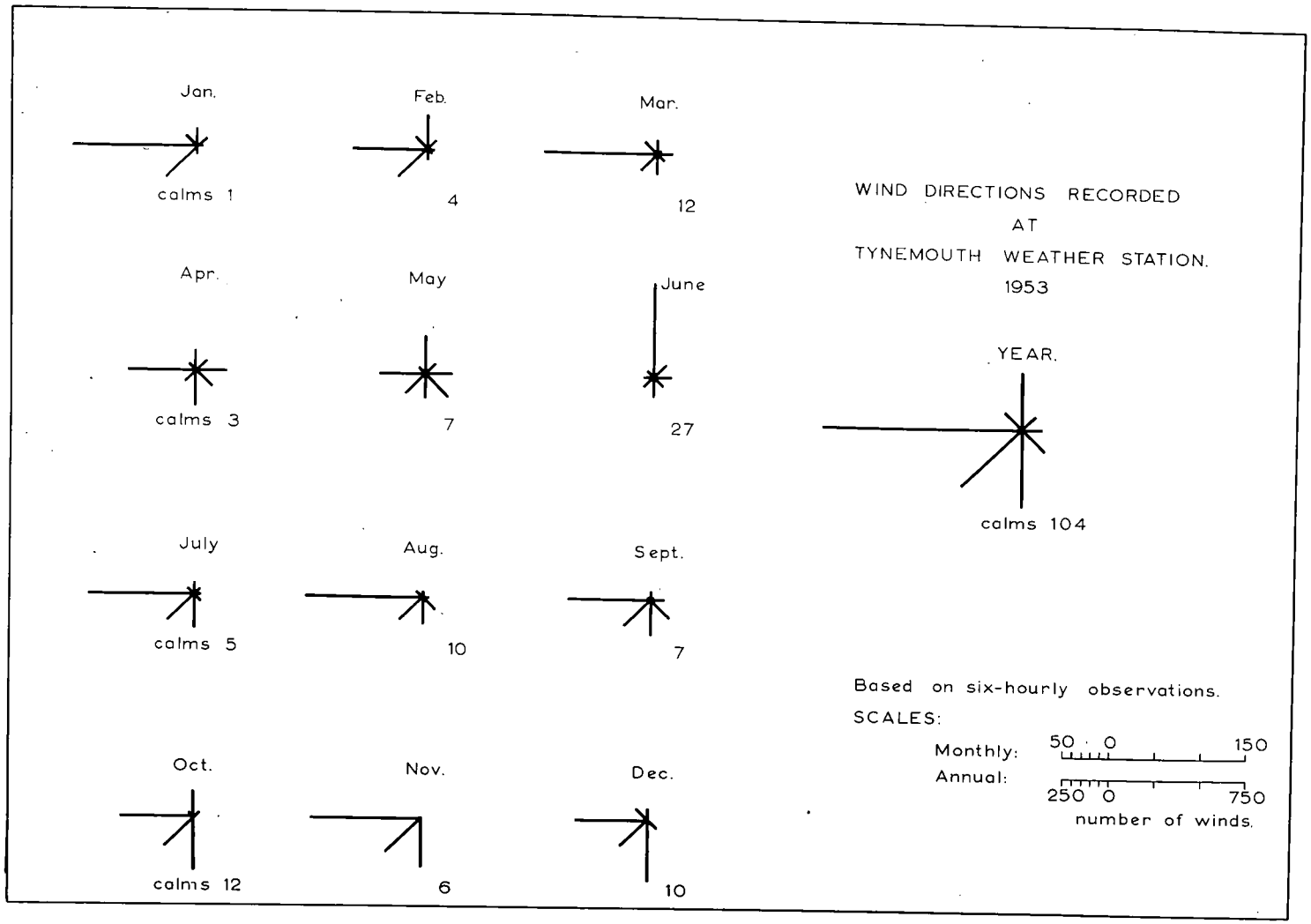

Jan.
calms 1
Feb.
4
Mar.
12
Apr.
calms 3
May
7
June
27
July
calms 5
Aug.
10
Sept.
7
Oct.
calms 12
Nov.
6
Dec.
10
WIND DIRECTIONS RECORDED
AT
TYNEMOUTH WEATHER STATION.
1953
YEAR.
calms 104
Based on six-hourly observations.
SCALES:
Monthly: 50 0 150
Annual: 250 0 750
number of winds.

FIG. 30

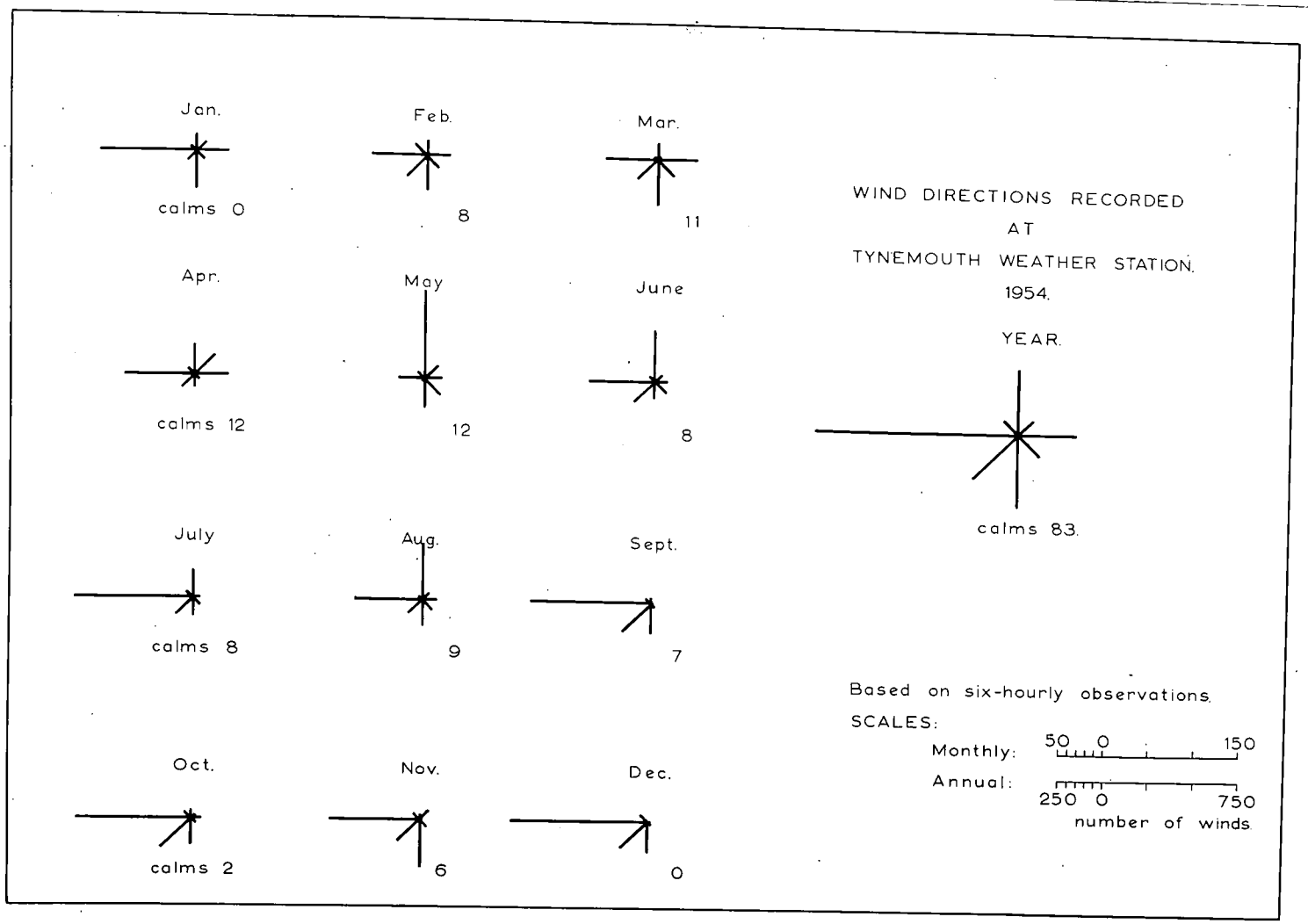

Jan.
calms 0
Feb.
8
Mar.
11
Apr.
calms 12
May
12
June
8
July
calms 8
Aug.
9
Sept.
7
Oct.
calms 2
Nov.
6
Dec.
0
WIND DIRECTIONS RECORDED
AT
TYNEMOUTH WEATHER STATION.
1954.
YEAR.
calms 83.
Based on six-hourly observations.
SCALES:
Monthly: 50 0 150
Annual: 250 0 750
number of winds

FIG. 31

FIG. 32

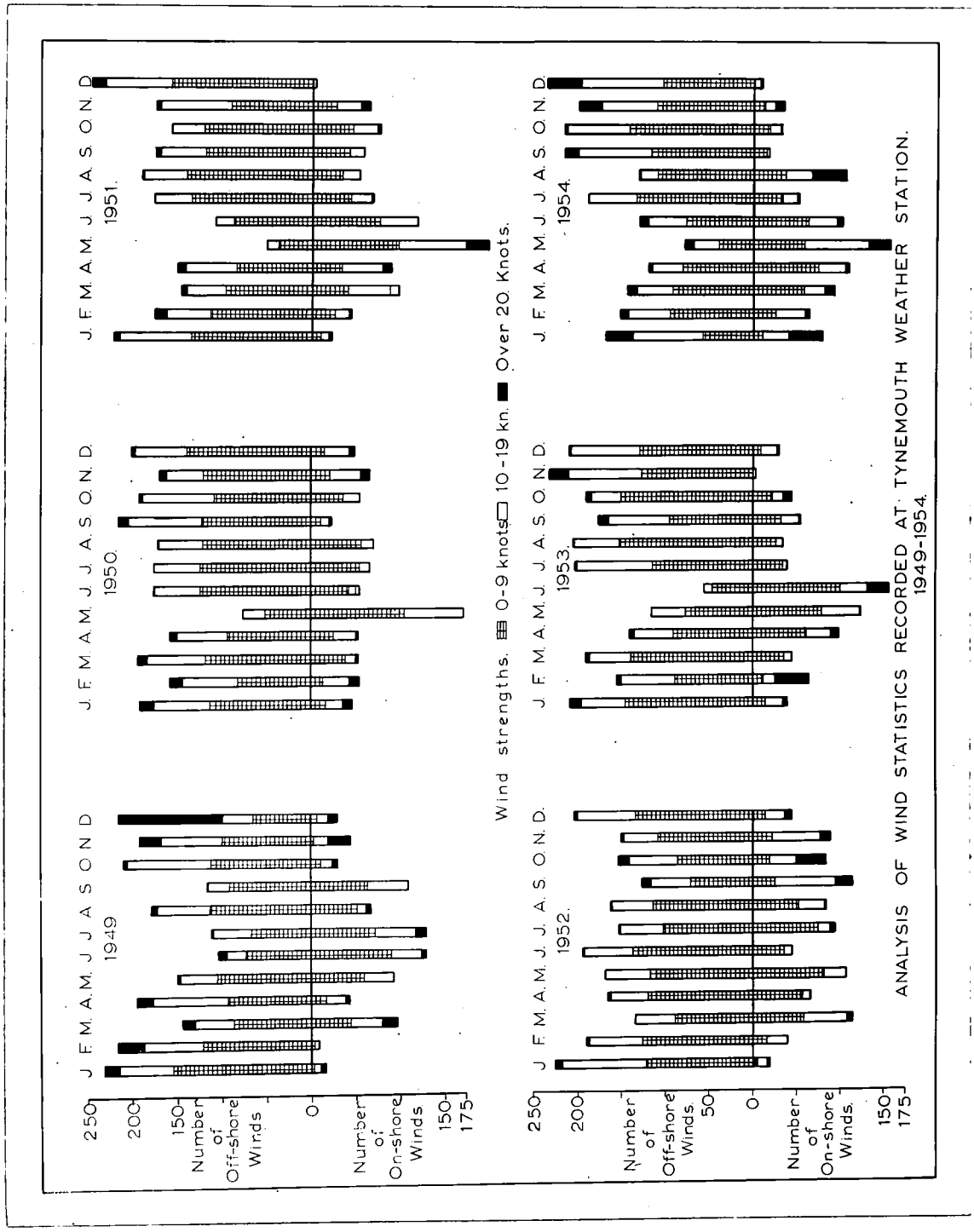

ANALYSIS OF WIND STATISTICS RECORDED AT TYNEMOUTH WEATHER STATION.
1949-1954.
Wind strengths. 0-9 knots 10-19 kn. Over 20 Knots.
1949
1950
1951
1952
1953
1954
J F M A M J J A S O N D
Number of Off-shore Winds
Number of On-shore Winds
250
200
150
50
0
150
175

FIG. 33.

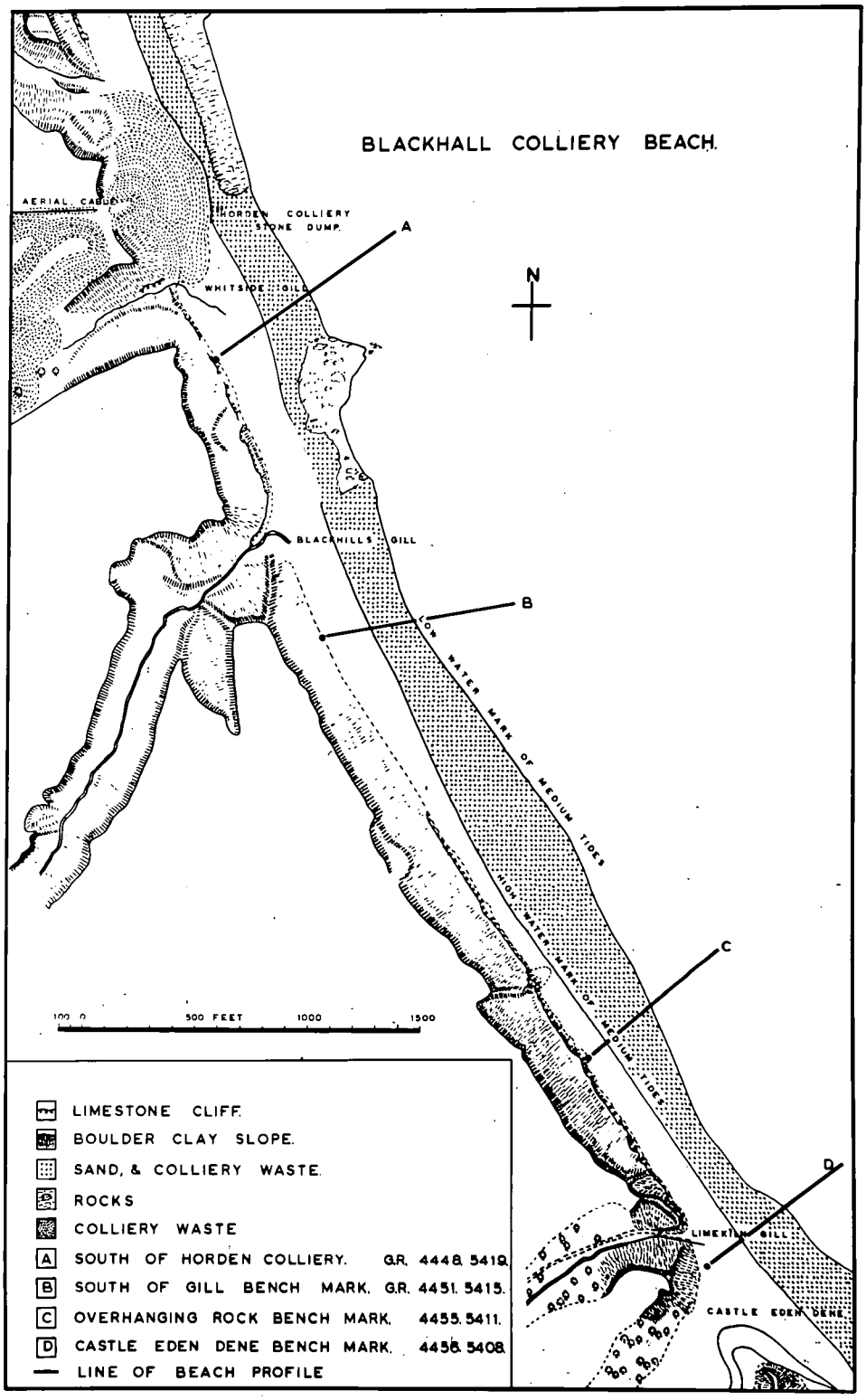
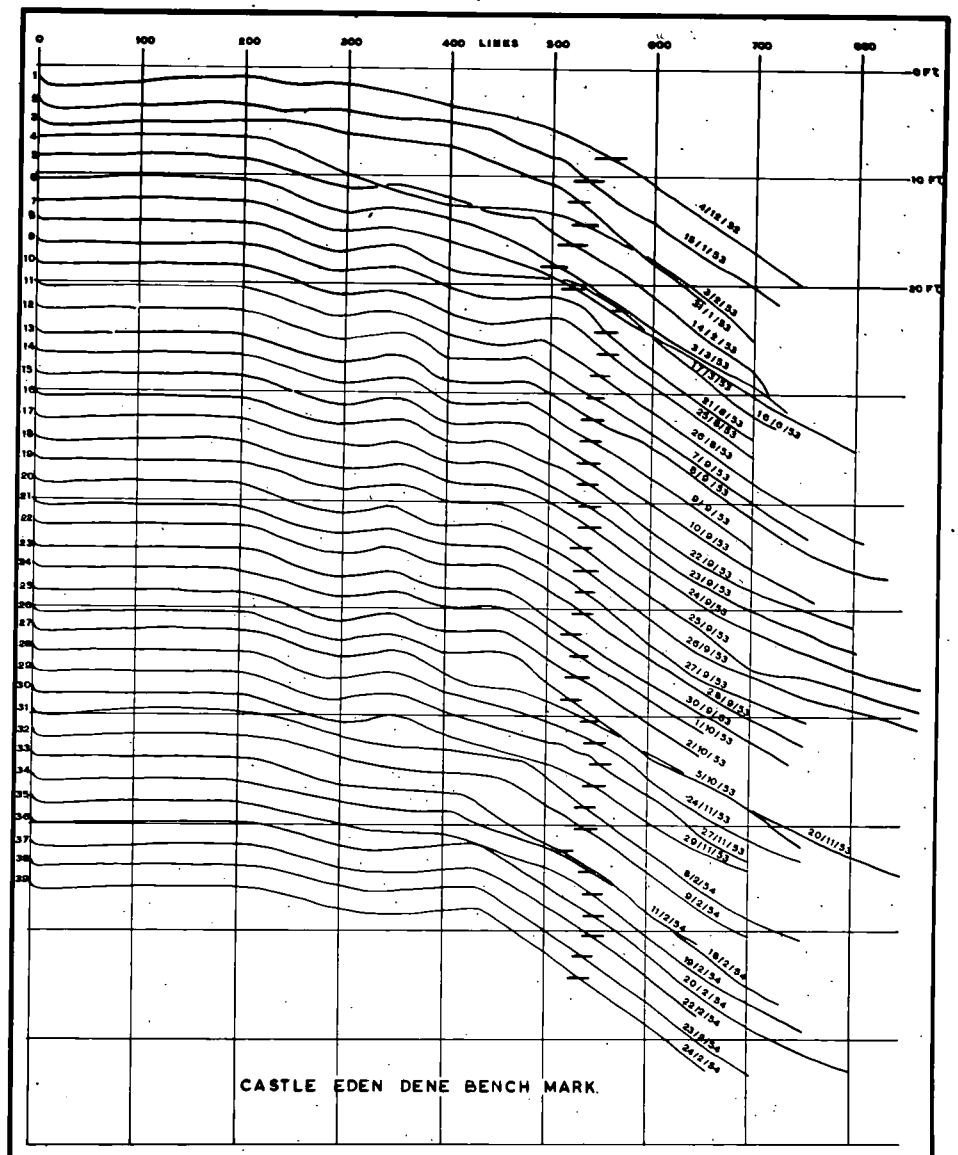

BLACKHALL COLLIERY BEACH.
AERIAL CABLE
HORDEN COLLIERY STONE DUMP.
WHITSIDE GILL
BLACKHILLS GILL
A
B
C
D
N
LOW WATER MARK OF MEDIUM TIDES
HIGH WATER MARK OF MEDIUM TIDES
100 0
500 FEET
1000
1500
LIMERICK GILL
CASTLE EDEN DENE
LIMESTONE CLIFF.
BOULDER CLAY SLOPE.
SAND, & COLLIERY WASTE.
ROCKS
COLLIERY WASTE
A SOUTH OF HORDEN COLLIERY. G.R. 4448. 5419.
B SOUTH OF GILL BENCH MARK. G.R. 4451. 5415.
C OVERHANGING ROCK BENCH MARK. 4455. 5411.
D CASTLE EDEN DENE BENCH MARK. 4458. 5408.
LINE OF BEACH PROFILE

FIG.34



BEACH PROFILES

MEASURED NORTH OF CASTLE EDEN DENE MOUTH.

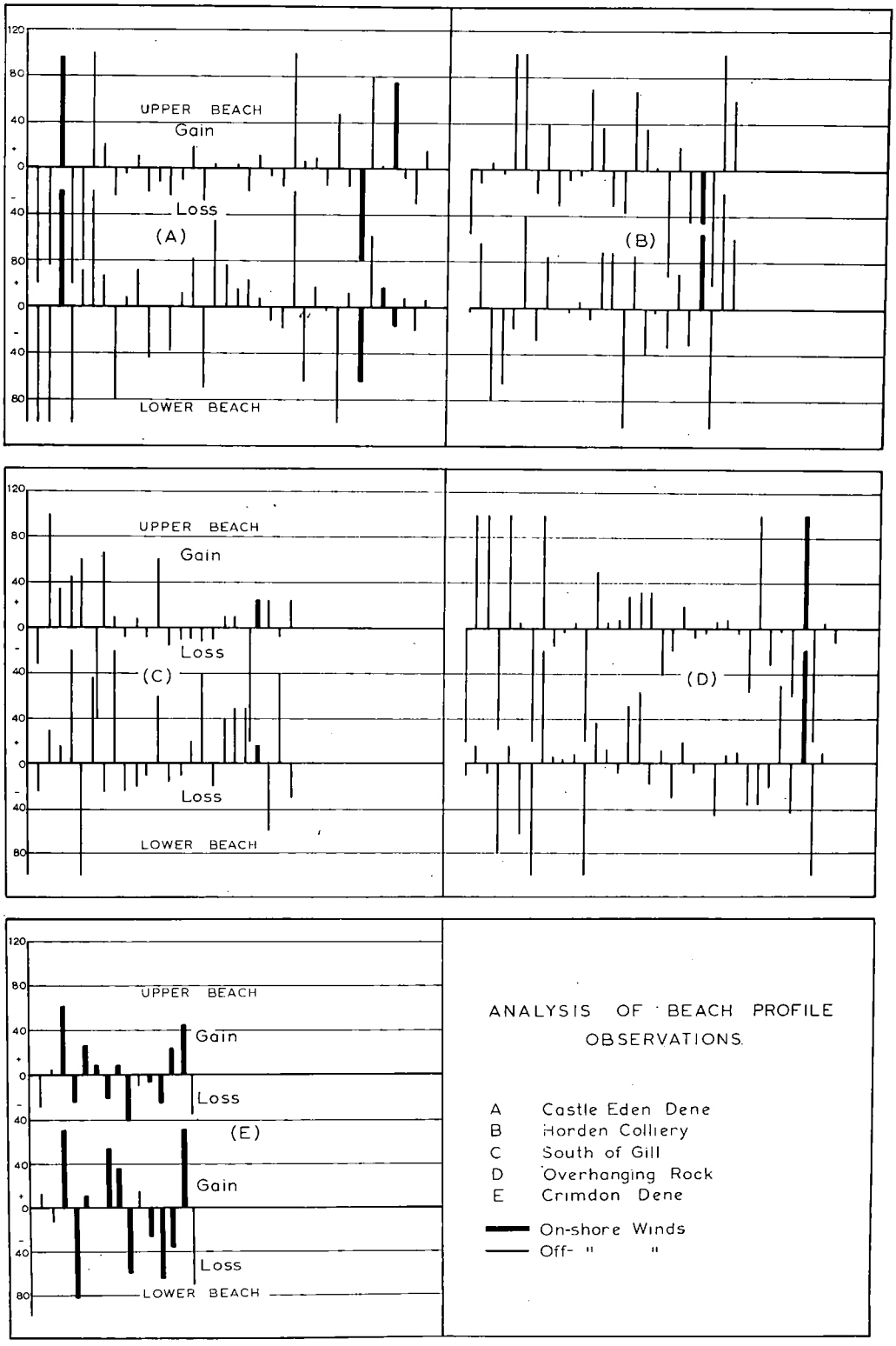
GRID REFERENCE 4456 5408.

HORIZONTAL SCALE: ONE INCH = 50 (GUNTER) LINKS OR 33 FEET

VERTICAL SCALE: ONE INCH = 5 FEET

⊟ : Mean High Water Spring Tides.
Height Of Temporary Bench Mark 16.02 ft. O.D.

FIG. 35


120
80
40
+
0
-
40
80
+
0
-
40
80
UPPER BEACH
Gain
Loss
(A)
LOWER BEACH
(B)
UPPER BEACH
Gain
Loss
(C)
Loss
LOWER BEACH
(D)
UPPER BEACH
Gain
Loss
(E)
Gain
Loss
LOWER BEACH
ANALYSIS OF BEACH PROFILE OBSERVATIONS.
A Castle Eden Dene
B Horden Colliery
C South of Gill
D Overhanging Rock
E Crimdon Dene
On-shore Winds
Off- " "

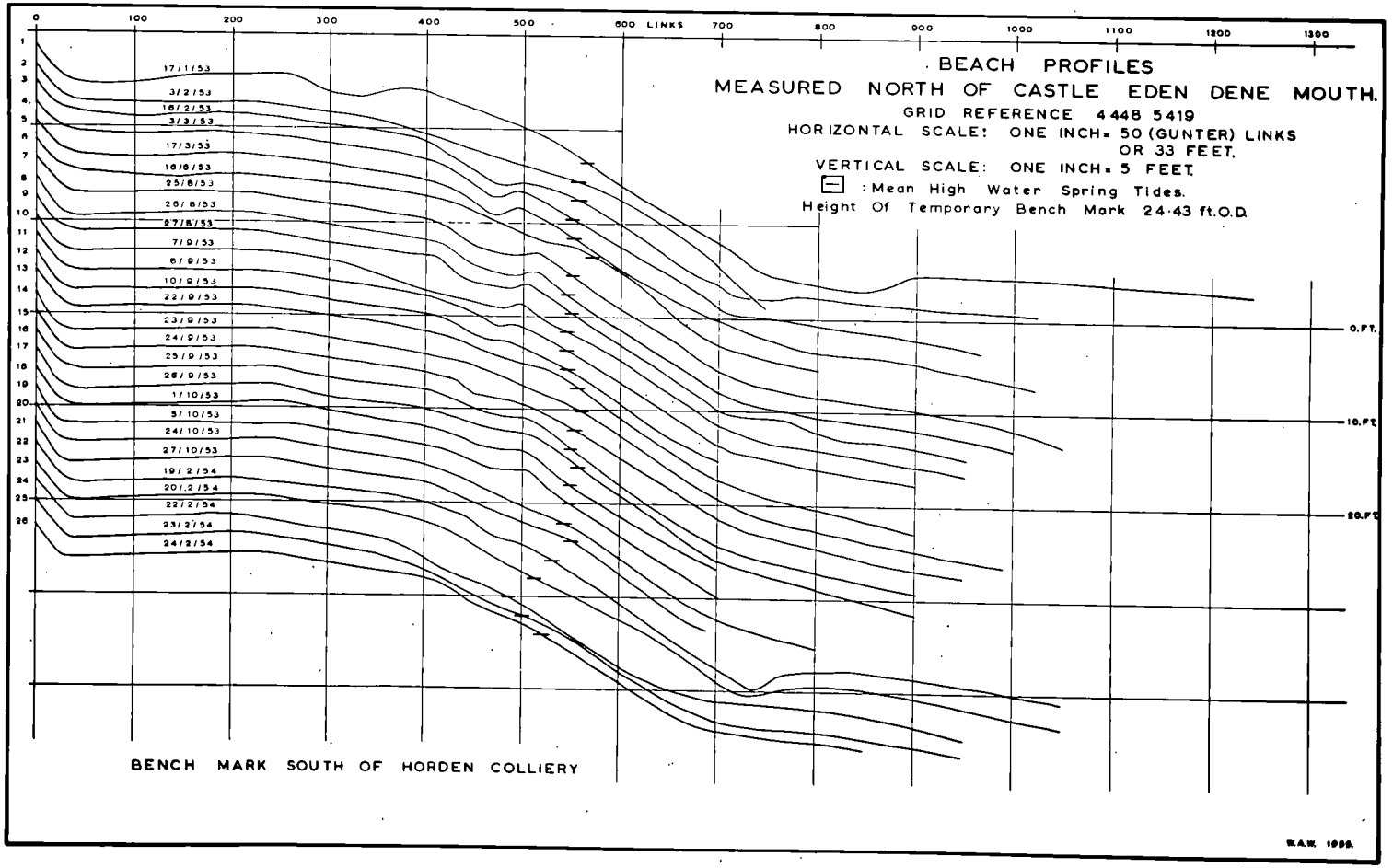

BEACH PROFILES
MEASURED NORTH OF CASTLE EDEN DENE MOUTH.
GRID REFERENCE 4448 5419
HORIZONTAL SCALE: ONE INCH = 50 (GUNTER) LINKS
OR 33 FEET.
VERTICAL SCALE: ONE INCH = 5 FEET.
: Mean High Water Spring Tides.
Height Of Temporary Bench Mark 24·43 ft.O.D.
0 100 200 300 400 500 600 LINKS 700 800 900 1000 1100 1200 1300
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
17/1/53
3/2/53
16/2/53
3/3/53
17/3/53
16/6/53
25/8/53
26/8/53
27/8/53
7/9/53
8/9/53
10/9/53
22/9/53
23/9/53
24/9/53
25/9/53
26/9/53
1/10/53
5/10/53
24/10/53
27/10/53
19/2/54
20/2/54
22/2/54
23/2/54
24/2/54
0 FT.
10 FT.
20 FT.
BENCH MARK SOUTH OF HORDEN COLLIERY
W.A.W. 1958.

FIG. 36

FIG. 37

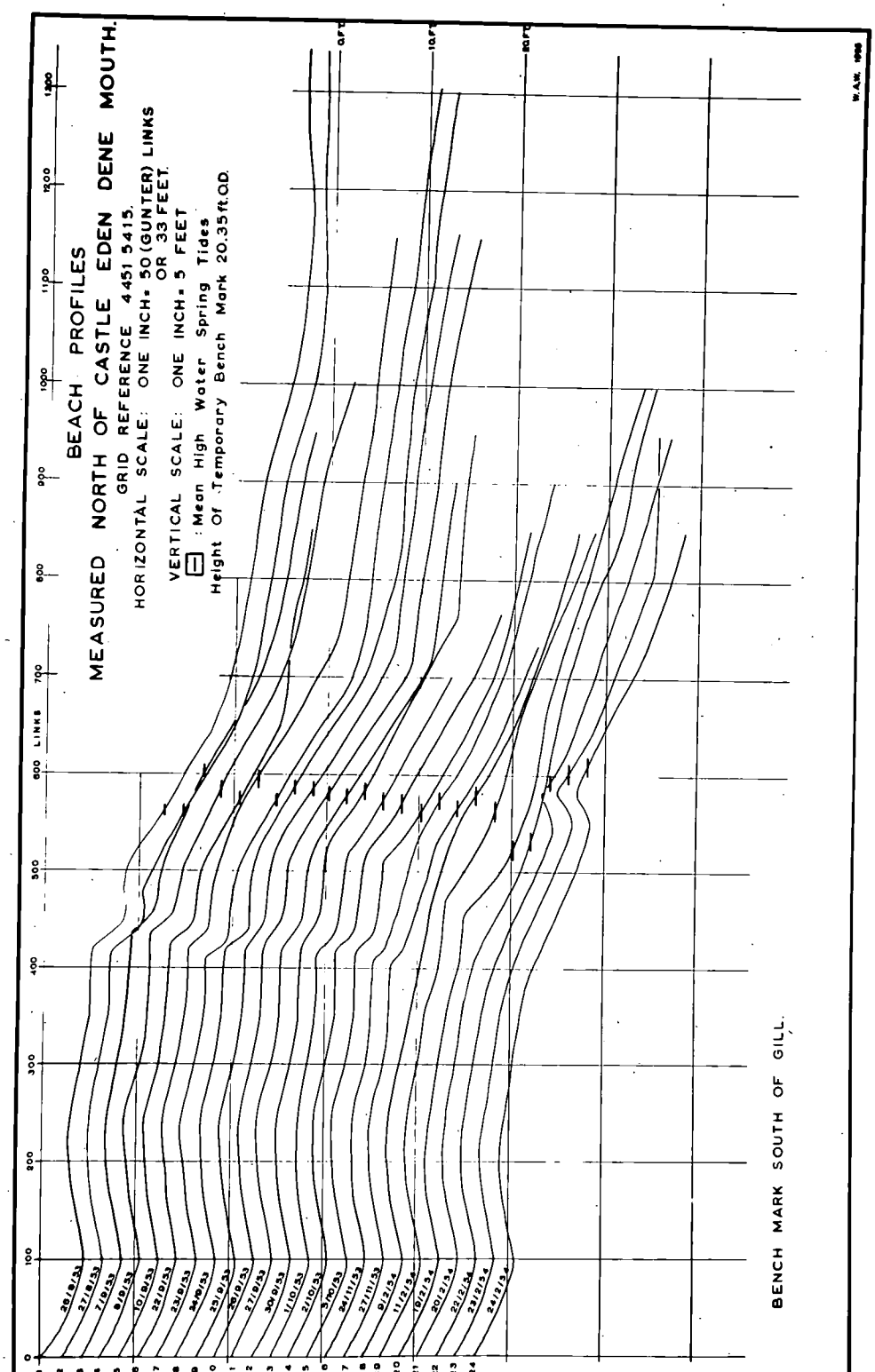
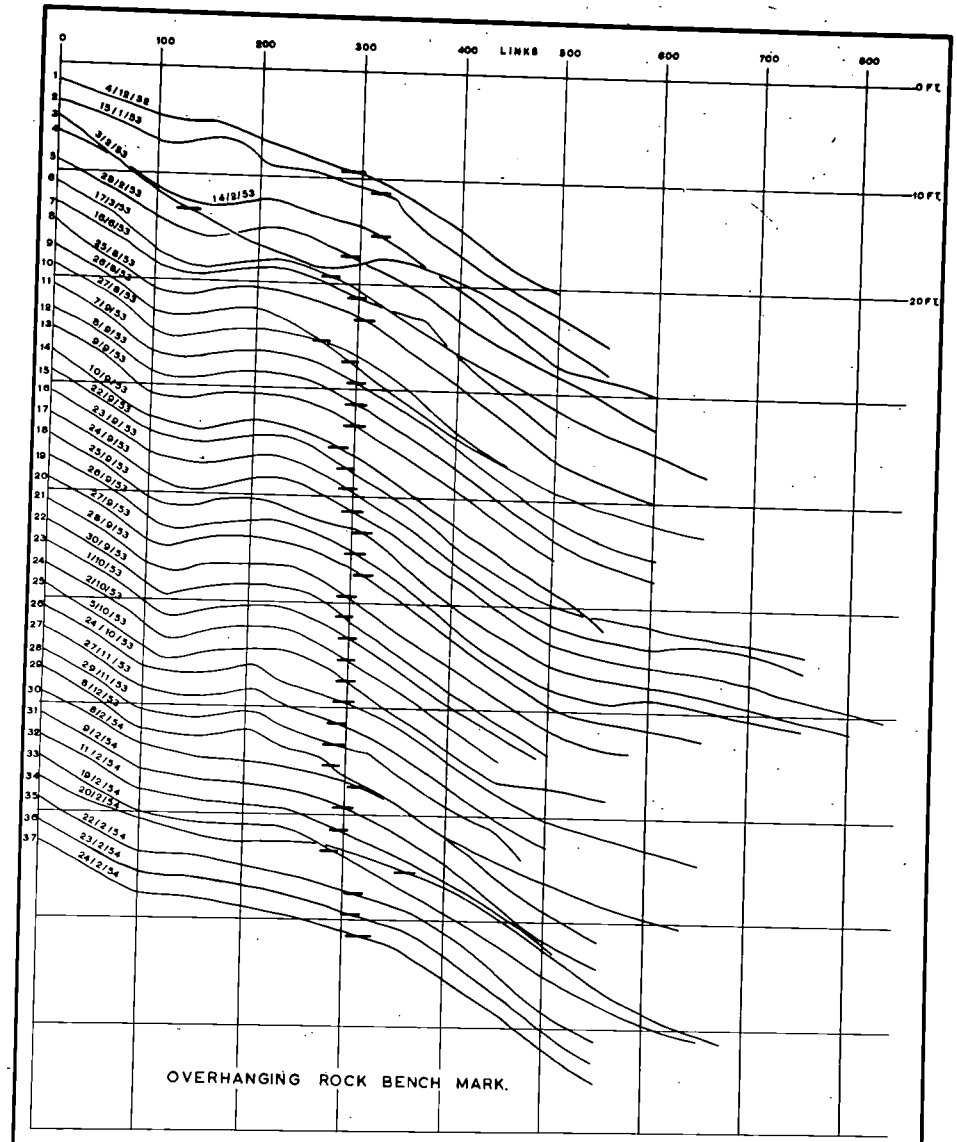

BEACH PROFILES
MEASURED NORTH OF CASTLE EDEN DENE MOUTH.
GRID REFERENCE 4451 5415.
HORIZONTAL SCALE: ONE INCH = 50 (GUNTER) LINKS OR 33 FEET.
VERTICAL SCALE: ONE INCH = 5 FEET
: Mean High Water Spring Tides
Height Of Temporary Bench Mark 20.35ft.OD.
LINKS
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
0 FT.
10 FT.
20 FT.
28/8/53
27/8/53
7/9/53
8/9/53
10/9/53
22/9/53
23/9/53
24/9/53
25/9/53
26/9/53
27/9/53
30/9/53
1/10/53
2/10/53
3/10/53
24/11/53
27/11/53
9/2/54
11/2/54
19/2/54
20/2/54
22/2/54
23/2/54
24/2/54
BENCH MARK SOUTH OF GILL.
W.A.M. 1953

FIG. 38



BEACH PROFILES

MEASURED NORTH OF CASTLE EDEN DENE MOUTH.

GRID REFERENCE 4455 5411.

HORIZONTAL SCALE: ONE INCH = 50 (GUNTER) LINKS OR 33 FEET.

VERTICAL SCALE: ONE INCH = 5 FEET.

⊟ : Mean High Water Spring Tides

Height Of Temporary Bench Mark 25.01ft O.D.

W.A.W. 1955

FIG. 39

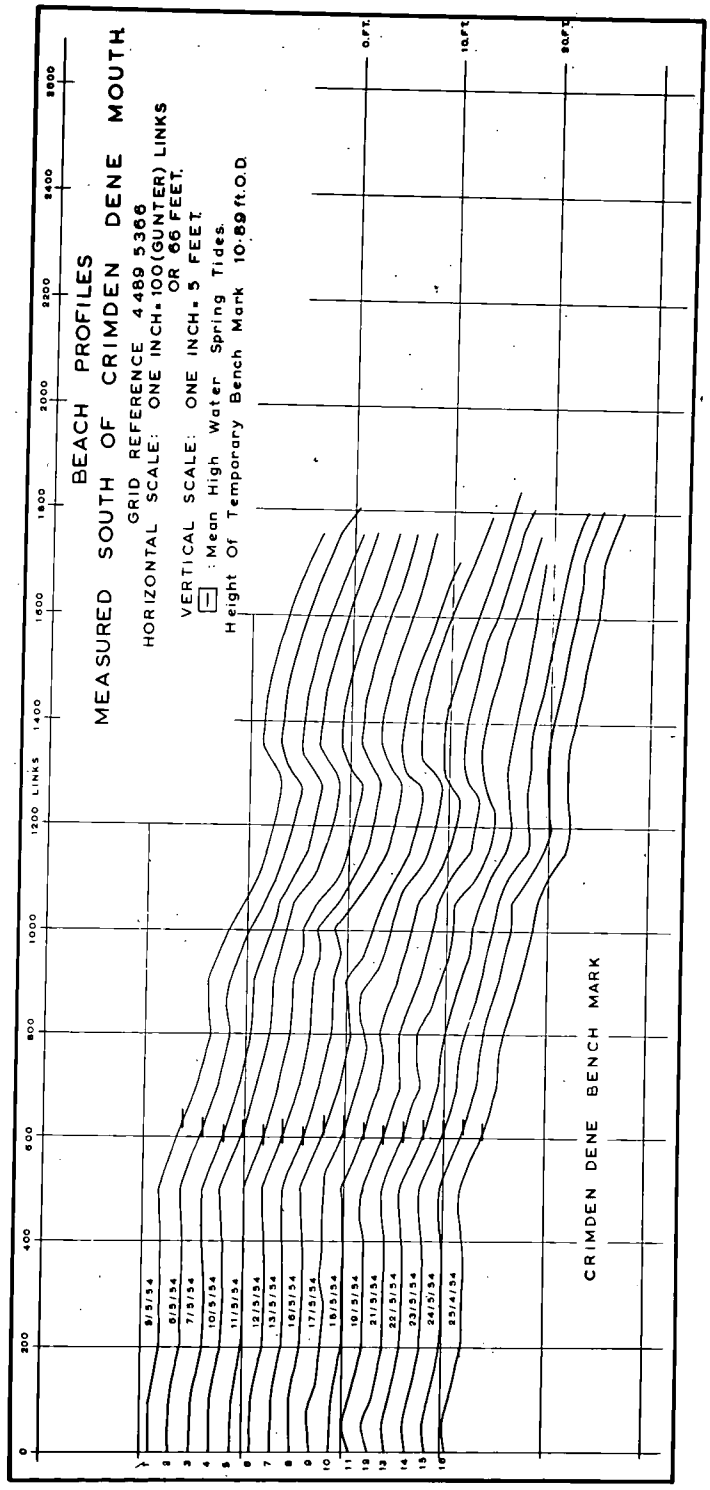
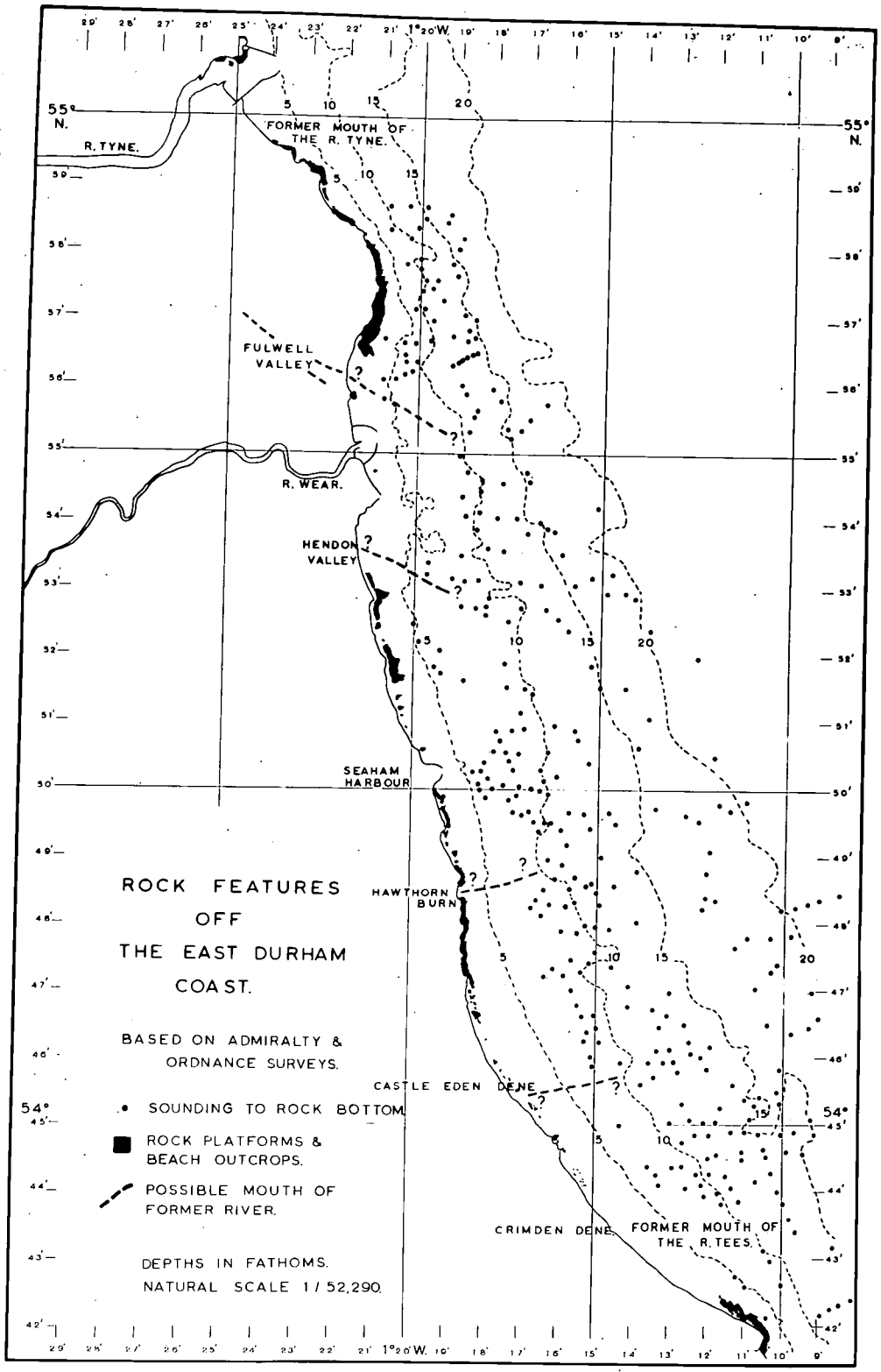

BEACH PROFILES
MEASURED SOUTH OF CRIMDEN DENE MOUTH
GRID REFERENCE 4489 5366
HORIZONTAL SCALE: ONE INCH = 100 (GUNTER) LINKS OR 66 FEET.
VERTICAL SCALE: ONE INCH = 5 FEET.
: Mean High Water Spring Tides.
Height Of Temporary Bench Mark 10·89 ft. O.D
0 FT.
10 FT.
20 FT.
0
200
400
600
800
1000
1200 LINKS
1400
1600
1800
2000
2200
2400
2600
8/5/34
9/5/34
7/5/34
10/5/34
11/5/34
12/5/34
13/5/34
16/5/34
17/5/34
18/5/34
19/5/34
21/5/34
22/5/34
23/5/34
24/5/34
25/4/34
CRIMDEN DENE BENCH MARK

FIG. 40


ROCK FEATURES
OFF
THE EAST DURHAM
COAST.
BASED ON ADMIRALTY &
ORDNANCE SURVEYS.
SOUNDING TO ROCK BOTTOM.
ROCK PLATFORMS &
BEACH OUTCROPS.
POSSIBLE MOUTH OF
FORMER RIVER.
DEPTHS IN FATHOMS.
NATURAL SCALE 1 / 52,290.
R. TYNE.
FORMER MOUTH OF
THE R. TYNE.
FULWELL
VALLEY
R. WEAR.
HENDON
VALLEY
SEAHAM
HARBOUR
HAWTHORN
BURN
CASTLE EDEN DENE
CRIMDEN DENE
FORMER MOUTH OF
THE R. TEES.
55° N.
54° N.
1°20' W.

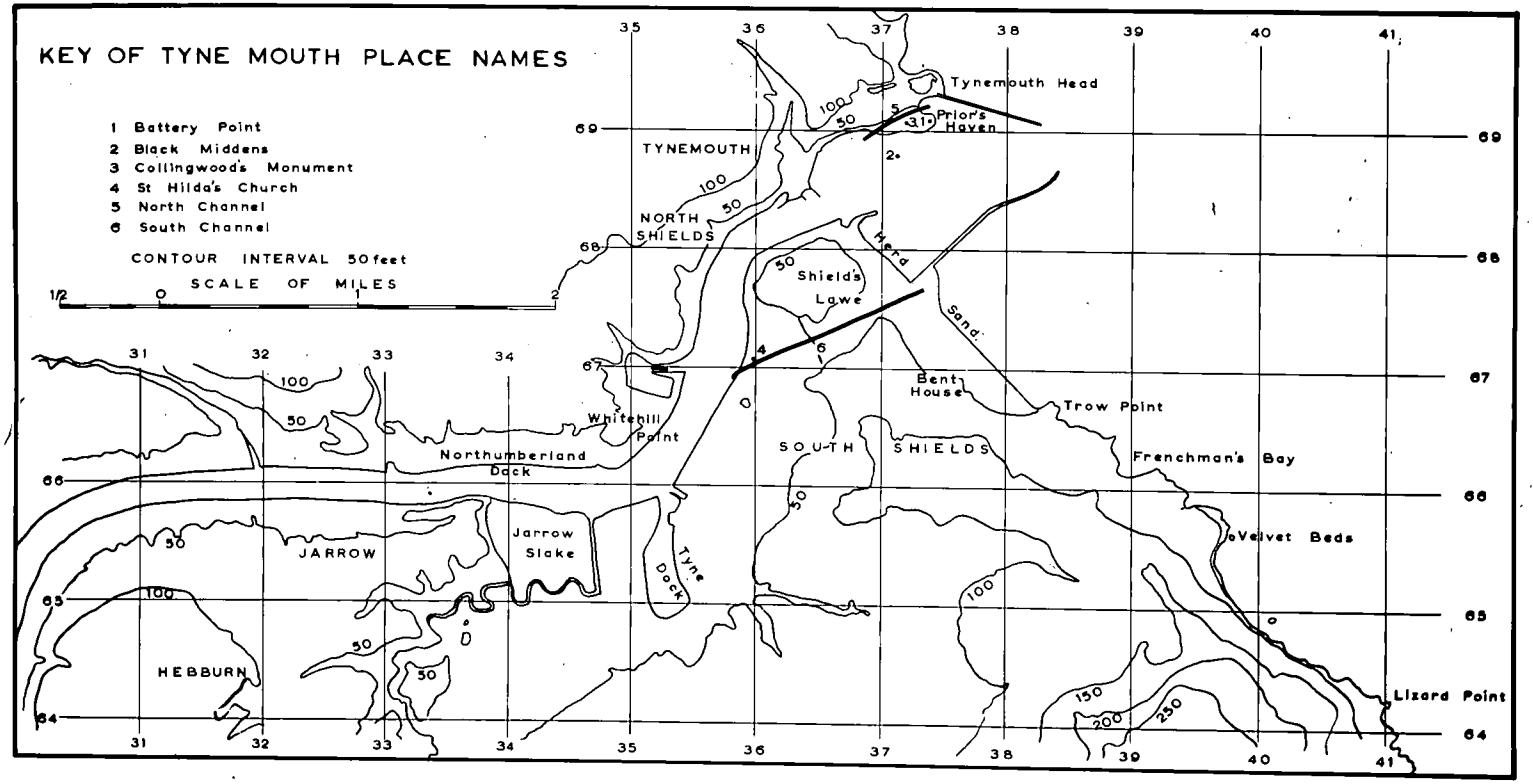

KEY OF TYNE MOUTH PLACE NAMES
1 Battery Point
2 Black Middens
3 Collingwood's Monument
4 St Hilda's Church
5 North Channel
6 South Channel
CONTOUR INTERVAL 50 feet
SCALE OF MILES
1/2
0
1
2
Tynemouth Head
Prior's Haven
TYNEMOUTH
NORTH SHIELDS
Herd Sand
Shield's Lawe
Bent House
Trow Point
Whitehill Point
Northumberland Dock
SOUTH SHIELDS
Frenchman's Bay
Velvet Beds
JARROW
Jarrow Slake
Tyne Dock
HEBBURN
Lizard Point
100
50
150
200
250
31
32
33
34
35
36
37
38
39
40
41
64
65
66
67
68
69

FIG. 41

FIG. 42

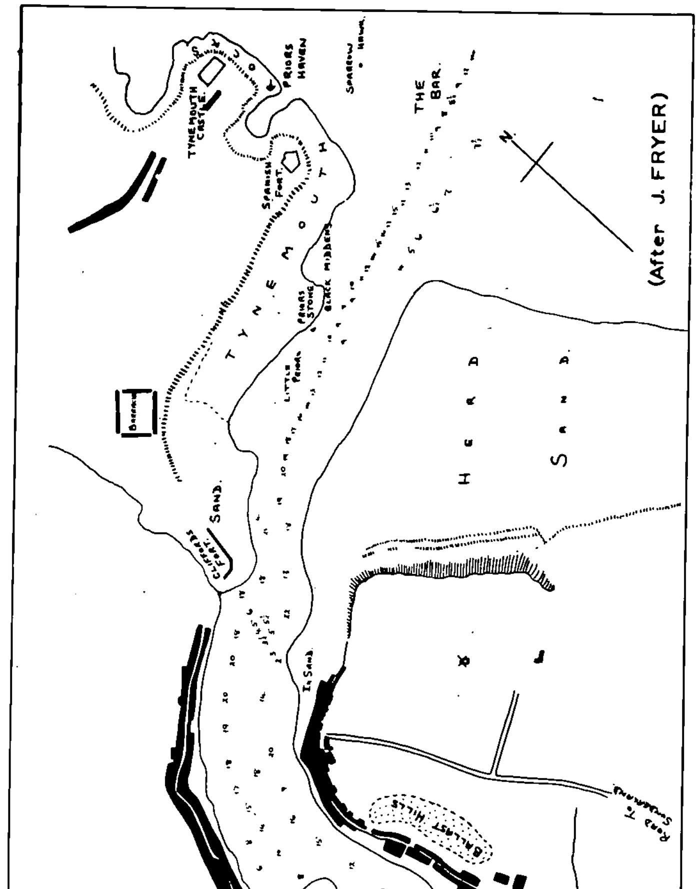

A PLAN OF THE RIVER TYNE 1773.
Soundings denote depth in feet at LOW WATER.
(After J. FRYER)
TYNEMOUTH CASTLE
PRIORS HAVEN
THE BAR.
SPANISH FORT
TYNE MOUTH
BLACK MIDDENS
PRIORS STONE
LITTLE PRIORS
HERD SAND
SAND
CLIFFORD'S FORT
ROAD TO SUNDERLAND
BALLAST HILLS
BURTWICK SAND
MILL DAM
COBLE DEAN
WHITEHILL POINT
JARROW SLAKE.

FIG. 43

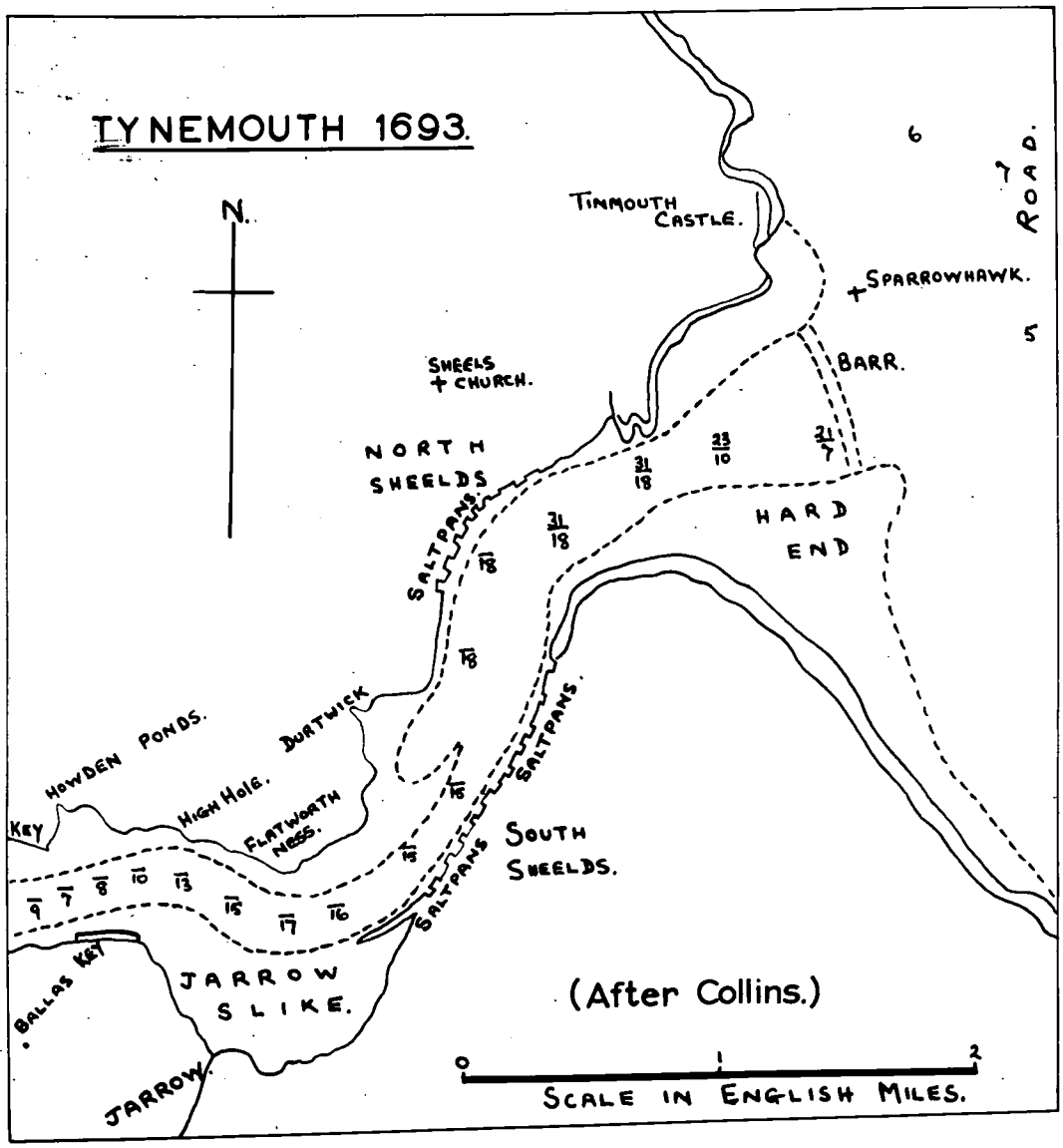

TYNEMOUTH 1693.
N.
TINMOUTH CASTLE.
SPARROWHAWK.
BARR.
SHEELS + CHURCH.
NORTH SHEELDS
SALTPANS.
HARD END
HOWDEN PONDS.
DURTWICK
KEY
HIGH HOLG.
FLATWORTH NESS.
SALTPANS.
SOUTH SHEELDS.
BALLAS KEY
JARROW SLIKE.
JARROW.
(After Collins.)
0
1
2
SCALE IN ENGLISH MILES.

FIG. 44

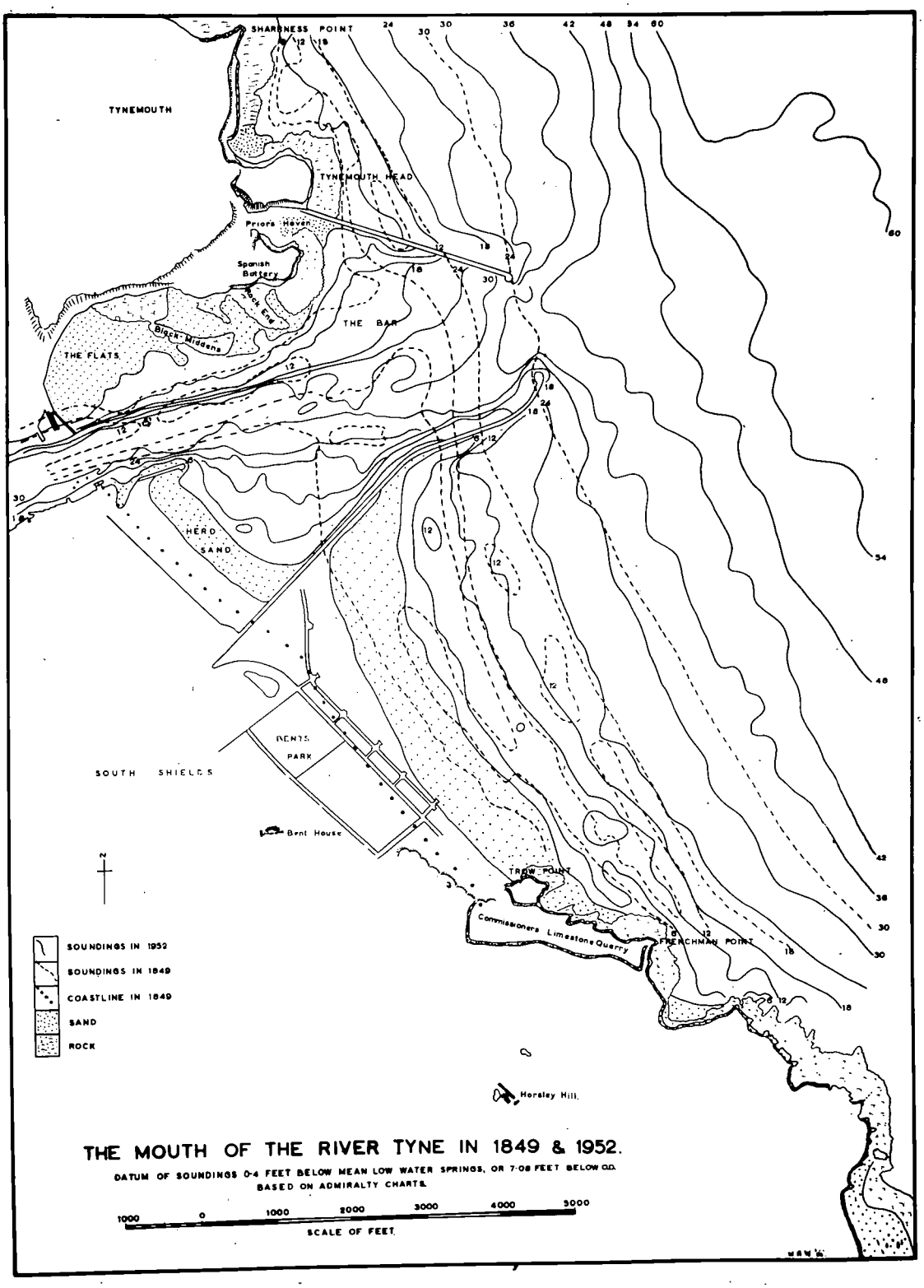
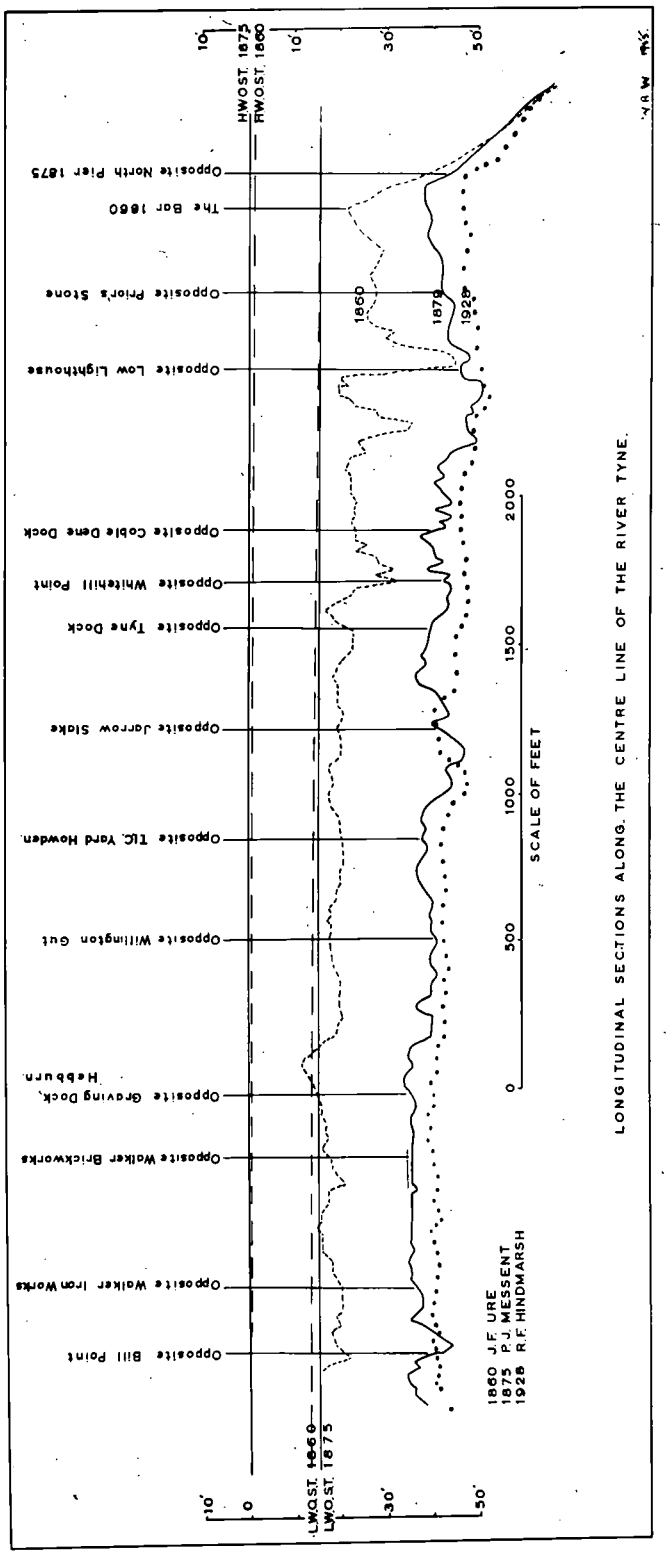

SHARPNESS POINT
TYNEMOUTH
TYNEMOUTH HEAD
Priors Haven
Spanish Battery
Black Middens
THE BAR
THE FLATS
HERD SAND
SOUTH SHIELDS
DENTS PARK
Brent House
TROW POINT
Commissioners Limestone Quarry
FREEMAN POINT
Horsley Hill
SOUNDINGS IN 1952
SOUNDINGS IN 1849
COASTLINE IN 1849
SAND
ROCK
THE MOUTH OF THE RIVER TYNE IN 1849 & 1952.
DATUM OF SOUNDINGS 0·4 FEET BELOW MEAN LOW WATER SPRINGS, OR 7·08 FEET BELOW O.D.
BASED ON ADMIRALTY CHARTS.
1000 0 1000 2000 3000 4000 5000
SCALE OF FEET.

FIG. 45


LONGITUDINAL SECTIONS ALONG THE CENTRE LINE OF THE RIVER TYNE.
SCALE OF FEET
0
500
1000
1500
2000
1860 J.F. URE
1875 P.J. MESSENT
1928 R.F. HINDMARSH
1860
1875
1928
HWOST. 1875
HWOST. 1860
LWOST. 1860
LWOST. 1875
10'
0
10'
30'
50'
Opposite Bill Point
Opposite Walker Iron Works
Opposite Walker Brickworks
Opposite Grayling Dock, Hebburn
Opposite Willington Gut
Opposite T.C. Yard Howden
Opposite Jarrow Slake
Opposite Tyne Dock
Opposite Whitehill Point
Opposite Coble Dene Dock
Opposite Low Lighthouse
Opposite Prior's Stone
The Bar 1860
Opposite North Pier 1875

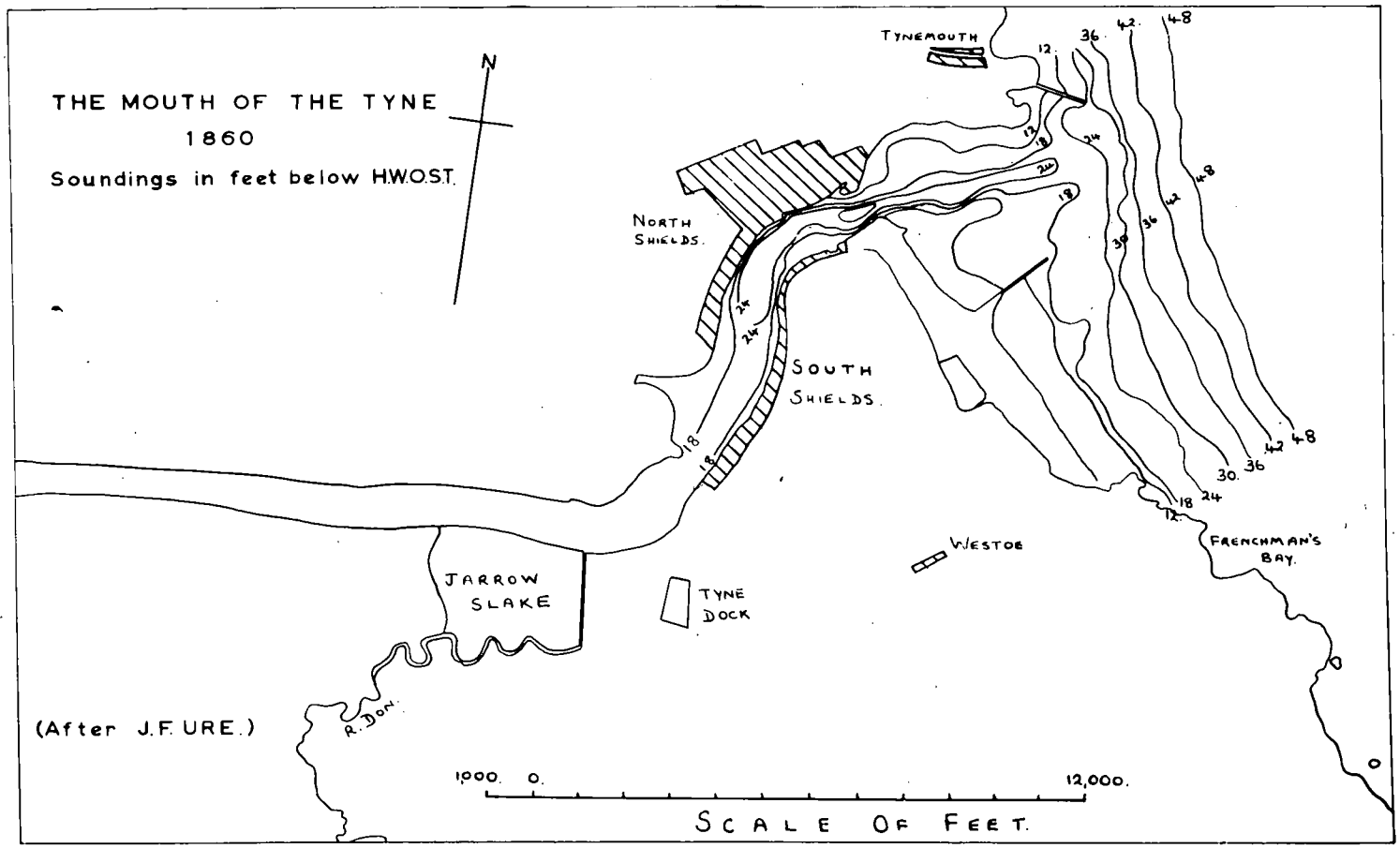
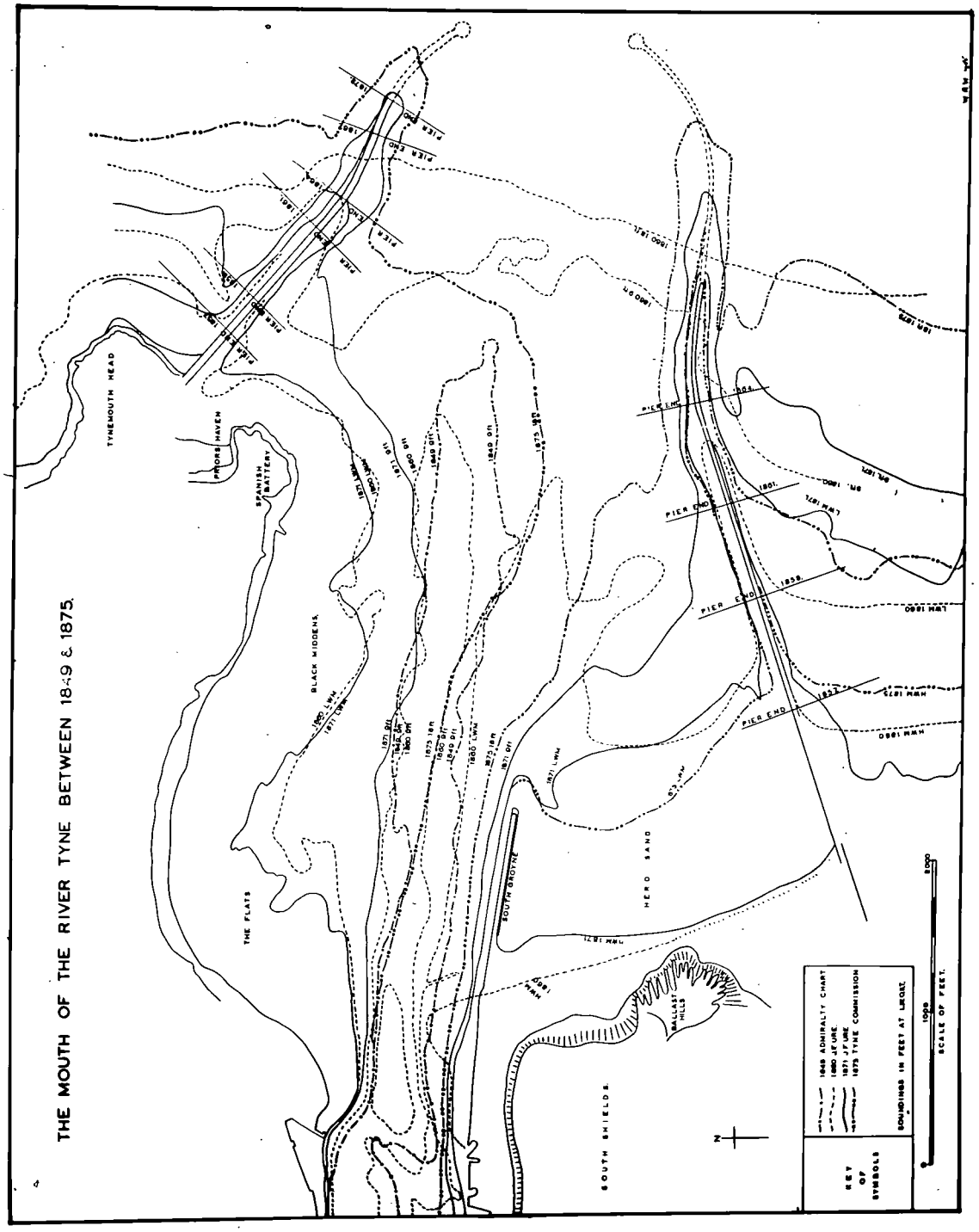

THE MOUTH OF THE TYNE
1860
Soundings in feet below H.W.O.S.T.
N
TYNEMOUTH
NORTH SHIELDS.
SOUTH SHIELDS.
JARROW SLAKE
TYNE DOCK
WESTOE
FRENCHMAN'S BAY.
R. DON.
(After J.F. URE.)
1,000. 0. 12,000.
SCALE OF FEET.
W.A.W. 1955.

FIG. 46

FIG. 47


THE MOUTH OF THE RIVER TYNE BETWEEN 1849 & 1875.
TYNEMOUTH HEAD
PRIORS HAVEN
SPANISH BATTERY
BLACK MIDDENS
THE FLATS
SOUTH GROYNE
HERD SAND
BALLAST HILLS
SOUTH SHIELDS
PIER END
KEY OF SYMBOLS
1849 ADMIRALTY CHART
1880 JF LINE
1871 JF LINE
1875 TYNE COMMISSION
SOUNDINGS IN FEET AT LWOST
SCALE OF FEET.
1000
5000
N

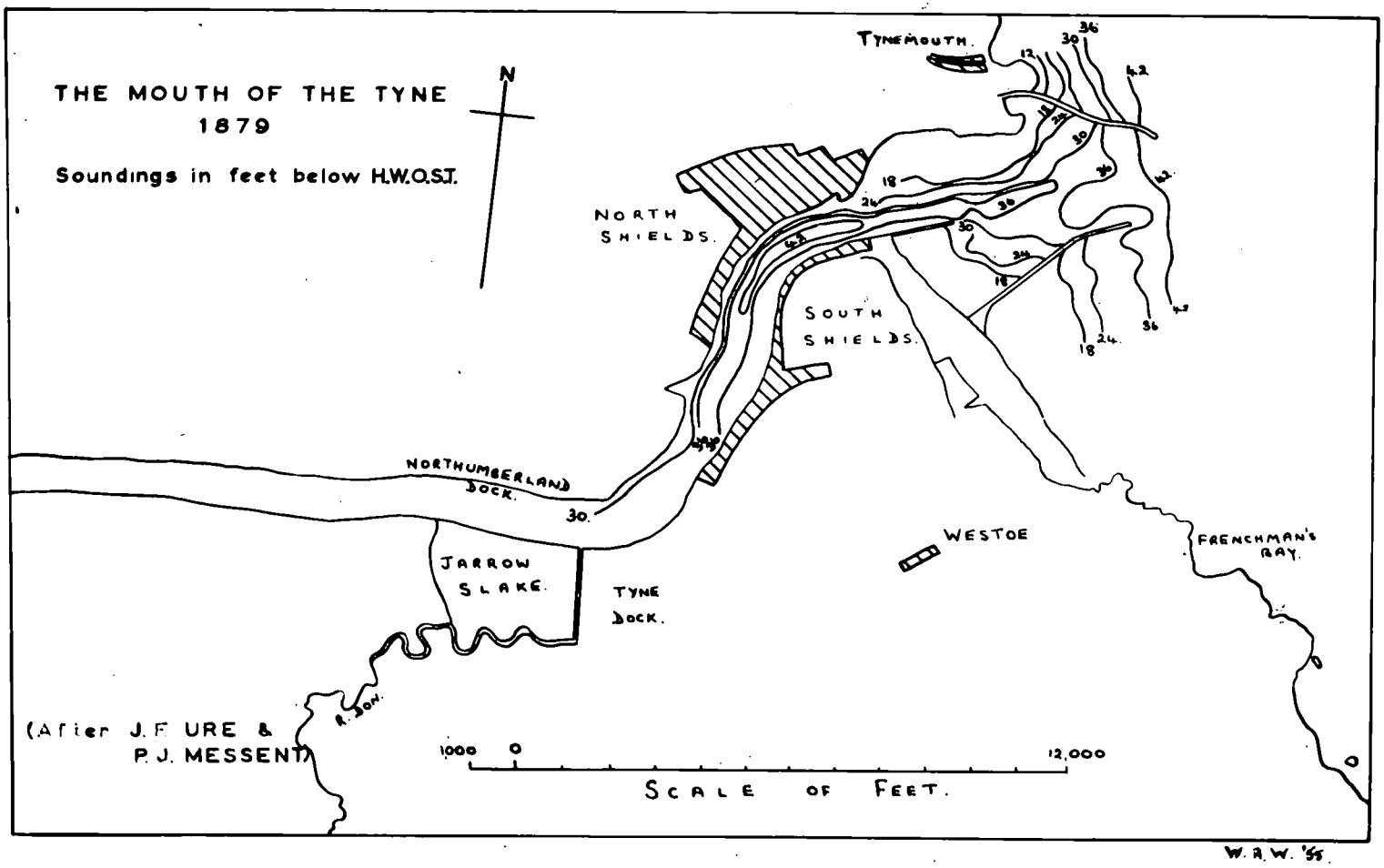

THE MOUTH OF THE TYNE
1879
Soundings in feet below H.W.O.S.T.
N
TYNEMOUTH.
NORTH SHIELDS.
SOUTH SHIELDS.
NORTHUMBERLAND DOCK.
JARROW SLAKE.
TYNE DOCK.
WESTOE
FRENCHMAN'S BAY.
R. DON.
(After J.F. URE & P.J. MESSENT)
1000 0 12,000
SCALE OF FEET.
W.R.W. '55

FIG. 48

FIG. 49

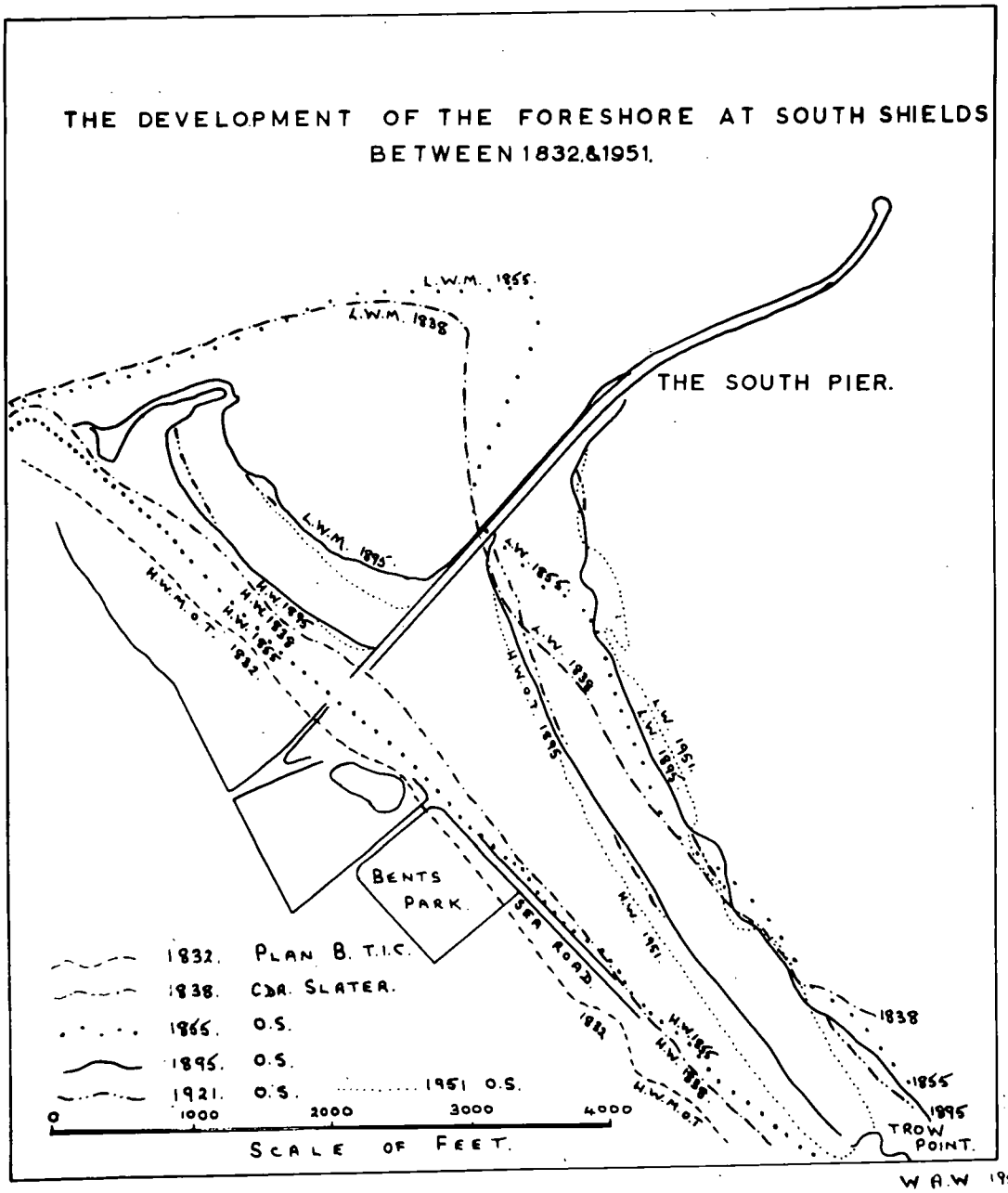
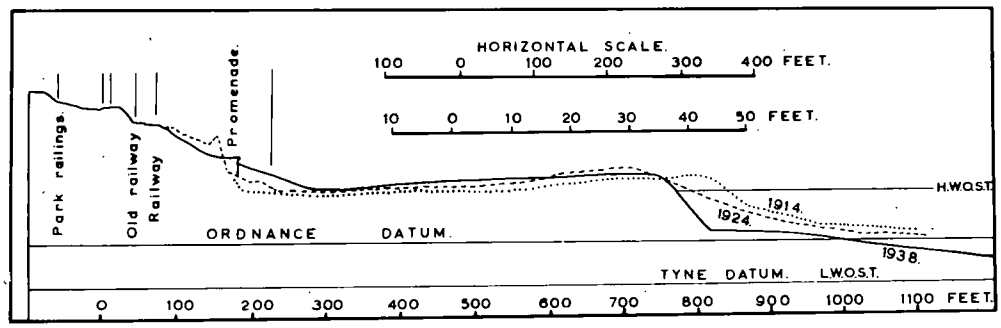
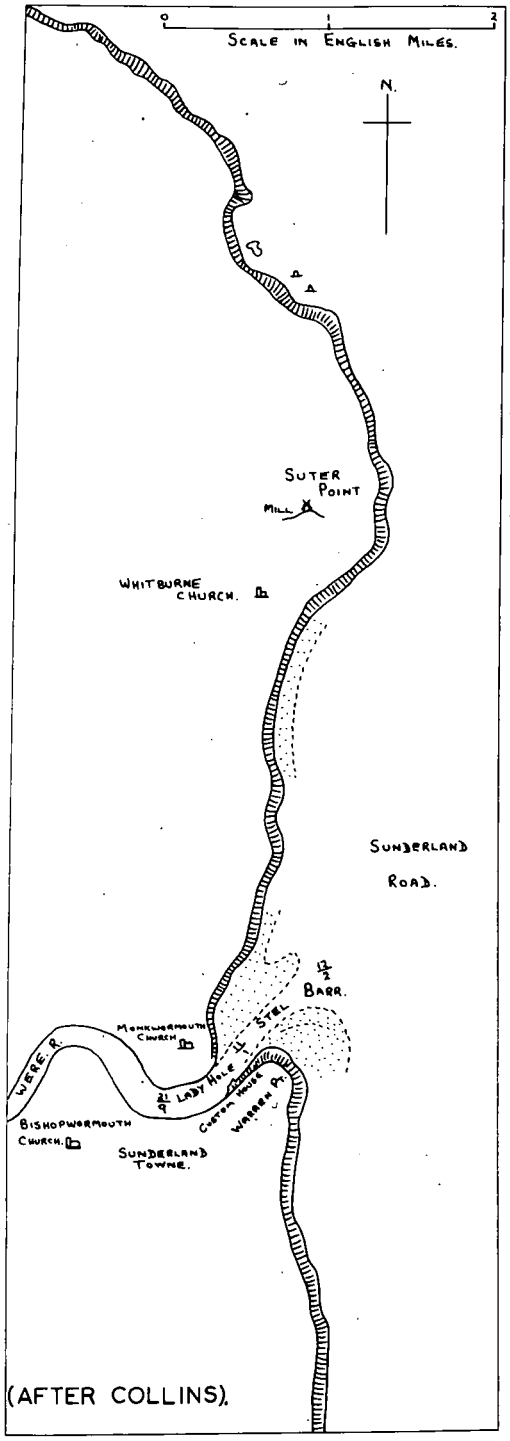

THE DEVELOPMENT OF THE FORESHORE AT SOUTH SHIELDS BETWEEN 1832 & 1951.
THE SOUTH PIER.
L.W.M. 1955.
L.W.M. 1838
L.W.M. 1895.
H.W.O.T. 1832.
H.W. 1838
H.W. 1895
H.W. 1955
L.W. 1955.
L.W. 1838
L.W. 1951.
L.W. 1895
H.W.O.T. 1895
H.W. 1951
BENTS PARK.
SEA ROAD.
1832
H.W. 1955
H.W. 1838
H.W.O.T.
1838
1855
1895
TROW POINT.
1832. PLAN B. T.I.C.
1838. CDR. SLATER.
1855. O.S.
1895. O.S.
1921. O.S.
1951 O.S.
0 1000 2000 3000 4000
SCALE OF FEET.
W.A.W. 1955.

FIG. 50



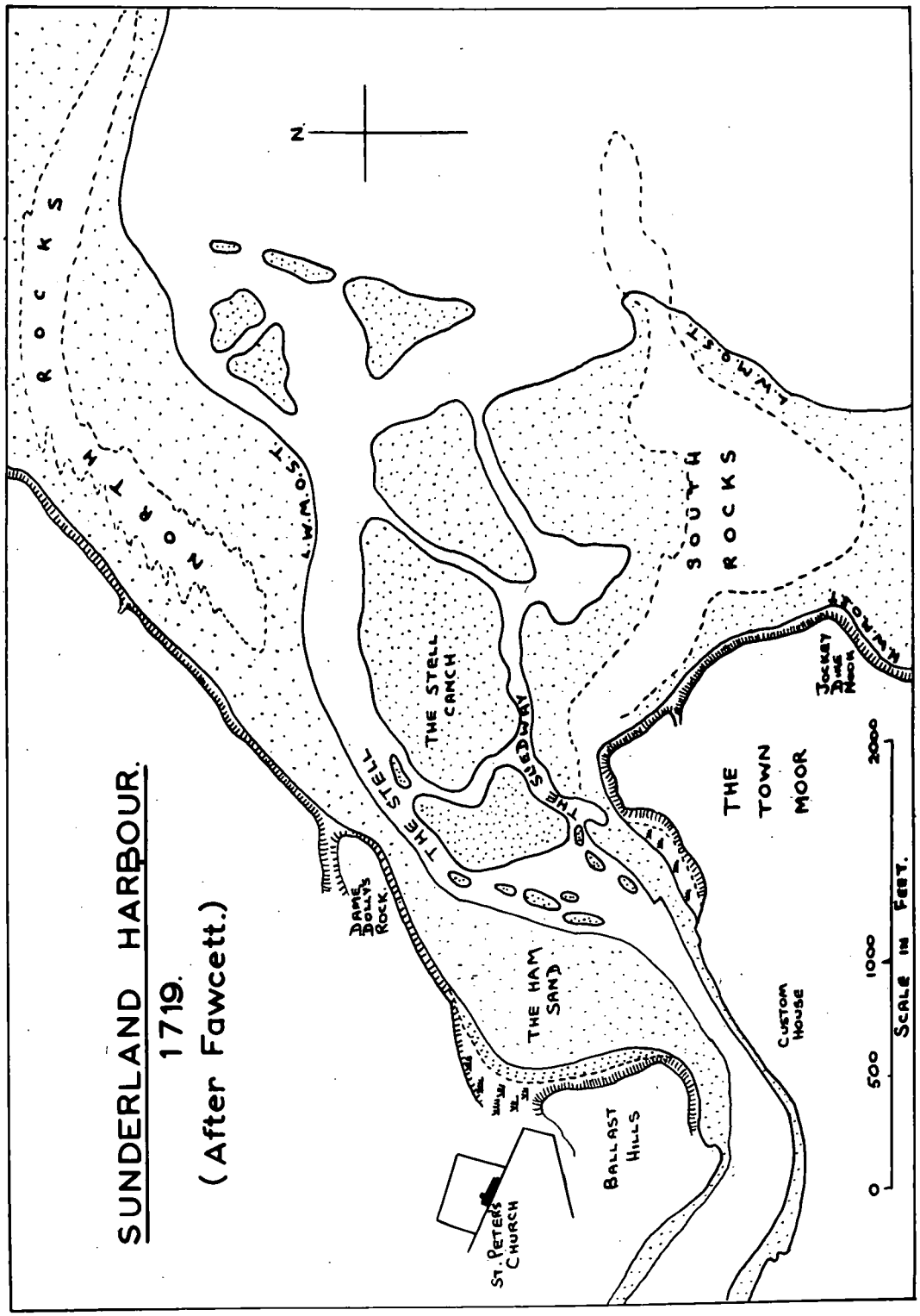
1913-1938. TYPICAL BEACH SECTIONS AT SOUTH SHIELDS.

FIG. 51



A PART OF THE COAST OF COUNTY DURHAM.
1693.

FIG. 52


SUNDERLAND HARBOUR.
1719.
(After Fawcett.)
ROCKS
L.W.M.O.S.T.
N
THE STELL
THE STELL CANCH
THE SLEDWAY
SOUTH ROCKS
L.W.M.O.S.T.
DANE BOLLS ROCK.
THE HAM SAND
BALLAST HILLS
ST. PETERS CHURCH
THE TOWN MOOR
CUSTOM HOUSE
JOCKEY DUKE NECK
L.W.M.O.S.T.
0
500
1000
2000
SCALE IN FEET.

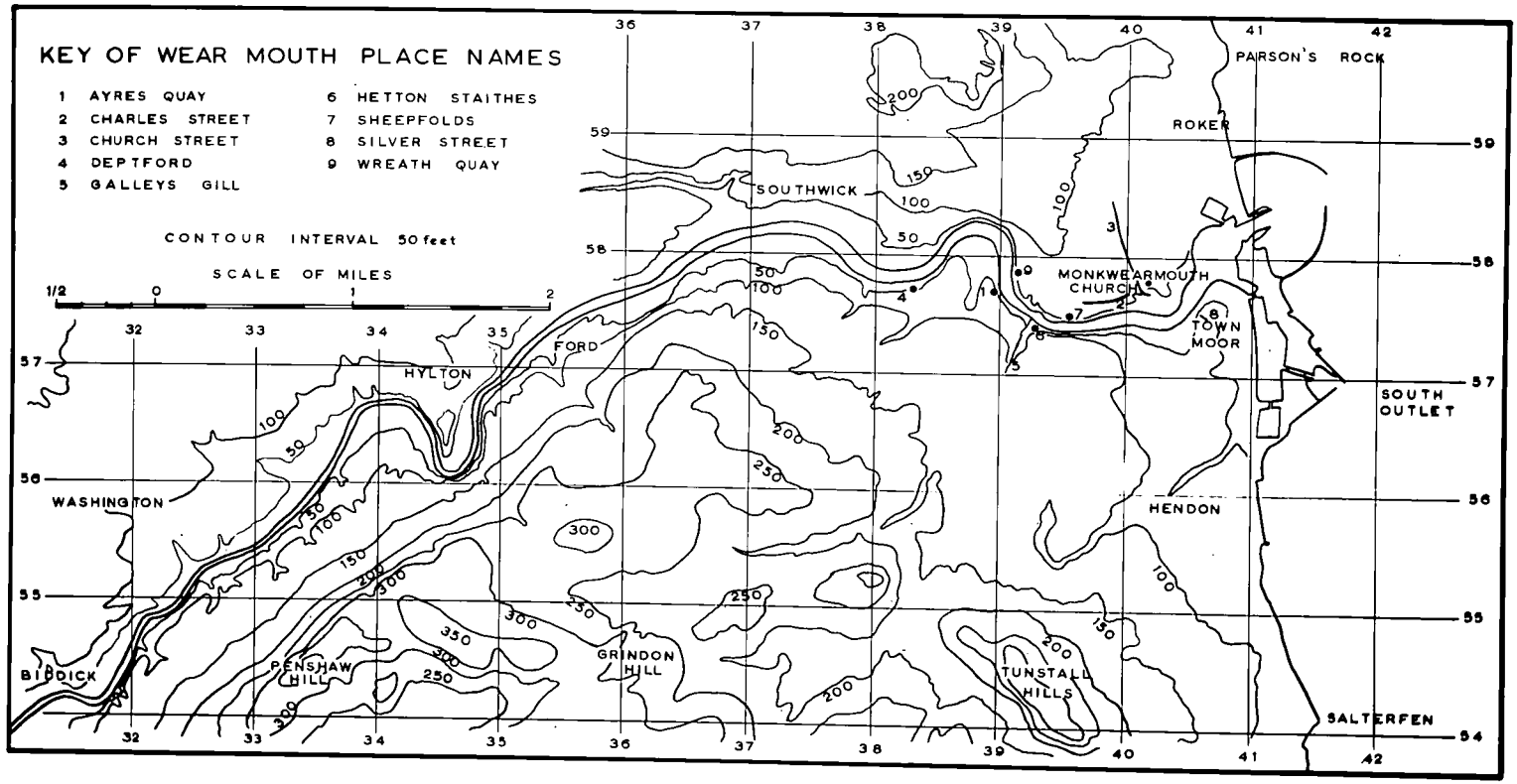
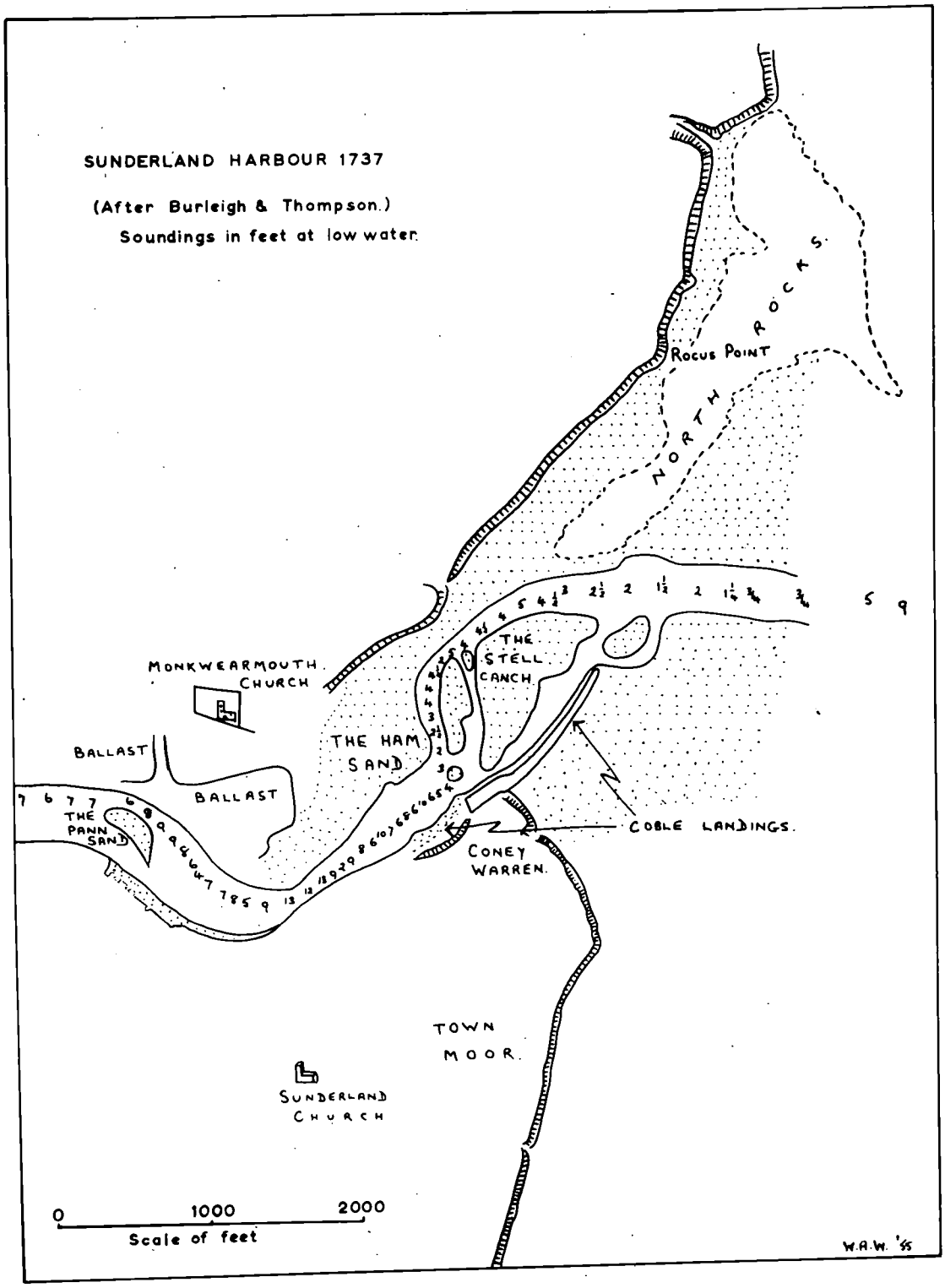

KEY OF WEAR MOUTH PLACE NAMES
1 AYRES QUAY
2 CHARLES STREET
3 CHURCH STREET
4 DEPTFORD
5 GALLEYS GILL
6 HETTON STAITHES
7 SHEEPFOLDS
8 SILVER STREET
9 WREATH QUAY
CONTOUR INTERVAL 50 feet
SCALE OF MILES
1/2 0 1 2
PARSON'S ROCK
ROKER
SOUTHWICK
MONKWEARMOUTH CHURCH
TOWN MOOR
SOUTH OUTLET
FORD
HYLTON
WASHINGTON
HENDON
BIDDICK
PENSHAW HILL
GRINDON HILL
TUNSTALL HILLS
SALTERFEN

FIG. 53

FIG. 54


SUNDERLAND HARBOUR 1737
(After Burleigh & Thompson.)
Soundings in feet at low water
NORTH ROCKS
Rocus Point
THE STELL CANCH
MONKWEARMOUTH CHURCH
BALLAST
BALLAST
THE HAM SAND
THE PANN SAND
CONEY WARREN.
COBLE LANDINGS.
TOWN MOOR.
SUNDERLAND CHURCH
0
1000
2000
Scale of feet
W.A.W. '55

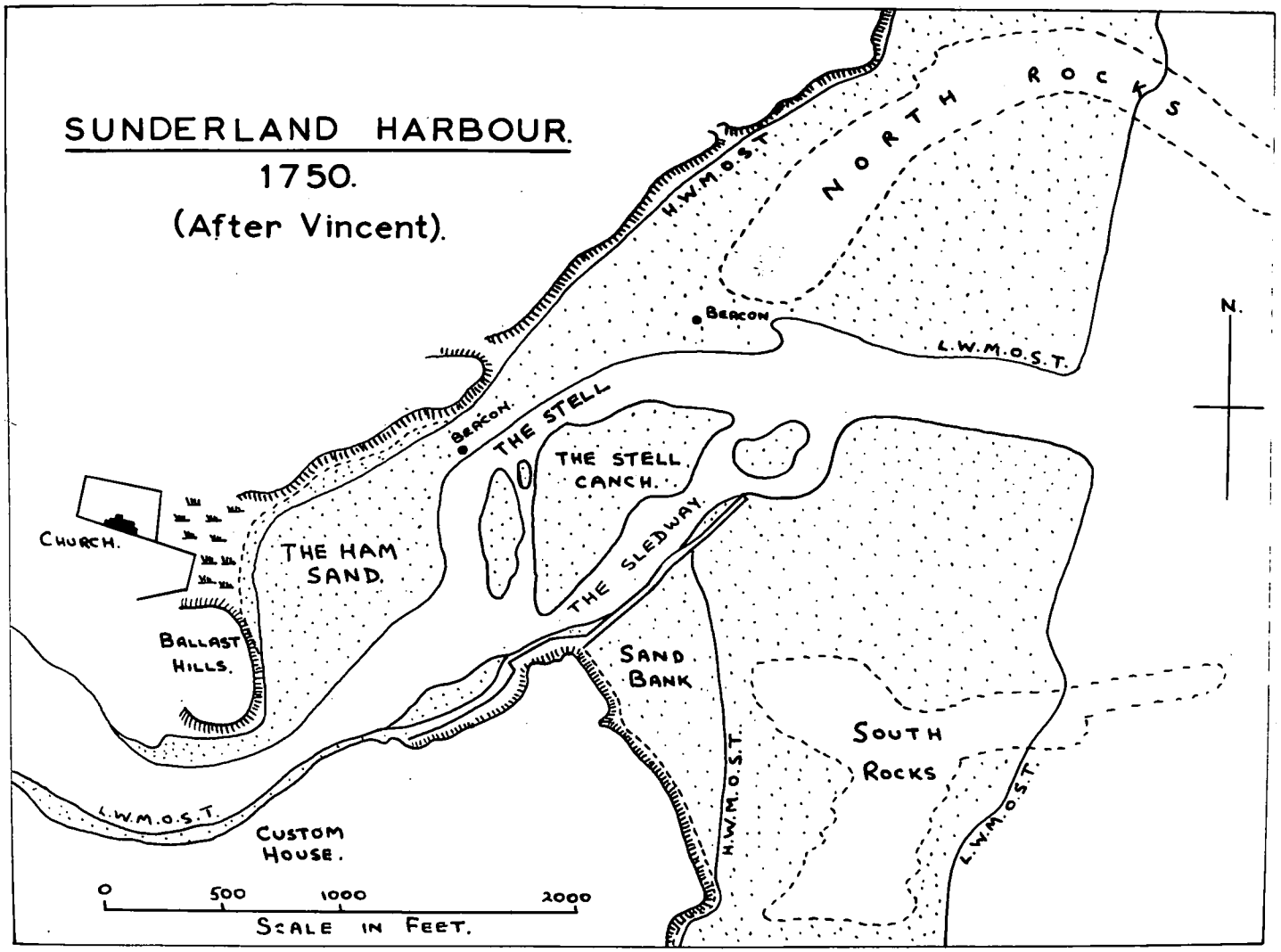

SUNDERLAND HARBOUR.
1750.
(After Vincent).
NORTH ROCKS
H.W.M.O.S.T.
BEACON
L.W.M.O.S.T.
N.
BEACON
THE STELL
THE STELL CANCH.
CHURCH.
THE HAM SAND.
THE SLEDWAY
BALLAST HILLS.
SAND BANK
SOUTH ROCKS
H.W.M.O.S.T.
L.W.M.O.S.T.
L.W.M.O.S.T.
CUSTOM HOUSE.
0 500 1000 2000
SCALE IN FEET.

FIG. 55

FIG. 56

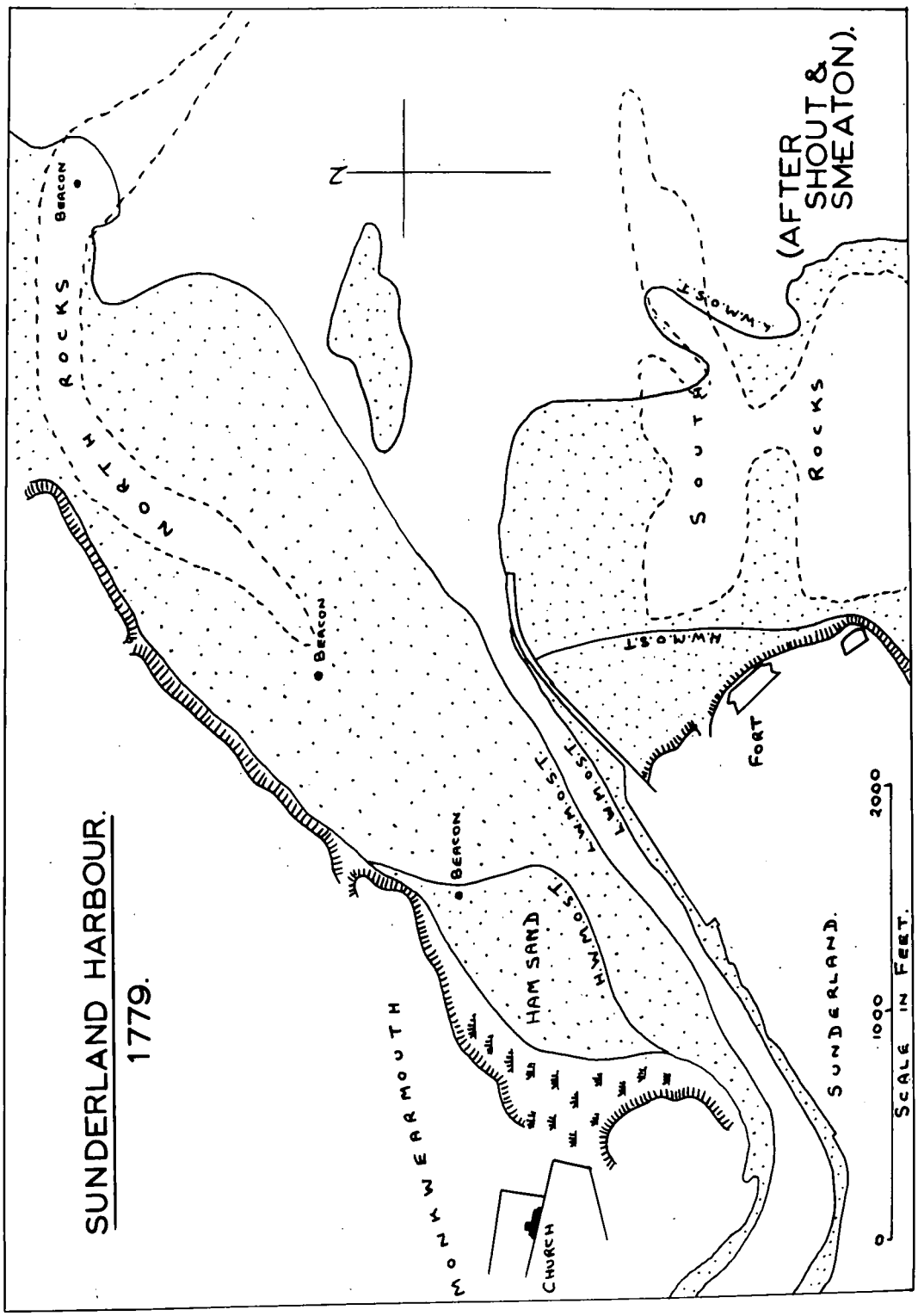
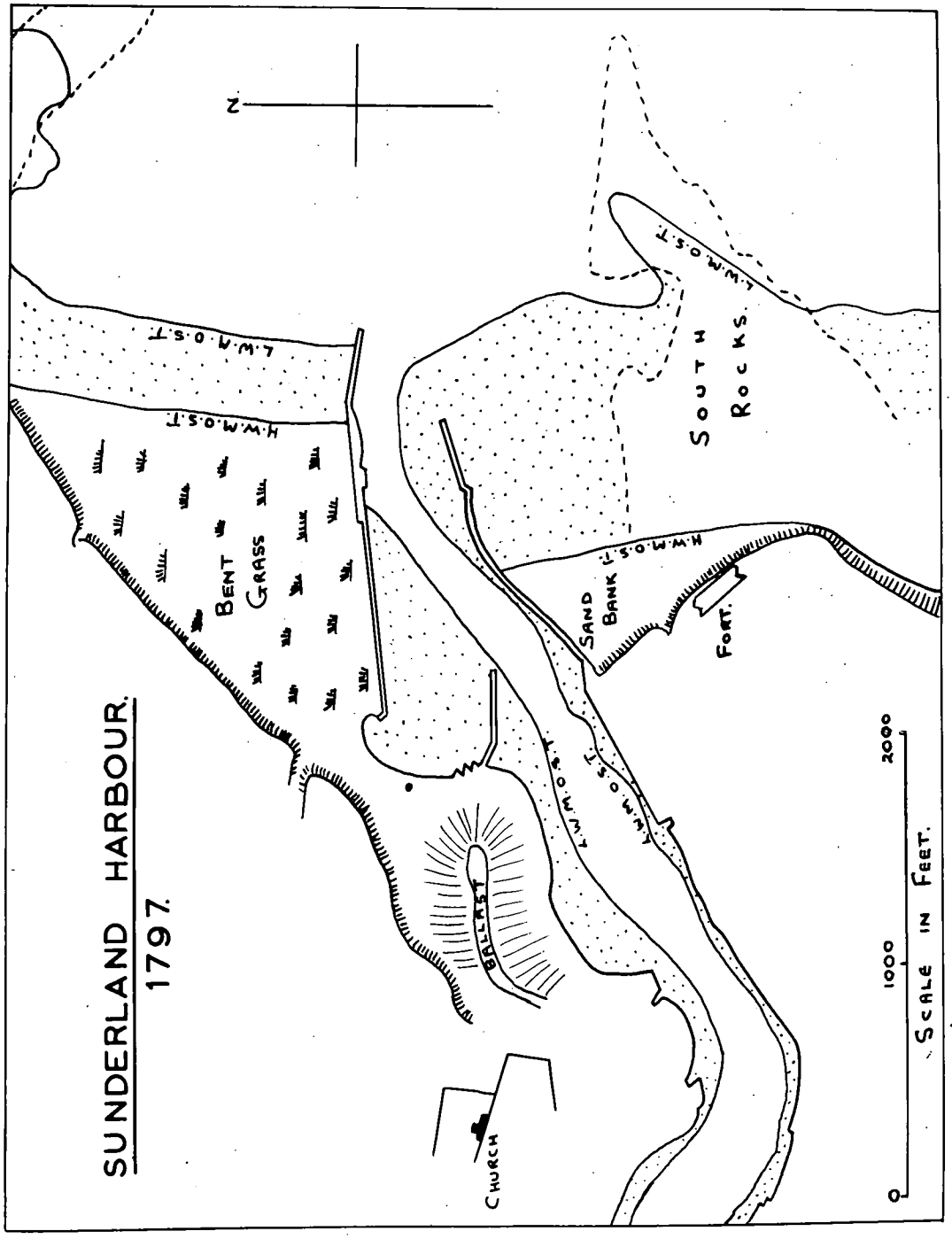

SUNDERLAND HARBOUR.
1779.
(AFTER SHOUT & SMEATON).
N
ROCKS
BEACON
BEACON
BEACON
SOUTH ROCKS
H.W.M.O.S.T.
L.W.M.O.S.T.
FORT
HAM SAND
CHURCH
MONKWEARMOUTH
SUNDERLAND.
0
1000
2000
SCALE IN FEET.

FIG. 57


SUNDERLAND HARBOUR.
1797.
N
L.W.M.O.S.T.
H.W.M.O.S.T.
BENT GRASS
SOUTH ROCKS
SAND BANK
FORT.
BALLAST
CHURCH
0
1000
2000
SCALE IN FEET.

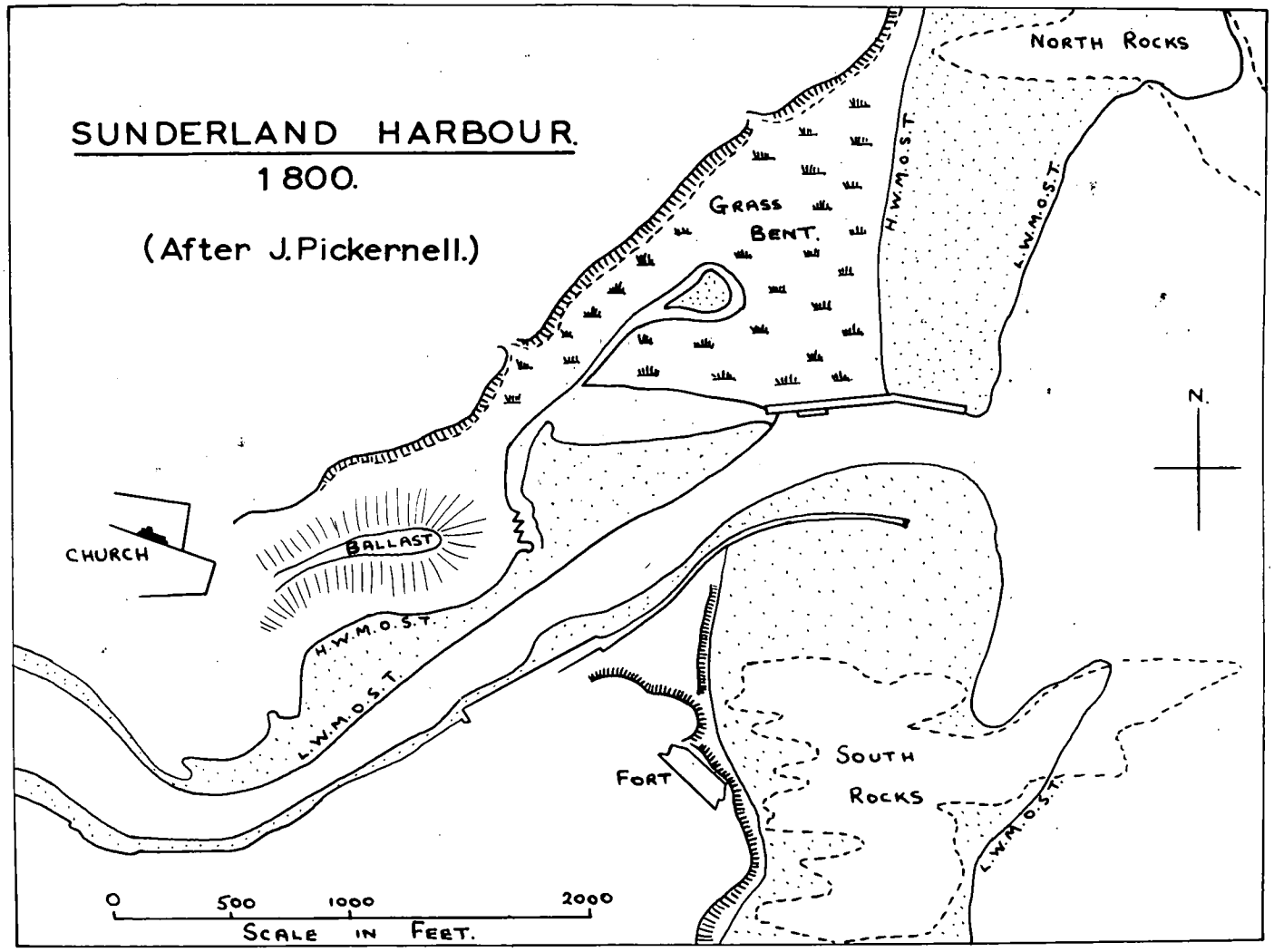

SUNDERLAND HARBOUR.
1800.
(After J. Pickernell.)
NORTH ROCKS
GRASS
BENT.
H.W.M.O.S.T.
L.W.M.O.S.T.
N.
CHURCH
BALLAST
H.W.M.O.S.T.
L.W.M.O.S.T.
FORT
SOUTH
ROCKS
L.W.M.O.S.T.
0
500
1000
2000
SCALE IN FEET.

FIG. 58

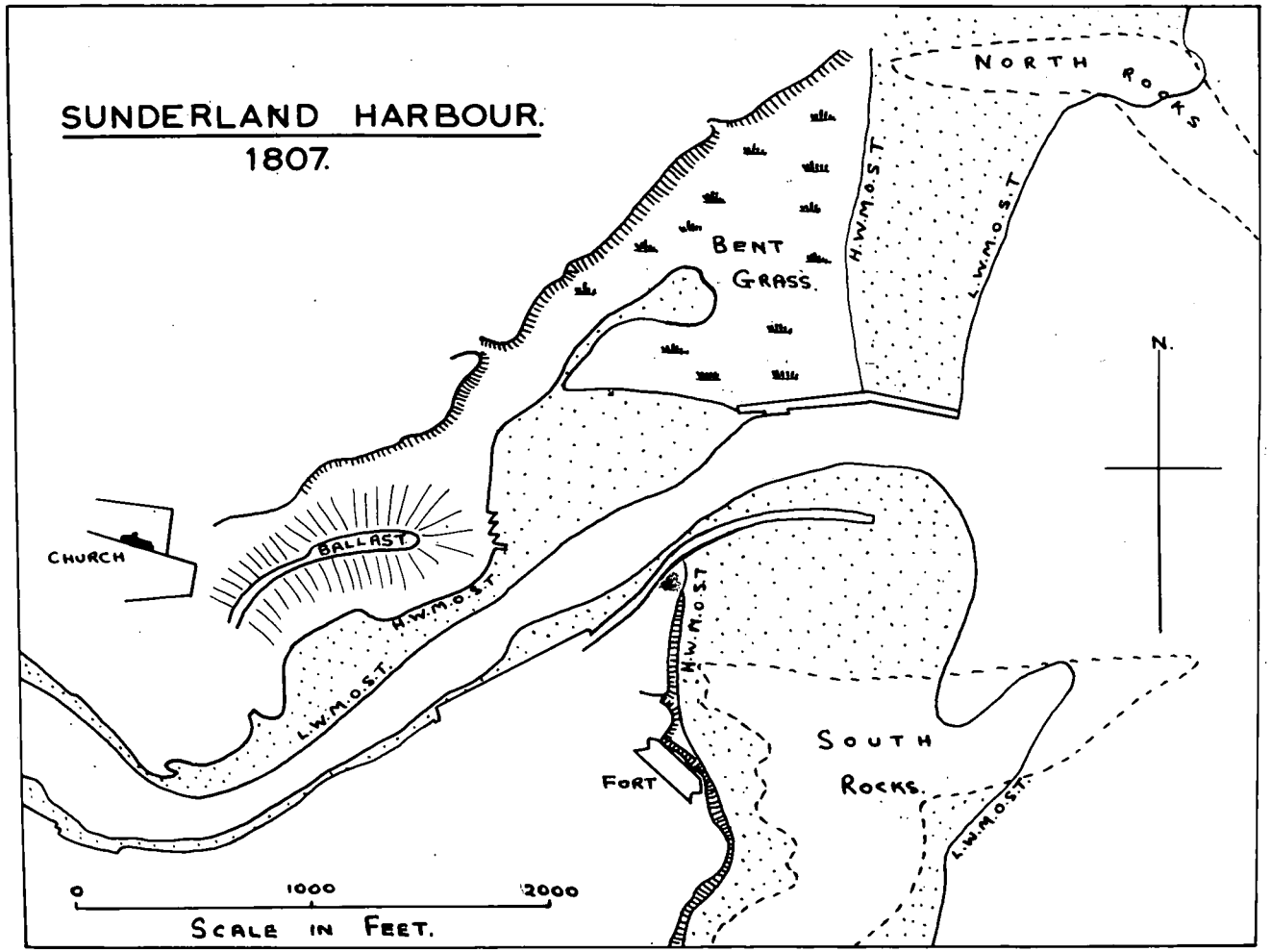

SUNDERLAND HARBOUR.
1807.
NORTH
BENT
GRASS.
H.W.M.O.S.T.
L.W.M.O.S.T.
N.
CHURCH
BALLAST
H.W.M.O.S.T.
L.W.M.O.S.T.
H.W.M.O.S.T.
FORT
SOUTH
ROCKS.
L.W.M.O.S.T.
0
1000
2000
SCALE IN FEET.

FIG. 59

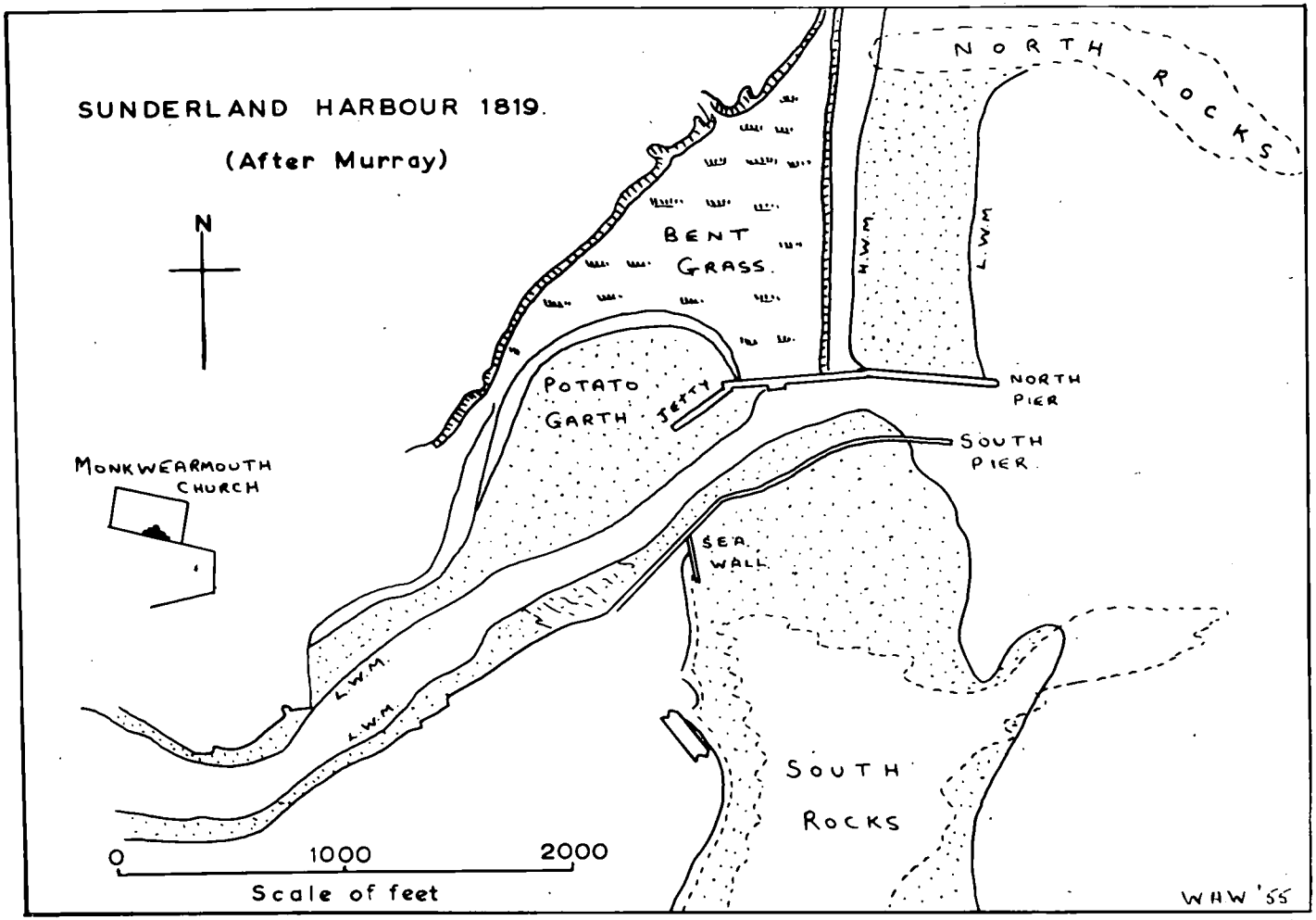

SUNDERLAND HARBOUR 1819.
(After Murray)
N
NORTH ROCKS
BENT GRASS.
H.W.M.
L.W.M.
POTATO GARTH JETTY
NORTH PIER
SOUTH PIER
MONKWEARMOUTH CHURCH
SEA WALL
L.W.M.
L.W.M.
SOUTH ROCKS
0
1000
2000
Scale of feet
WHW '55

FIG. 60

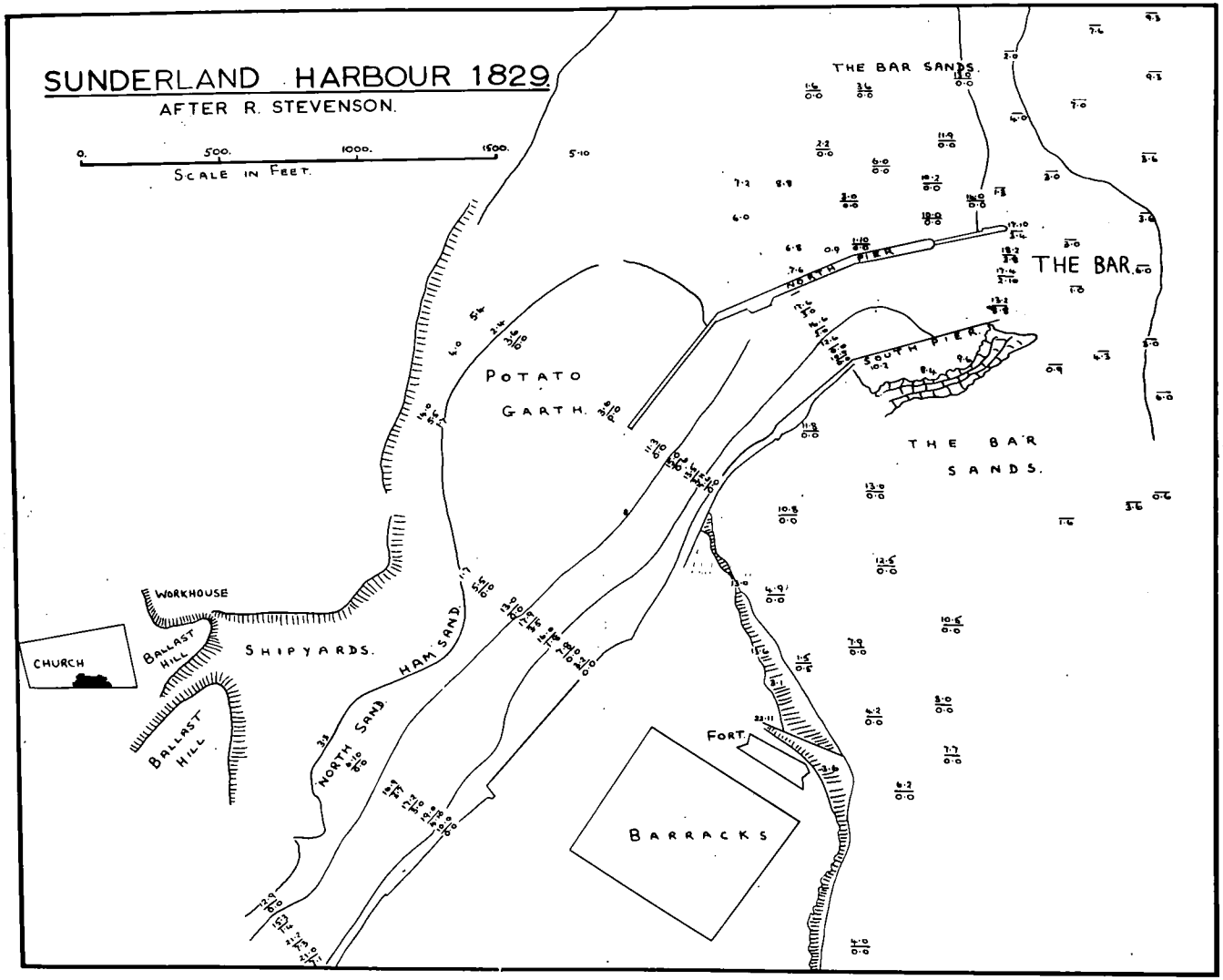

SUNDERLAND HARBOUR 1829.
AFTER R. STEVENSON.
0. 500. 1000. 1500.
SCALE IN FEET.
THE BAR SANDS.
NORTH PIER
THE BAR.
SOUTH PIER
POTATO GARTH.
THE BAR SANDS.
WORKHOUSE
CHURCH
BALLAST HILL
SHIPYARDS.
HAM SAND.
NORTH SAND
BALLAST HILL
FORT.
BARRACKS

FIG. 61

FIG. 62

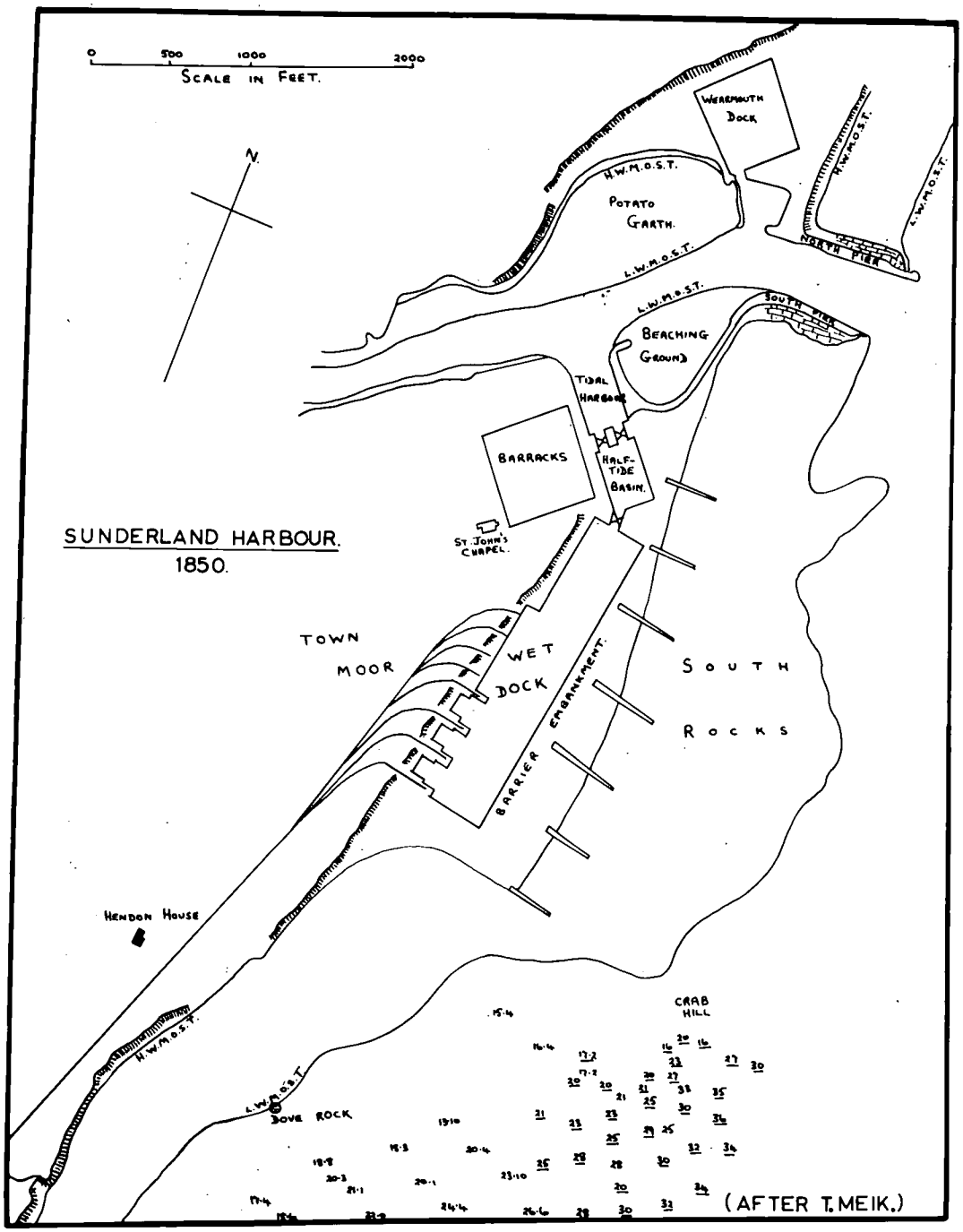
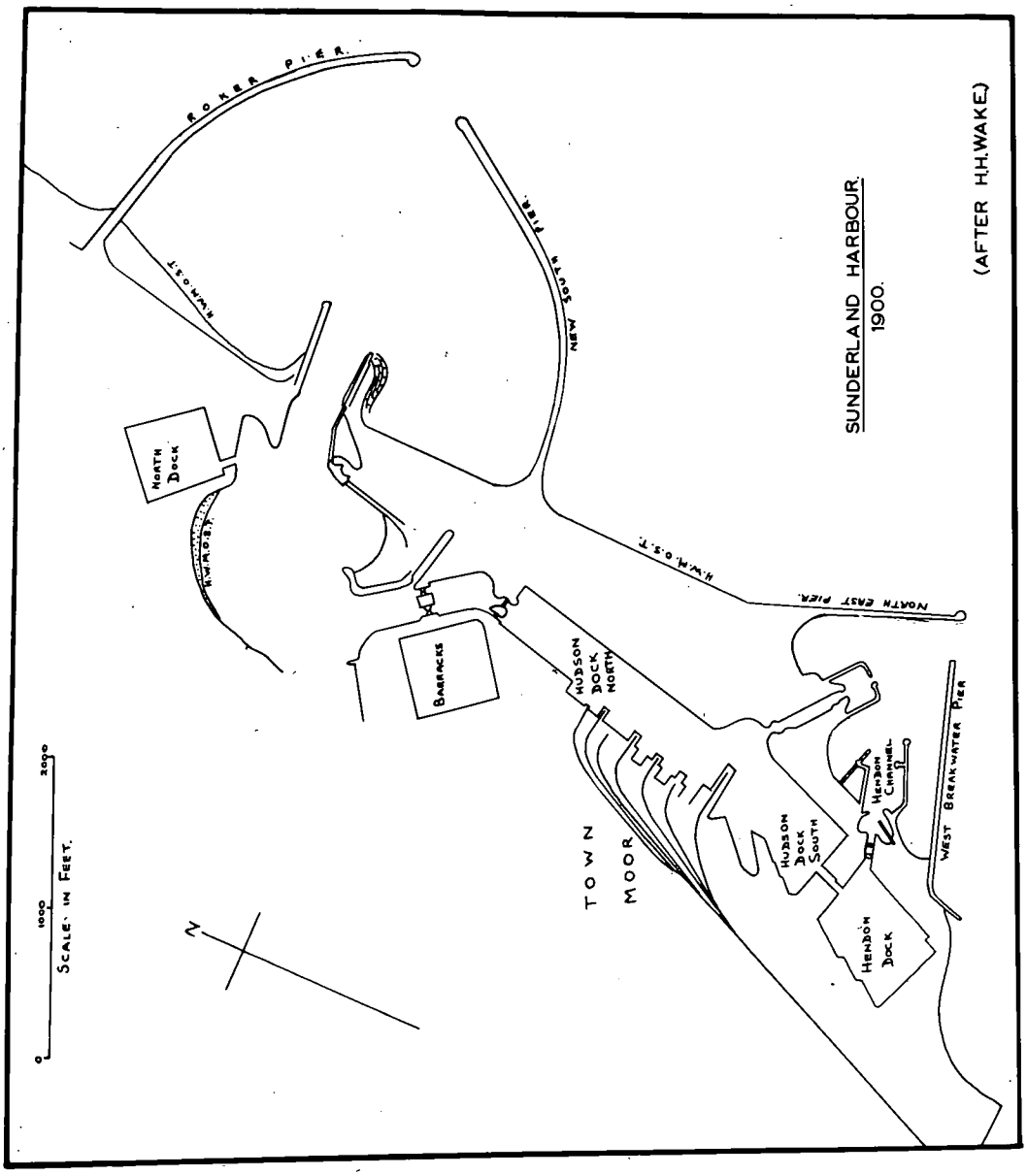
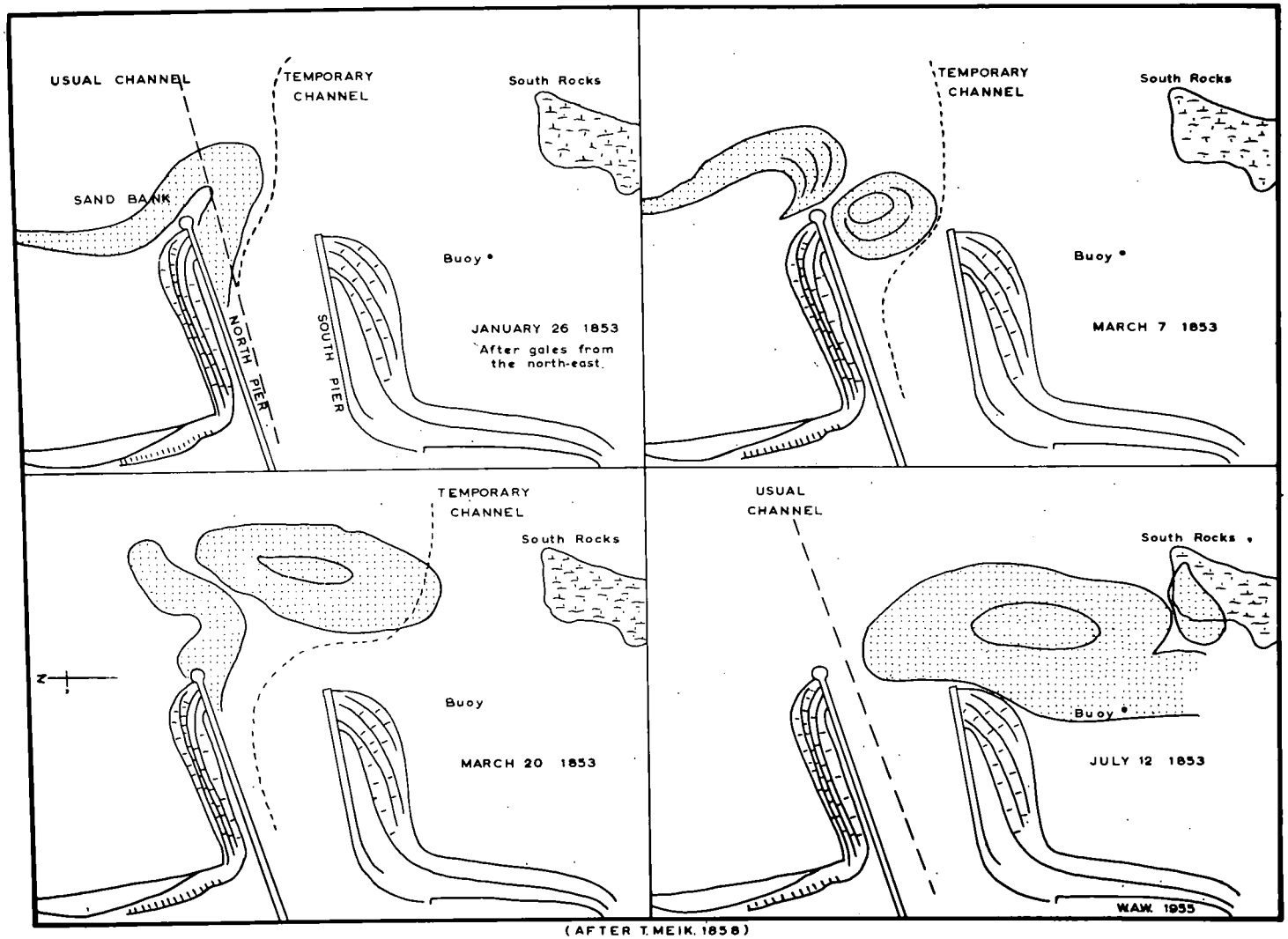

0 500 1000 2000
SCALE IN FEET.
N.
WEARMOUTH DOCK
H.W.M.O.S.T.
POTATO GARTH.
L.W.M.O.S.T.
NORTH PIER
SOUTH PIER
BEACHING GROUND
TIDAL HARBOUR
BARRACKS
HALF-TIDE BASIN.
ST. JOHN'S CHAPEL.
SUNDERLAND HARBOUR.
1850.
TOWN MOOR
WET DOCK
BARRIER EMBANKMENT.
SOUTH ROCKS
HENDON HOUSE
CRAB HILL
DOVE ROCK
(AFTER T. MEIK.)

FIG. 63


SUNDERLAND HARBOUR.
1900.
(AFTER H.H. WAKE.)
POKER PIER.
MAIN SOUTH PIER.
H.W.M.O.S.T.
NORTH DOCK
H.W.M.O.S.T.
H.W.A.O.S.T.
BARRACKS
HUDSON DOCK NORTH
NORTH EAST PIER.
TOWN MOOR
HUDSON DOCK SOUTH
HENDON CHANNEL
HENDON DOCK
WEST BREAKWATER PIER
N
0
1000
2000
SCALE: IN FEET.

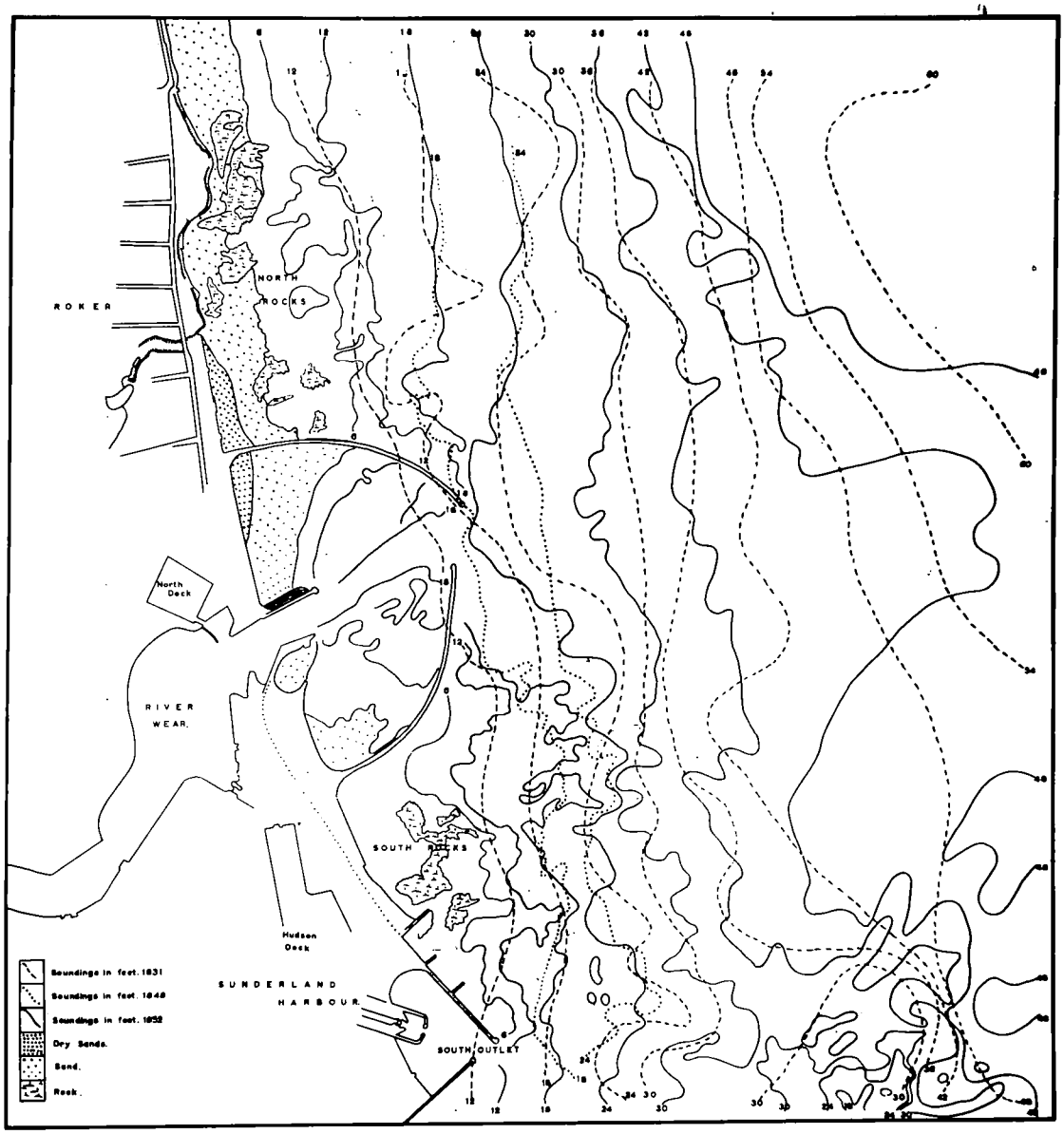
The Reopening Of The North Channel (Sunderland) By Natural Means



(AFTER T. MEIK. 1858)

FIG. 64

FIG. 65



THE ENTRANCE OF SUNDERLAND HARBOUR IN 1831 & 1952

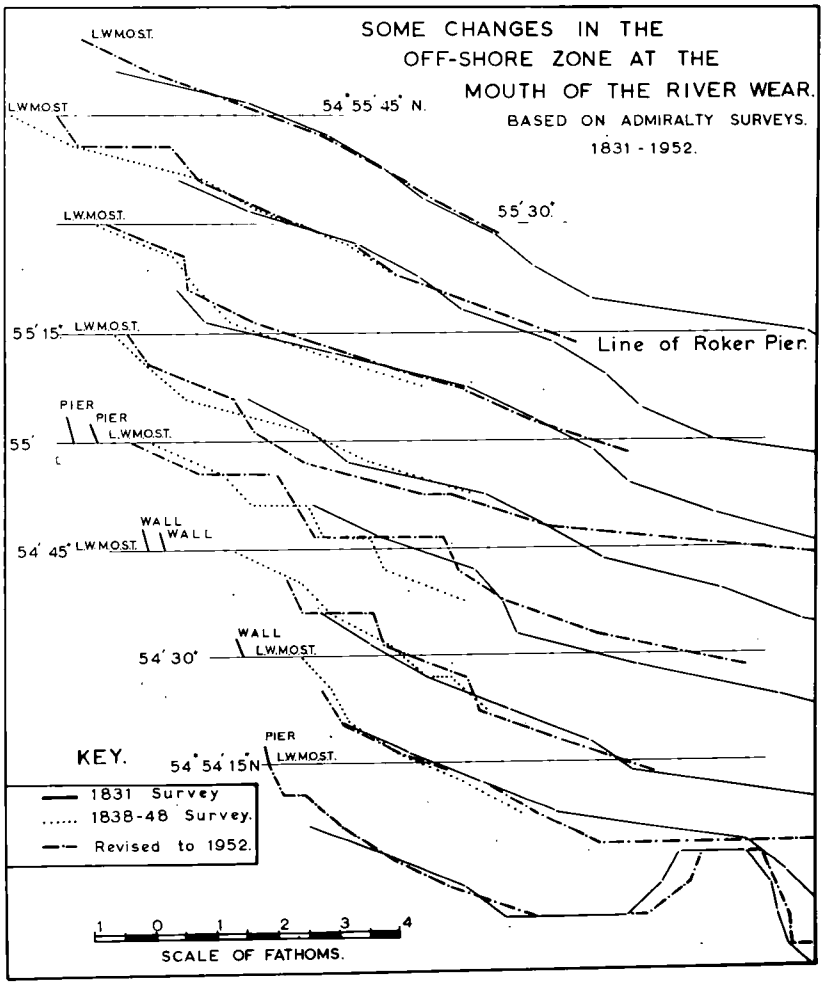
DATUM OF SOUNDINGS 0.7 FEET BELOW MEAN LOW WATER SPRINGS OR 7.03 FEET BELOW O.D.
BASED ON ADMIRALTY CHARTS

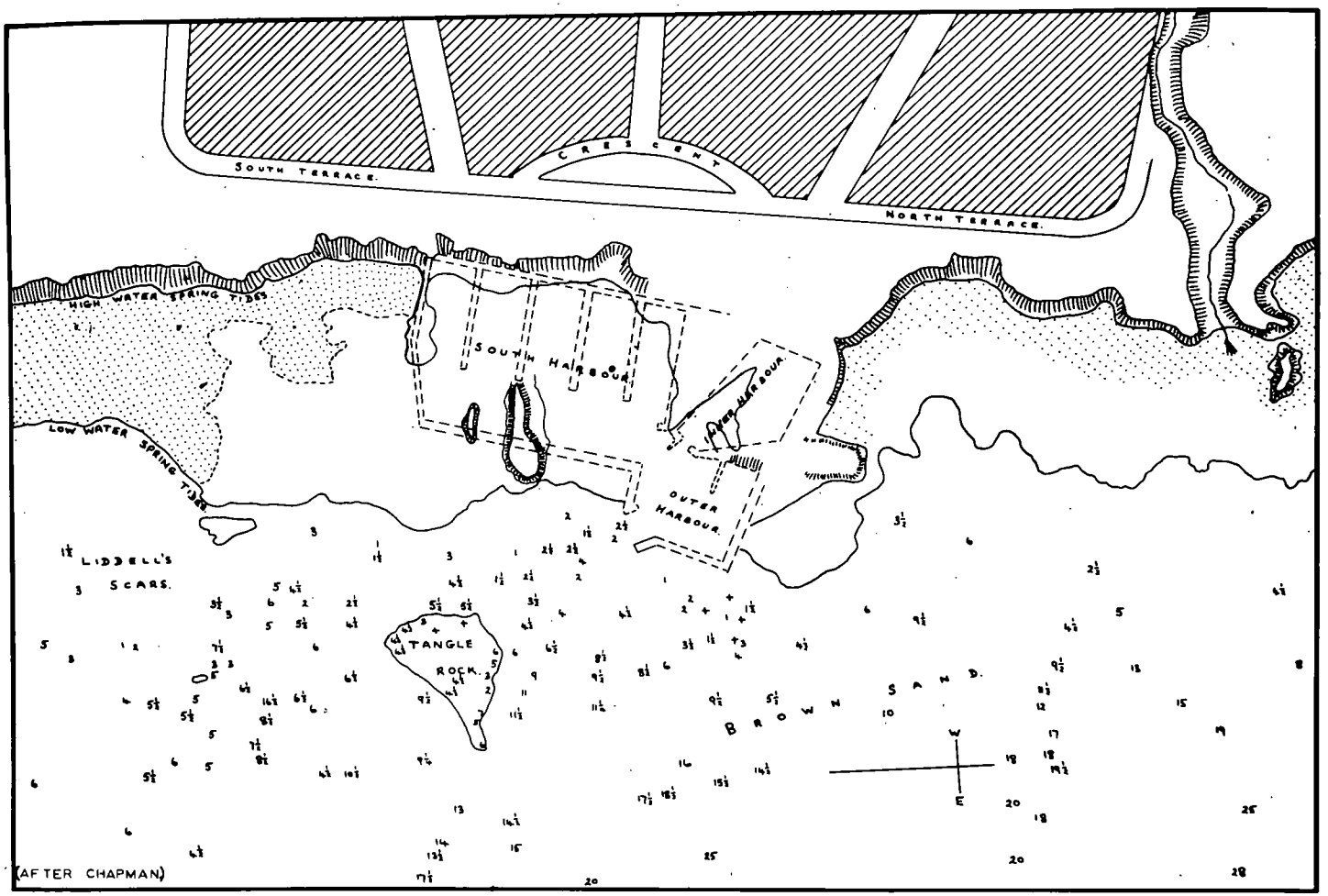
1000 0 1000 2000 3000 4000

SCALE OF FEET

W.B.W.'67.

FIG. 66


SOME CHANGES IN THE
OFF-SHORE ZONE AT THE
MOUTH OF THE RIVER WEAR.
BASED ON ADMIRALTY SURVEYS.
1831 - 1952.
L.W.M.O.S.T.
54° 55' 45" N.
55' 30"
Line of Roker Pier.
55' 15"
PIER
PIER
55'
WALL
WALL
54' 45"
WALL
54' 30"
PIER
54° 54' 15"N
KEY.
1831 Survey
1838-48 Survey.
Revised to 1952.
1 0 1 2 3 4
SCALE OF FATHOMS.

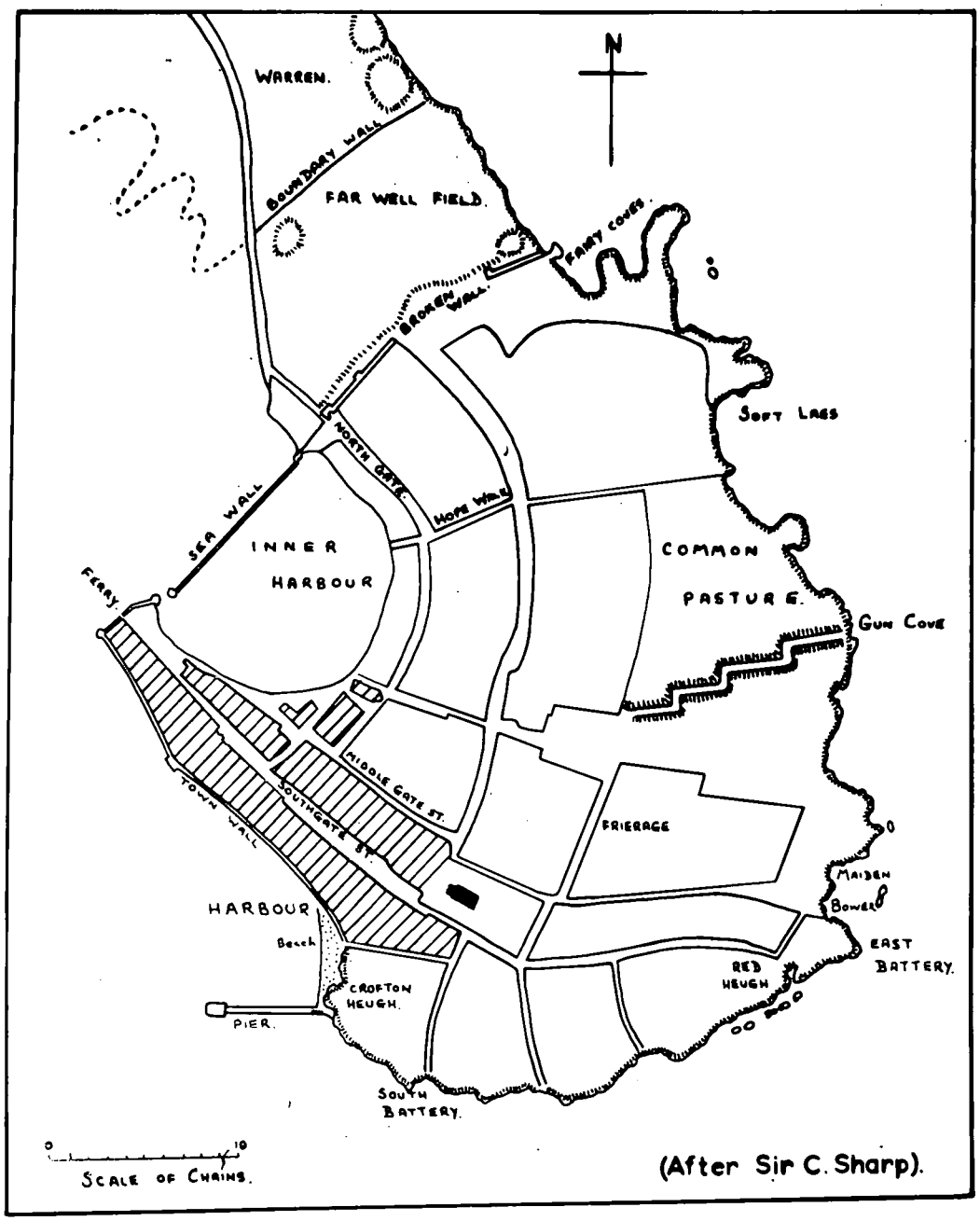


PLAN OF PROPOSED HARBOUR AT SEAHAM.
1830.

SOUNDINGS ARE IN FEET AT LOW WATER SPRING TIDE. EAST SEAHAM AFTER DOBSON 1830.

FIG. 67

FIG. 68



A PLAN OF HARTLEPOOL
1816.

W.A.W '66

THE TOWN. OF
HARTLEPOOL.
1841.

FROM A SURVEY BY,
T. T. W. BELL.
OF CASTLE EDEN.

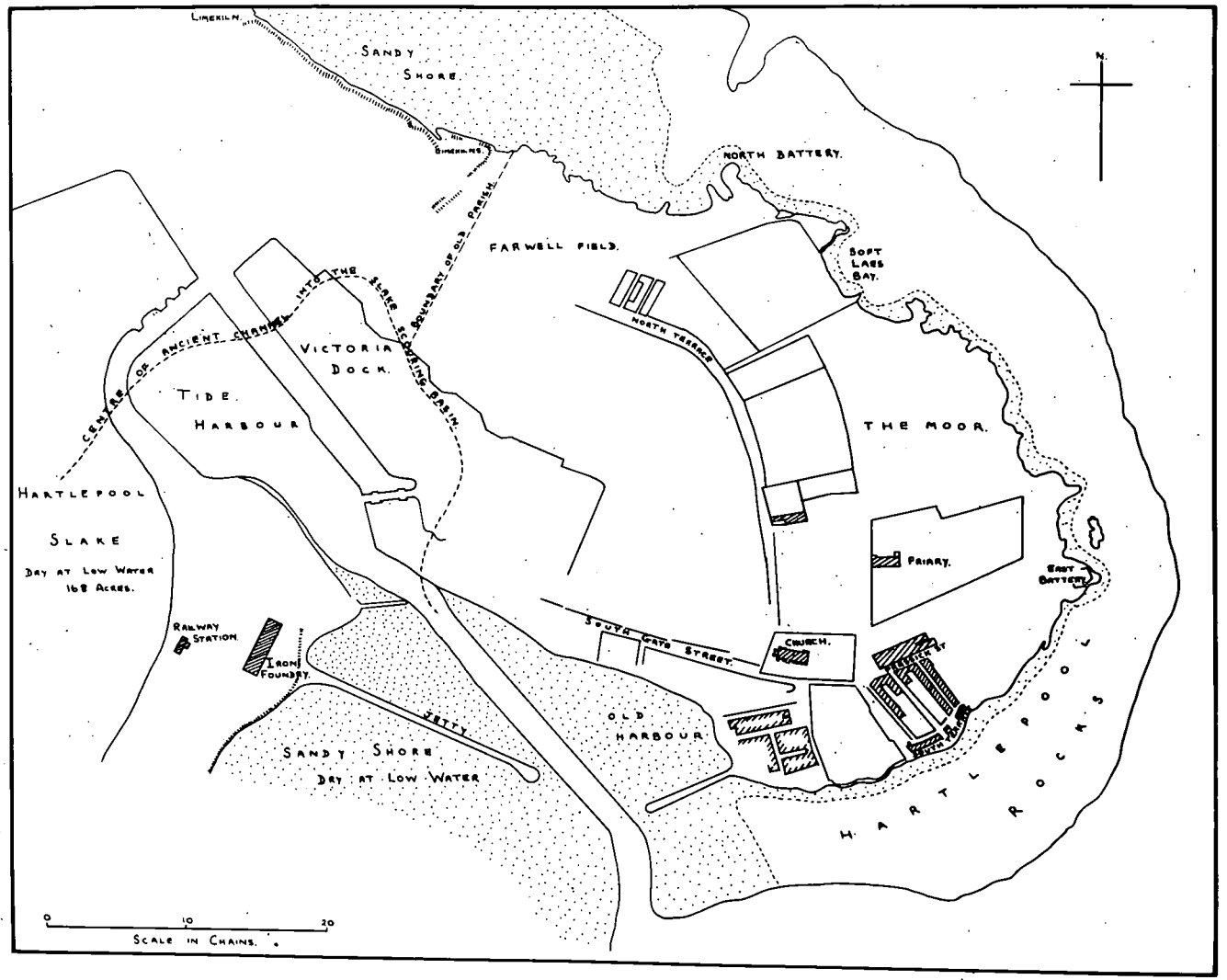


FIG. 69

FIG. 70

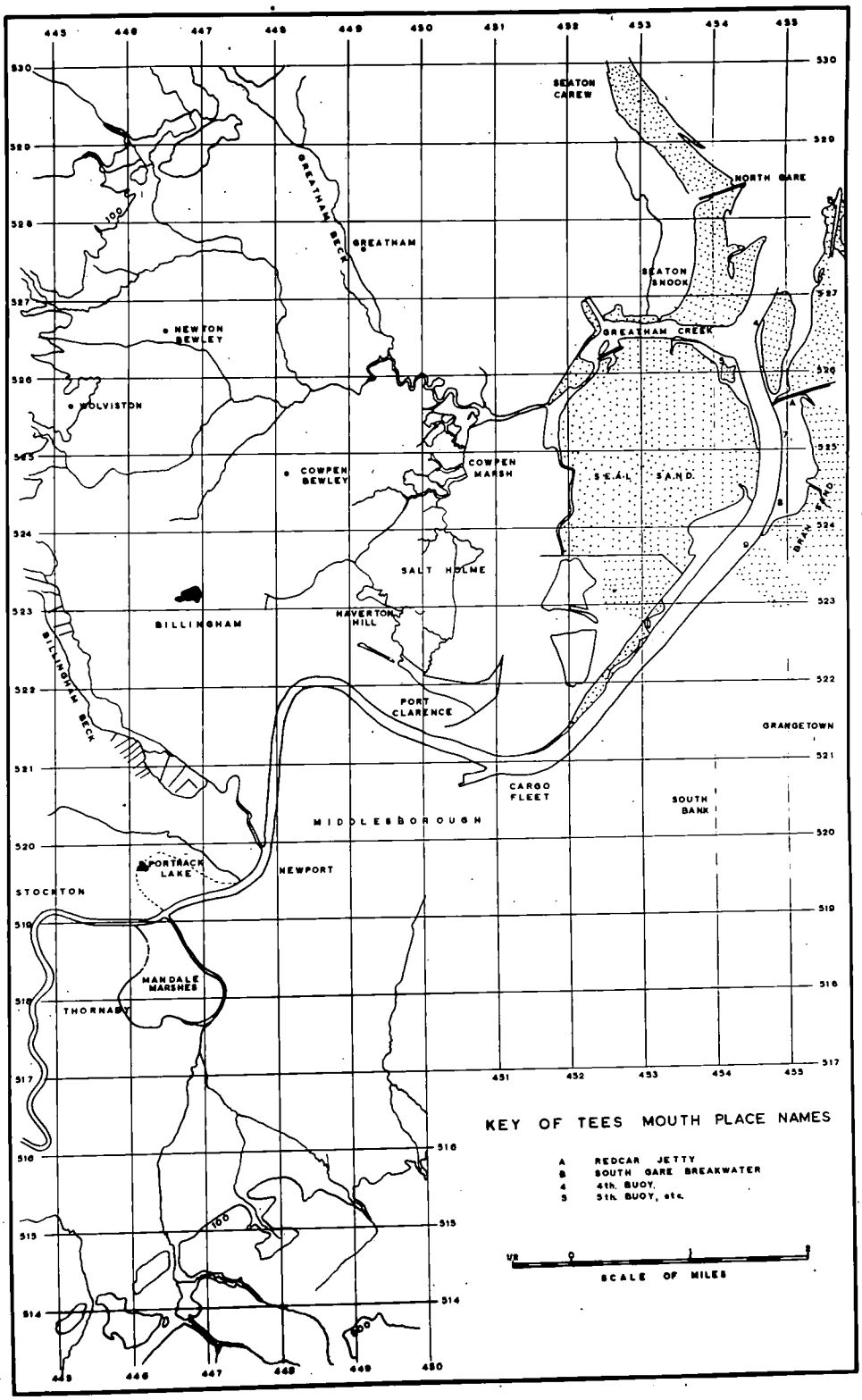
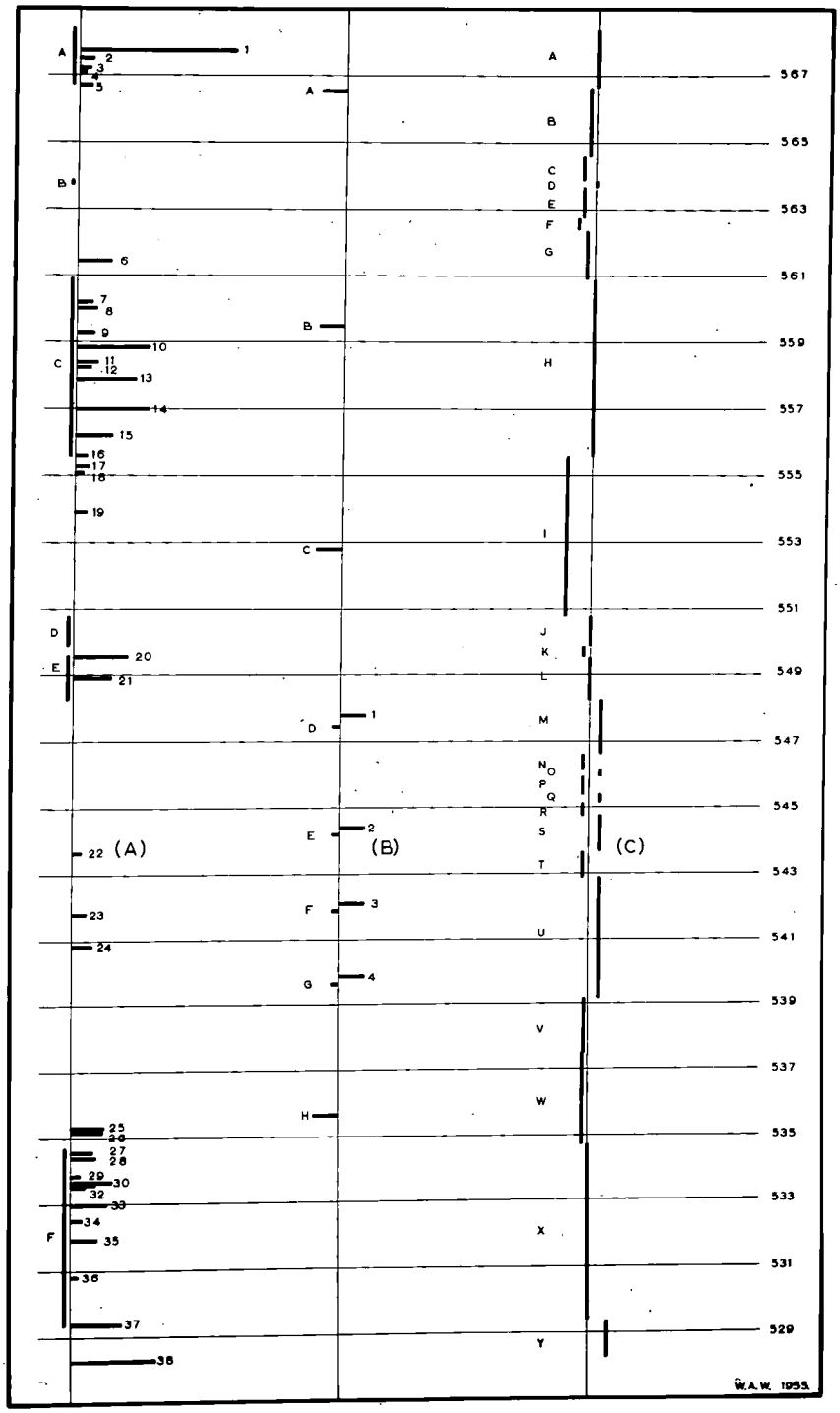

445
446
447
448
449
450
451
452
453
454
455
530
529
528
527
526
525
524
523
522
521
520
519
518
517
516
515
514
SEATON CAREW
NORTH GARE
GREATHAM BECK
GREATHAM
SEATON SNOOK
GREATHAM CREEK
NEWTON BEWLEY
WOLVISTON
COWPEN BEWLEY
COWPEN MARSH
SEAL SAND
BRAN SAND
SALT HOLME
HAVERTON HILL
BILLINGHAM
BILLINGHAM BECK
PORT CLARENCE
GRANGETOWN
CARGO FLEET
SOUTH BANK
MIDDLESBOROUGH
PORTRACK LAKE
NEWPORT
STOCKTON
MANDALE MARSHES
THORNABY
100
KEY OF TEES MOUTH PLACE NAMES
A REDCAR JETTY
B SOUTH GARE BREAKWATER
4 4th. BUOY.
5 5th. BUOY, etc.
SCALE OF MILES

FIG. 71

DIAGRAMS OF THE DURHAM COAST

PARTS A, B AND C.



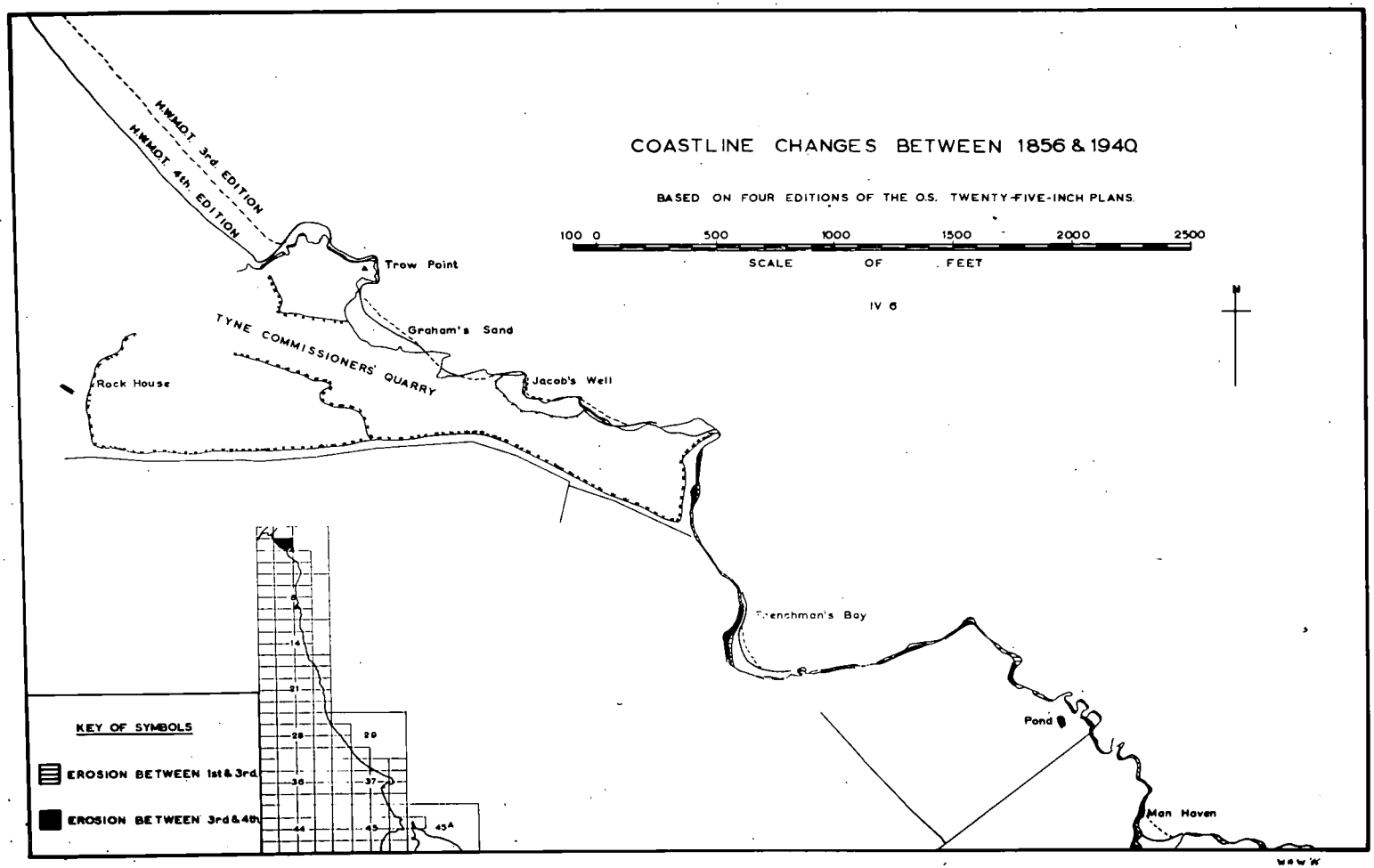

COASTLINE CHANGES BETWEEN 1856 & 1940
BASED ON FOUR EDITIONS OF THE O.S. TWENTY-FIVE-INCH PLANS.
100 0 500 1000 1500 2000 2500
SCALE OF FEET
IV 6
N
H.W.M.O.T. 3rd. EDITION
H.W.M.O.T. 4th. EDITION
Trow Point
Graham's Sand
TYNE COMMISSIONERS' QUARRY
Rock House
Jacob's Well
Frenchman's Bay
Pond
Man Haven
KEY OF SYMBOLS
EROSION BETWEEN 1st & 3rd.
EROSION BETWEEN 3rd & 4th
6
14
21
28
29
36
37
44
45
45A

FIG. 72

FIG. 73

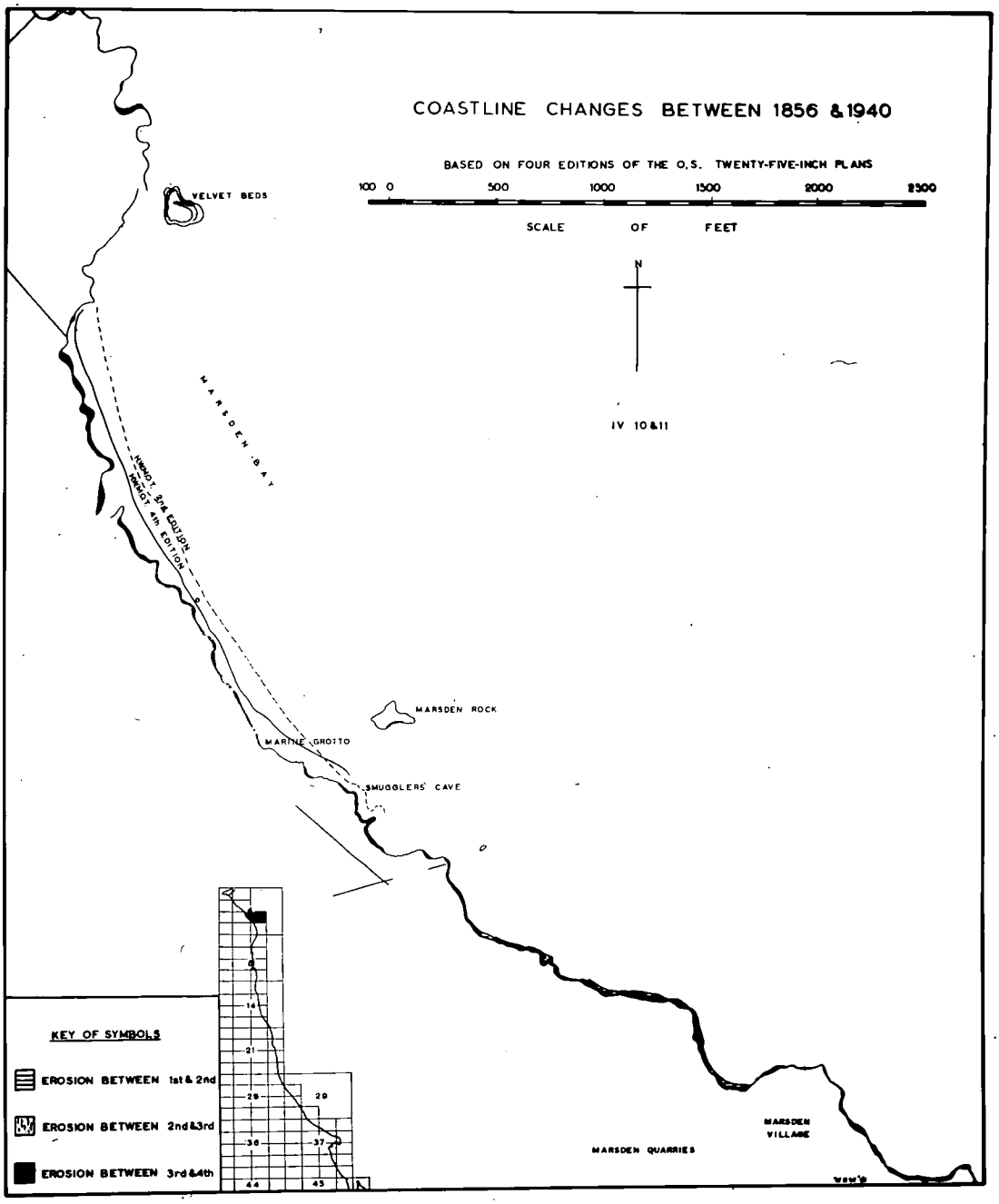

COASTLINE CHANGES BETWEEN 1856 & 1940
BASED ON FOUR EDITIONS OF THE O.S. TWENTY-FIVE-INCH PLANS
100 0 500 1000 1500 2000 2500
SCALE OF FEET
N
IV 10&11
VELVET BEDS
MARSDEN BAY
HMOT. 2nd EDITION
HMOT. 4th EDITION
MARSDEN ROCK
MARTIN'S GROTTO
SMUGGLERS' CAVE
MARSDEN QUARRIES
MARSDEN VILLAGE
KEY OF SYMBOLS
EROSION BETWEEN 1st & 2nd
EROSION BETWEEN 2nd & 3rd
EROSION BETWEEN 3rd & 4th

FIG. 74

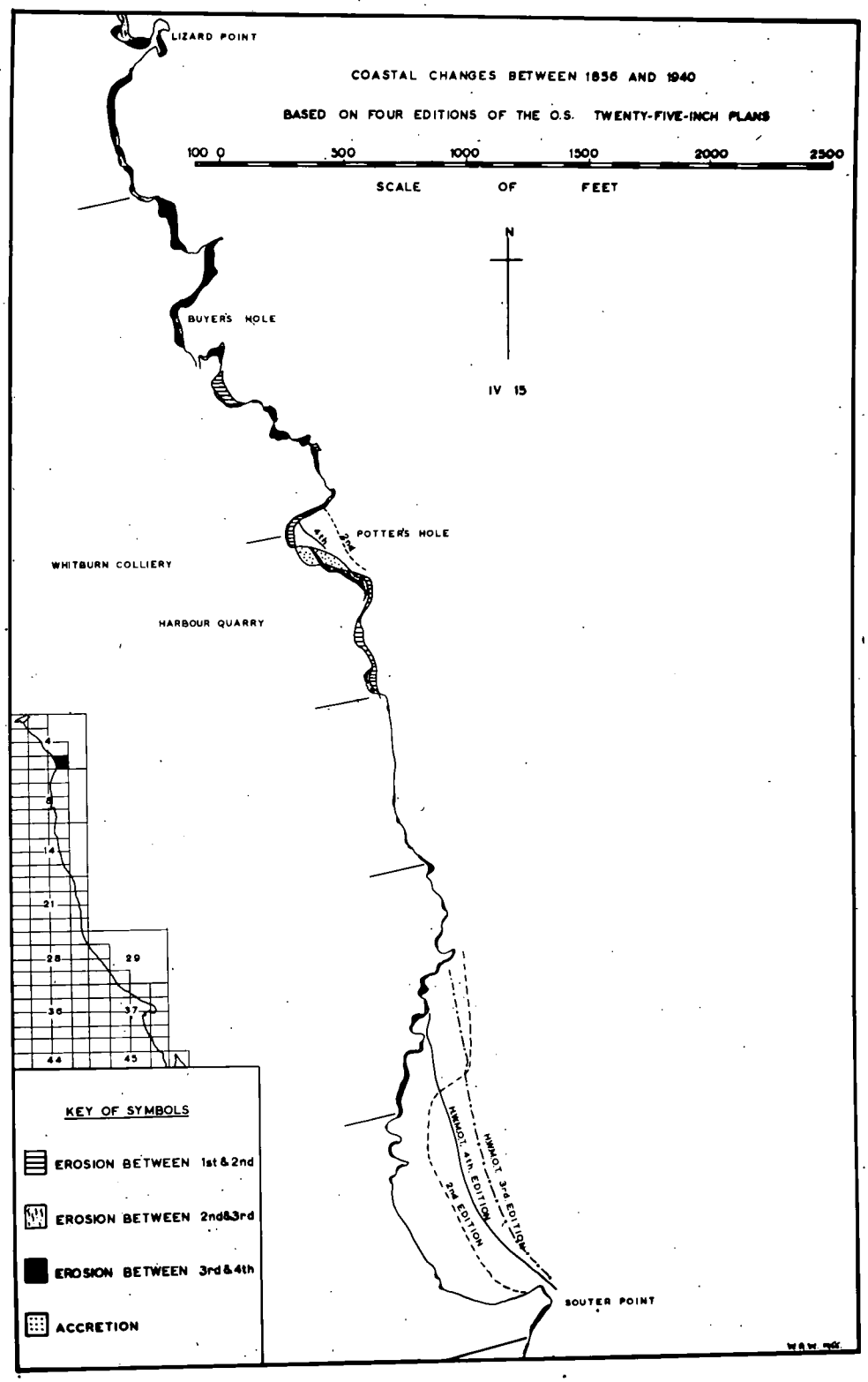

LIZARD POINT
COASTAL CHANGES BETWEEN 1856 AND 1940
BASED ON FOUR EDITIONS OF THE O.S. TWENTY-FIVE-INCH PLANS
100 0 300 1000 1500 2000 2500
SCALE OF FEET
N
IV 15
BUYER'S HOLE
POTTER'S HOLE
WHITBURN COLLIERY
HARBOUR QUARRY
4
9
14
21
28
29
36
37
44
45
KEY OF SYMBOLS
EROSION BETWEEN 1st & 2nd
EROSION BETWEEN 2nd & 3rd
EROSION BETWEEN 3rd & 4th
ACCRETION
HWMOT. 4th EDITION
HWMOT. 3rd EDITION
2nd EDITION
SOUTER POINT

FIG. 75

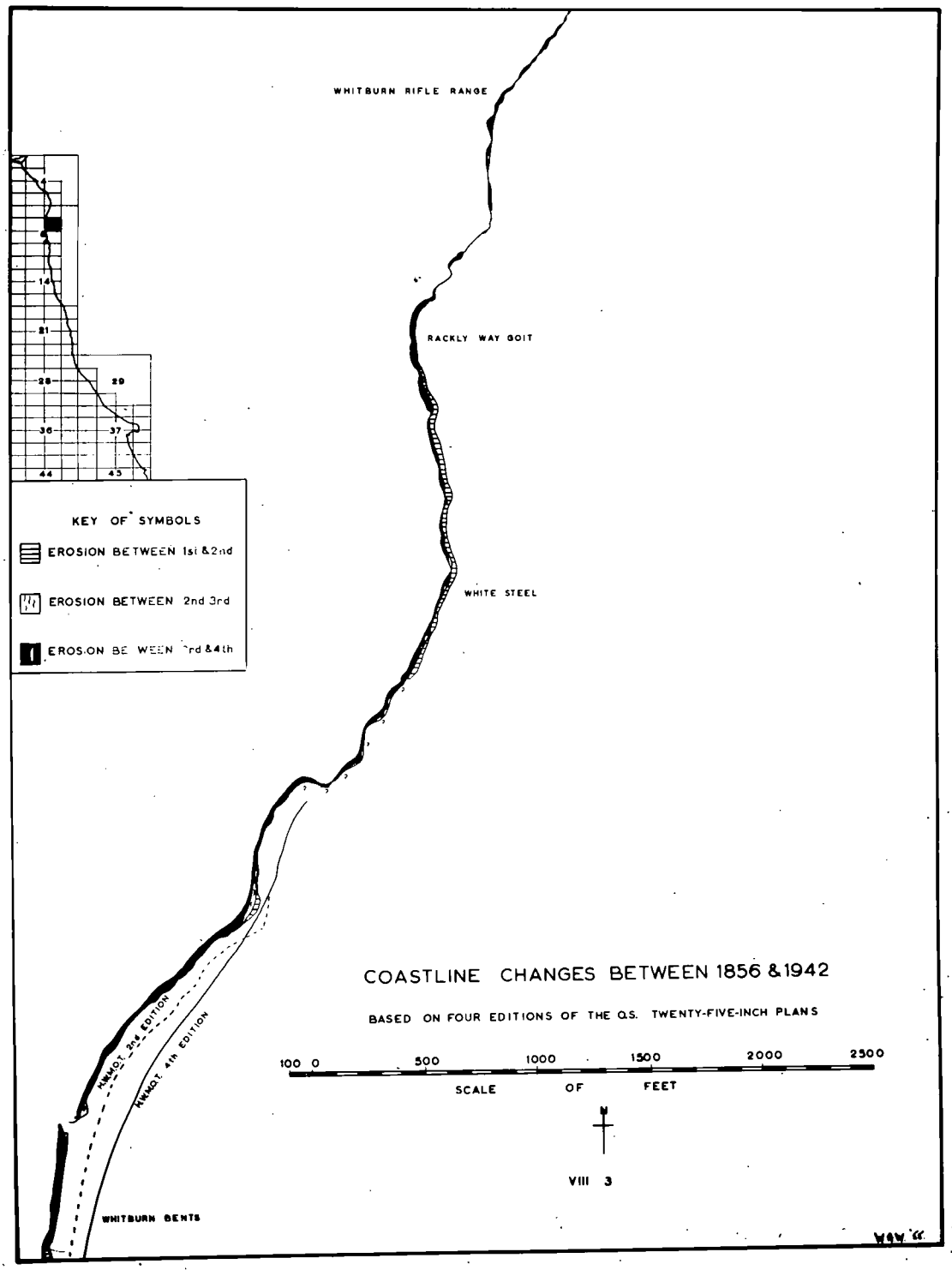

WHITBURN RIFLE RANGE
RACKLY WAY GOIT
WHITE STEEL
WHITBURN BENTS
1
6
14
21
28
29
36
37
44
45
KEY OF SYMBOLS
EROSION BETWEEN 1st & 2nd
EROSION BETWEEN 2nd 3rd
EROSION BETWEEN 3rd & 4th
NIMMO'S 2nd EDITION
NIMMO'S 4th EDITION
COASTLINE CHANGES BETWEEN 1856 & 1942
BASED ON FOUR EDITIONS OF THE O.S. TWENTY-FIVE-INCH PLANS
100 0 500 1000 1500 2000 2500
SCALE OF FEET
VIII 3

FIG. 76

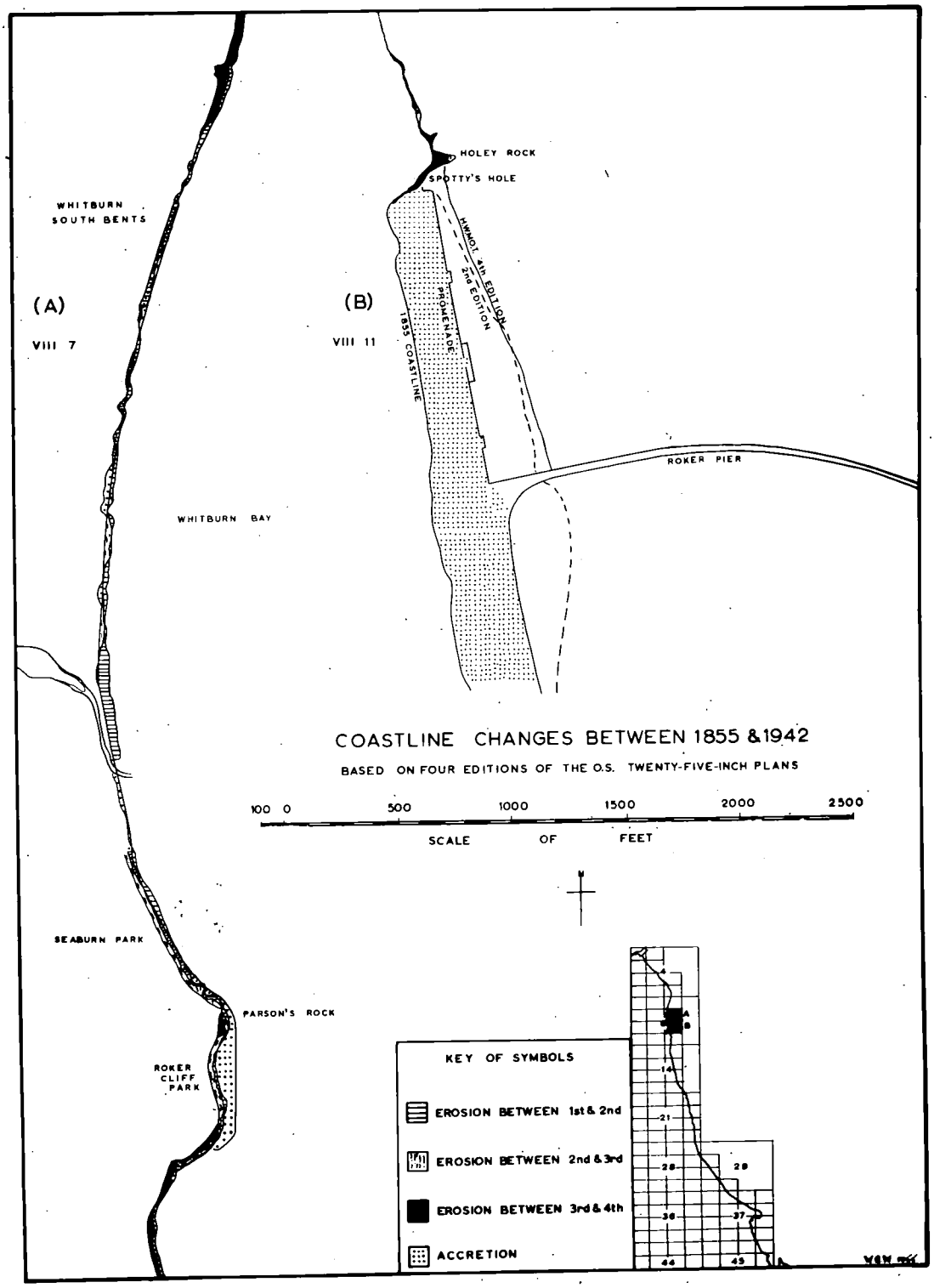
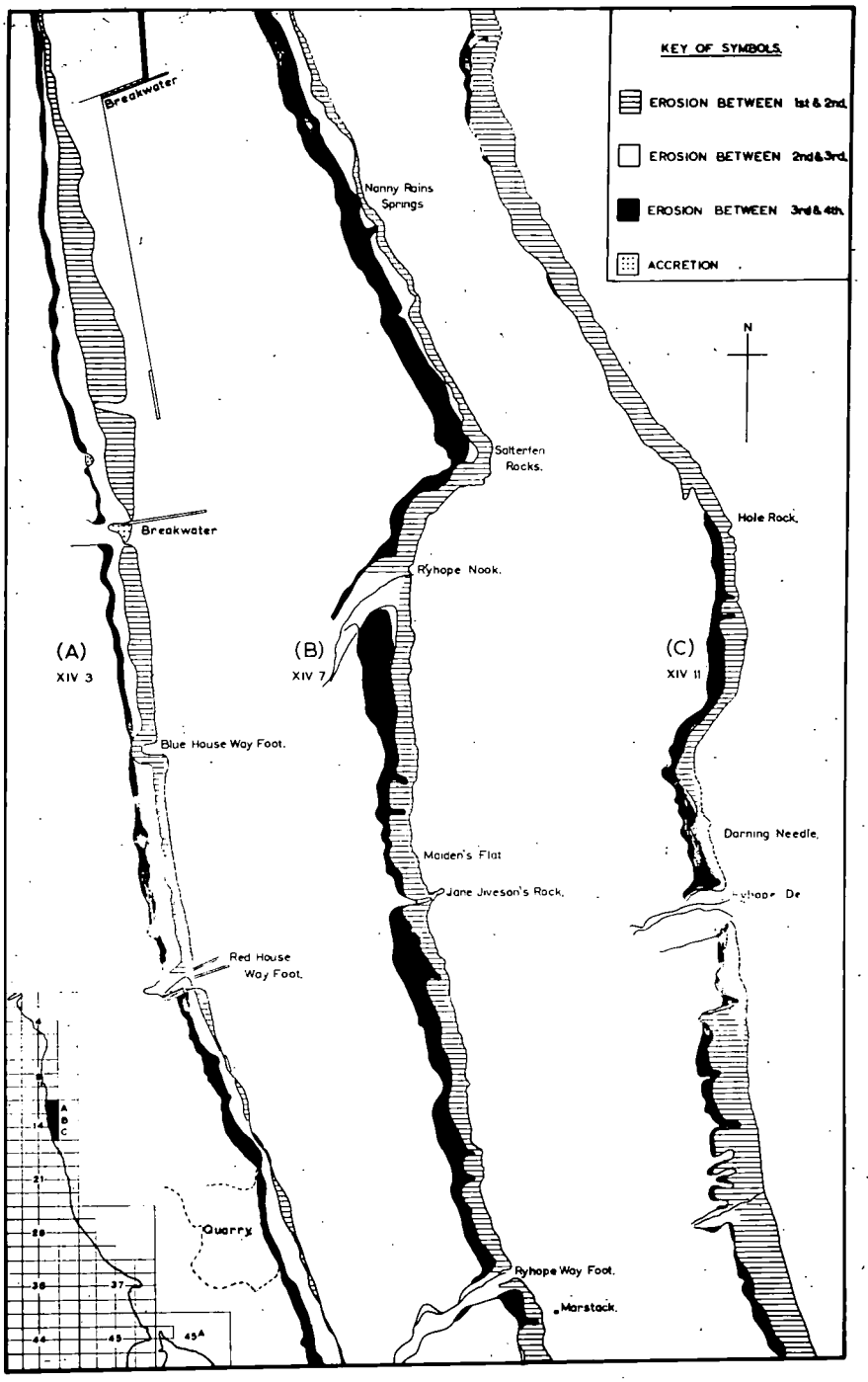

HOLEY ROCK
SPOTTY'S HOLE
WHITBURN SOUTH BENTS
(A)
VIII 7
(B)
VIII 11
HMMOT 4th EDITION
2nd EDITION
PROMENADE
1855 COASTLINE
ROKER PIER
WHITBURN BAY
COASTLINE CHANGES BETWEEN 1855 & 1942
BASED ON FOUR EDITIONS OF THE O.S. TWENTY-FIVE-INCH PLANS
100 0 500 1000 1500 2000 2500
SCALE OF FEET
SEABURN PARK
PARSON'S ROCK
ROKER CLIFF PARK
KEY OF SYMBOLS
EROSION BETWEEN 1st & 2nd
EROSION BETWEEN 2nd & 3rd
EROSION BETWEEN 3rd & 4th
ACCRETION

FIG. 77



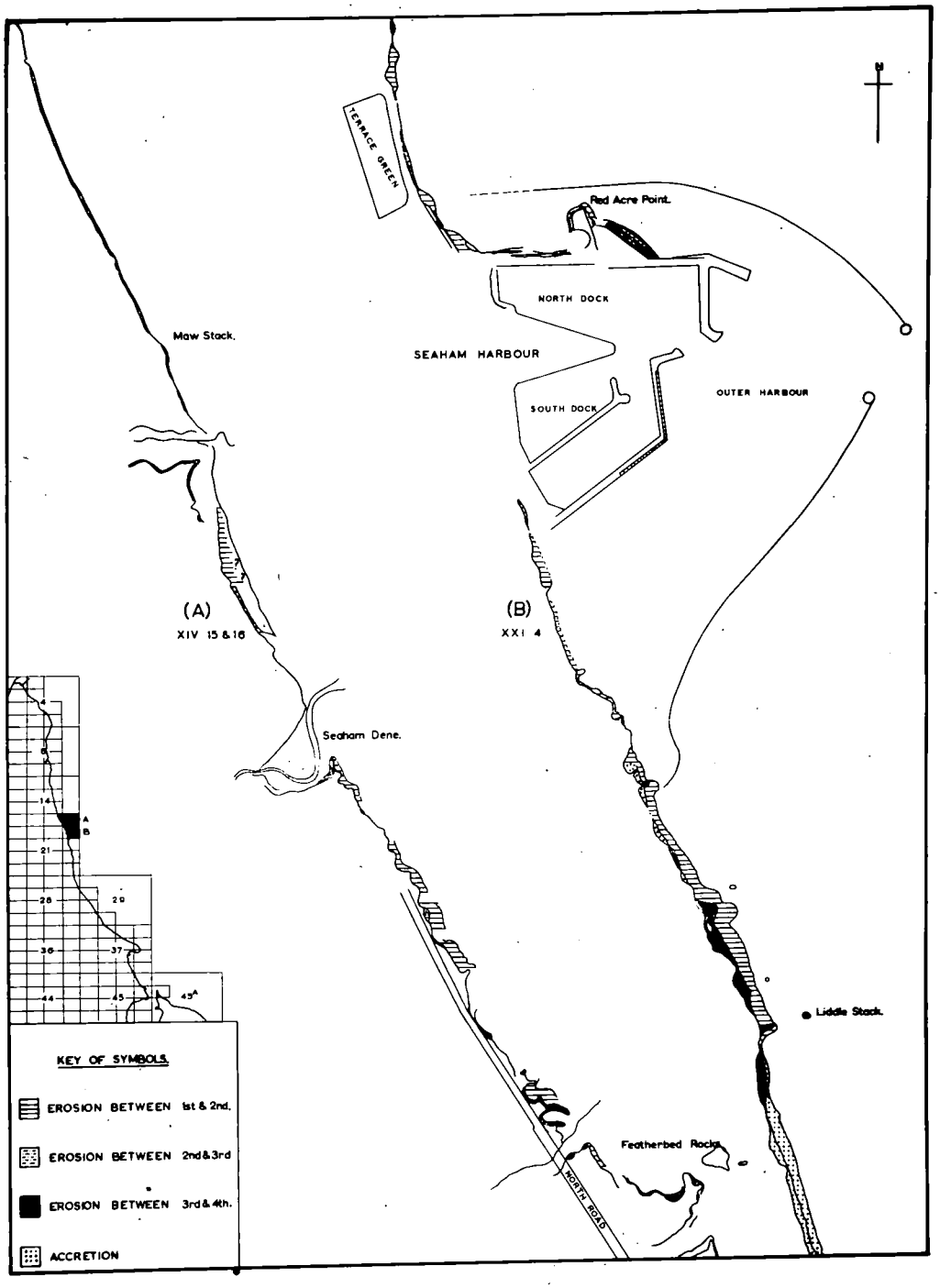
COASTLINE CHANGES BETWEEN 1856 & 1939.

BASED ON FOUR EDITIONS OF THE O.S. TWENTY-FIVE-INCH PLANS.

100 0 500 1000 1500 2000 2500

SCALE OF FEET.

FIG. 78



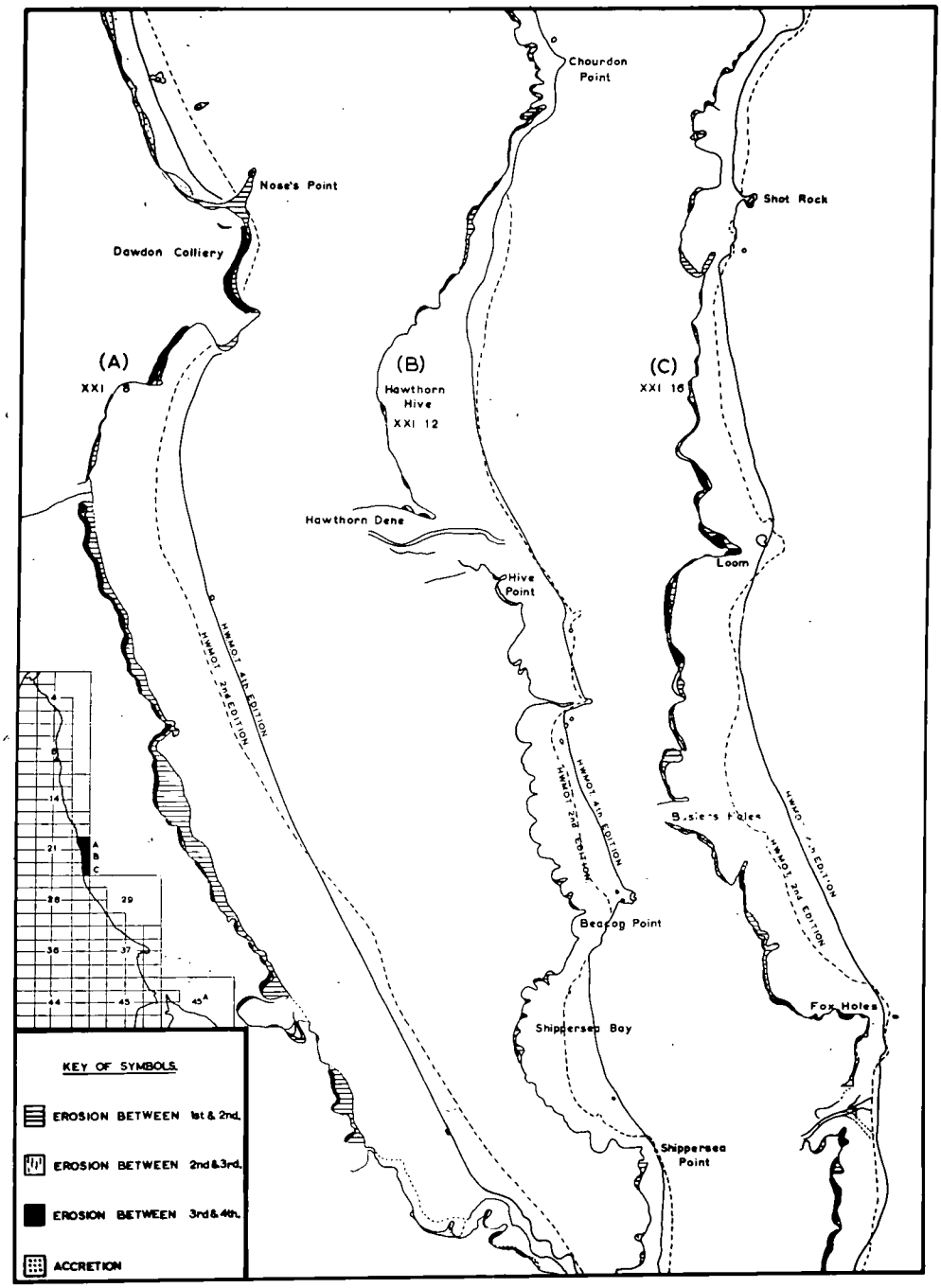
COASTLINE CHANGES BETWEEN 1856 & 1939

BASED ON FOUR EDITIONS OF THE O. S. TWENTY-FIVE-INCH PLANS.

100 0 500 1000 1500 2000 2500

SCALE OF FEET.

FIG. 79



COASTLINE CHANGES BETWEEN 1856 & 1939.

BASED ON FOUR EDITIONS OF THE O. S. TWENTY-FIVE-INCH PLANS.

100 0 500 1000 1500 2000 2500

SCALE OF FEET.

FIG. 80

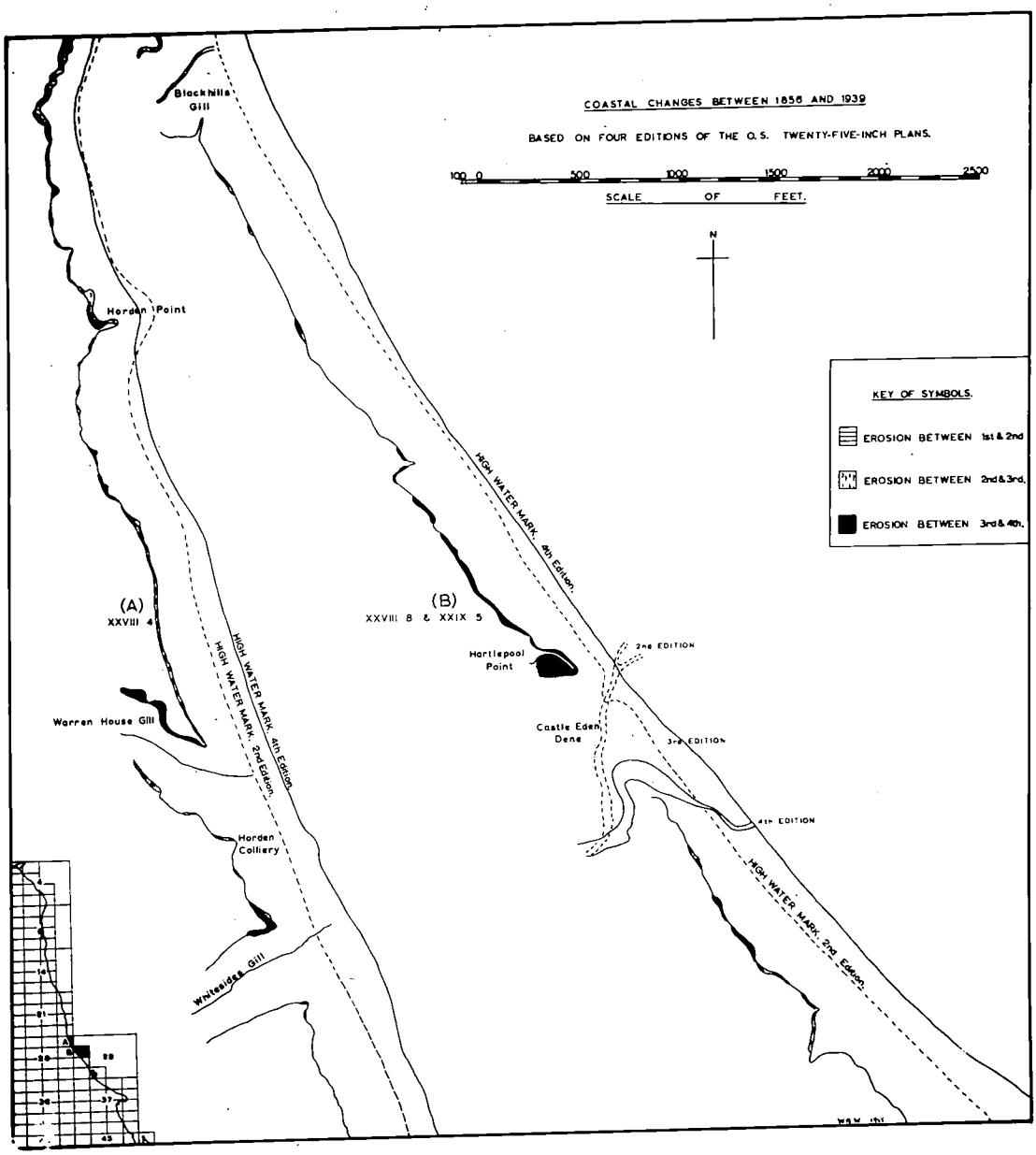
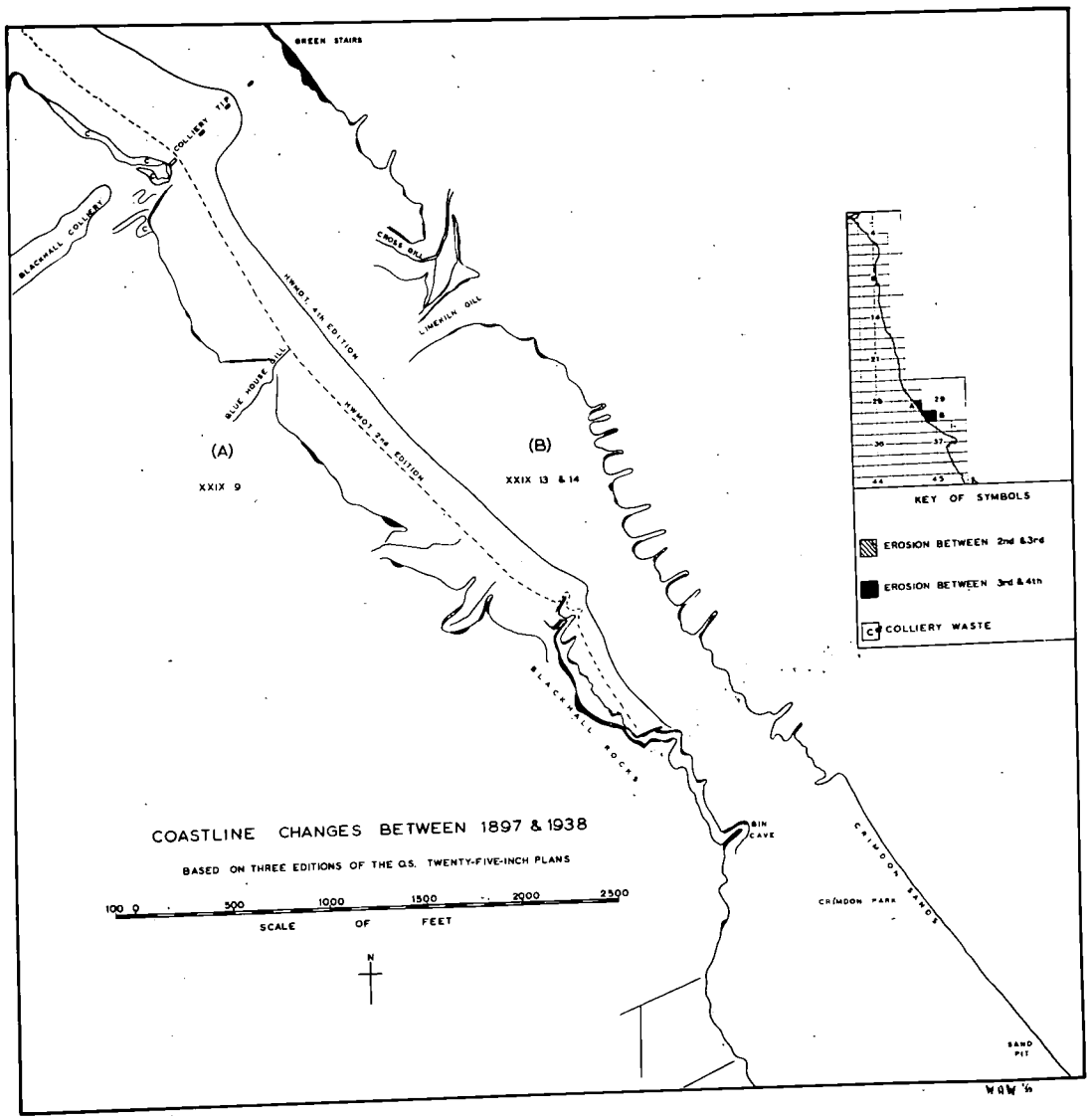

COASTAL CHANGES BETWEEN 1858 AND 1939
BASED ON FOUR EDITIONS OF THE O.S. TWENTY-FIVE-INCH PLANS.
100 0 500 1000 1500 2000 2500
SCALE OF FEET.
N
KEY OF SYMBOLS.
EROSION BETWEEN 1st & 2nd
EROSION BETWEEN 2nd & 3rd.
EROSION BETWEEN 3rd & 4th.
Blackhills Gill
Horden Point
(A)
XXVIII 4
(B)
XXVIII 8 & XXIX 5
HIGH WATER MARK, 4th Edition.
HIGH WATER MARK, 2nd Edition.
Hartlepool Point
2nd EDITION
3rd EDITION
4th EDITION
Warren House Gill
Castle Eden Dene
Horden Colliery
Whitebridge Gill

FIG. 81


GREEN STAIRS
COLLIERY
BLACKHALL COLLIERY
CHOKE DELL
LIMEKILN DELL
BLUE HOUSE DELL
HMSO 4th EDITION
HMSO 2nd EDITION
(A)
XXIX 9
(B)
XXIX 13 & 14
BLACKHALL ROCKS
BIN CAVE
CRIMDON SANDS
CRIMDON PARK
SAND PIT
KEY OF SYMBOLS
EROSION BETWEEN 2nd &3rd
EROSION BETWEEN 3rd & 4th
COLLIERY WASTE
COASTLINE CHANGES BETWEEN 1897 & 1938
BASED ON THREE EDITIONS OF THE O.S. TWENTY-FIVE-INCH PLANS
100 0 500 1000 1500 2000 2500
SCALE OF FEET
N

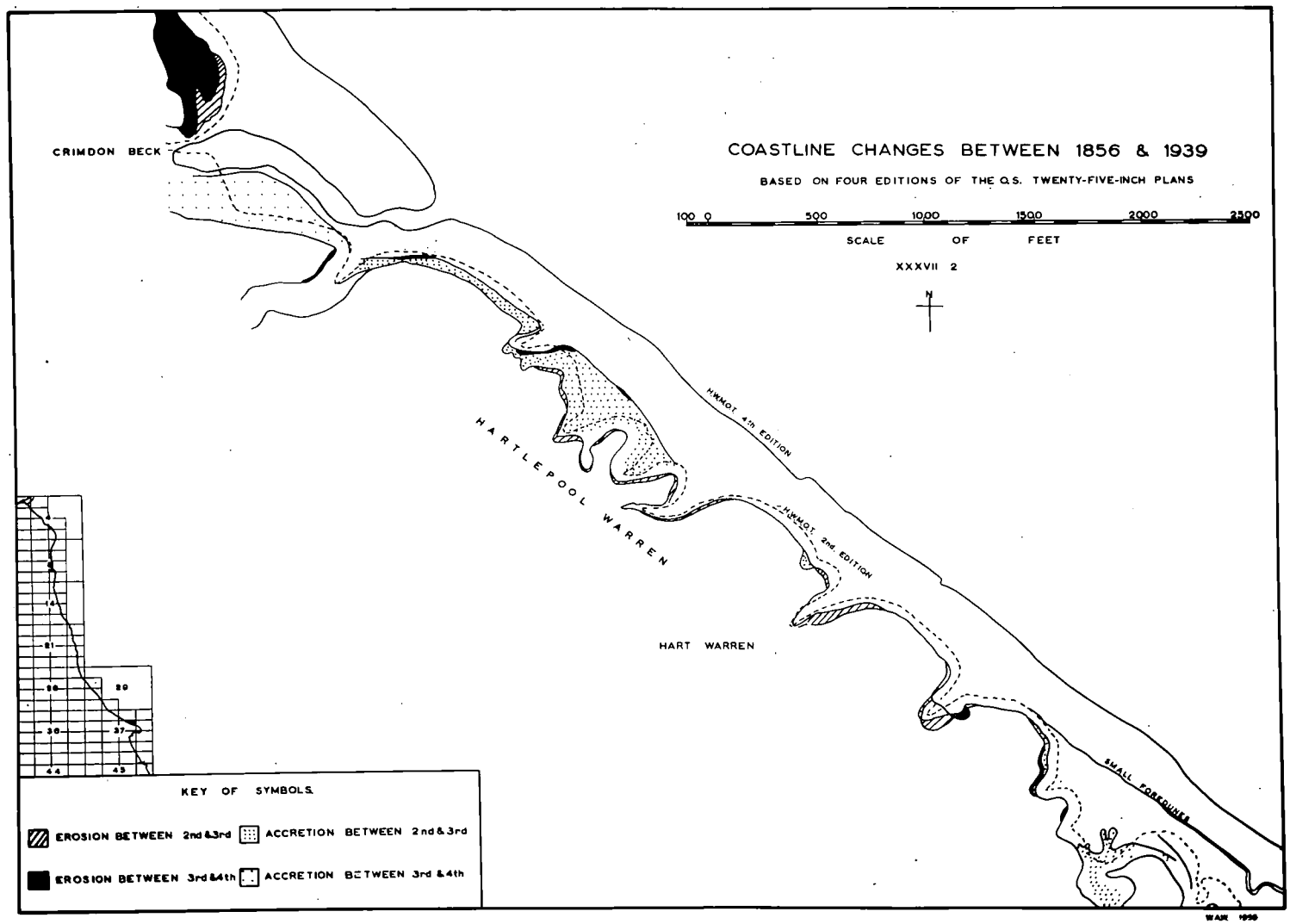

COASTLINE CHANGES BETWEEN 1856 & 1939
BASED ON FOUR EDITIONS OF THE O.S. TWENTY-FIVE-INCH PLANS
100 0 500 1000 1500 2000 2500
SCALE OF FEET
XXXVII 2
N
CRIMDON BECK
HARTLEPOOL WARREN
HART WARREN
HWMOT 4th EDITION
HWMOT 2nd EDITION
SMALL FOREDUNES
KEY OF SYMBOLS
EROSION BETWEEN 2nd & 3rd
ACCRETION BETWEEN 2nd & 3rd
EROSION BETWEEN 3rd & 4th
ACCRETION BETWEEN 3rd & 4th

FIG. 82

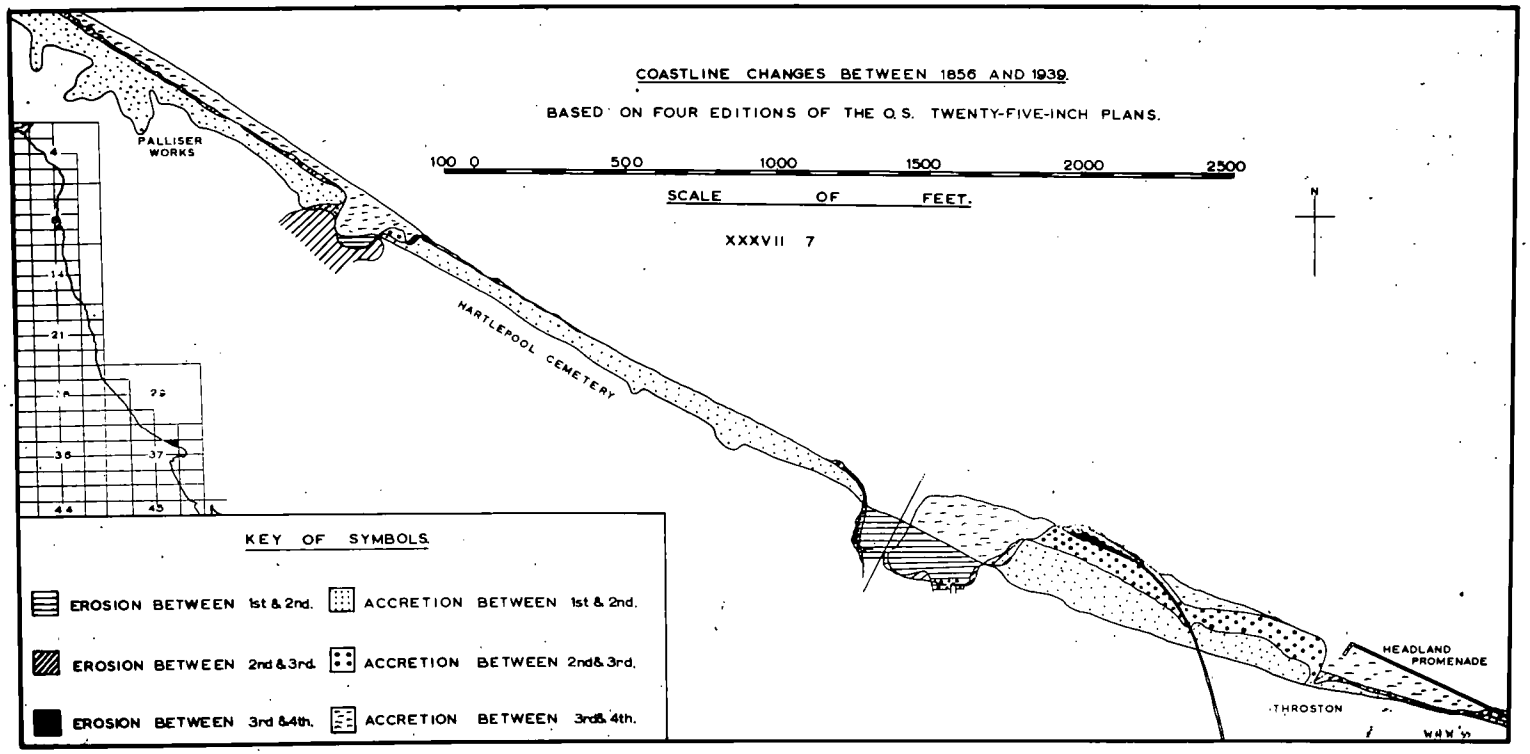

COASTLINE CHANGES BETWEEN 1856 AND 1939.
BASED ON FOUR EDITIONS OF THE O.S. TWENTY-FIVE-INCH PLANS.
100 0 500 1000 1500 2000 2500
SCALE OF FEET.
XXXVII 7
N
PALLISER WORKS
HARTLEPOOL CEMETERY
HEADLAND PROMENADE
THROSTON
KEY OF SYMBOLS.
EROSION BETWEEN 1st & 2nd.
ACCRETION BETWEEN 1st & 2nd.
EROSION BETWEEN 2nd & 3rd.
ACCRETION BETWEEN 2nd & 3rd.
EROSION BETWEEN 3rd & 4th.
ACCRETION BETWEEN 3rd & 4th.

FIG. 83

Plate I: East of Cleadon Hills the coastal plain forms a marked feature of the landscape. There is an absence of surface drainage and bare outcrops of limestone are frequent. The piece of the plain shown is south of Frenchman's Bay, seen in the foreground.

Plate II: Well bedded Lower Limestone with N-S fracturing forms the base of the cliffs south of Trow Point, and has occasionally been left standing as a stack on the floor of the Tyne Commissioner's Quarry.

Plate III: Spheroidal Concretionary Limestone resulting from the segregation of calcium carbonate.

Plate IV: Water-worn Cellular Limestone produced by the removal of magnesium carbonate.

Plate V: Bedded breccias on the east of the 'Shell Reef' often form the base of headlands. Local fracturing is sometimes well marked and forms lines of weakness.

Plate VI: South of Tunstall Hope the gravels and sands associated with the Tunstall overflow channel form an important part of the sea cliffs. These superficial deposits suffer from atmospheric as well as marine denudation. The large boulders fall when the supporting pebbles are washed away by rain wash, and they tend to accumulate on the top of the boulder clay.

Plate: VII: The Easington 'Raised Beach' on the flanks of Beacon Hill has been considered marine by Woolacott, Lamplugh, Merrick and Trechmann, though they disagreed over its age.

Plate VIII: Bare surfaces of boulder clay are readily scoured by running water, and there is little chance of vegetation growing upon slopes which also suffer greatly from wind erosion.

Plate IX: Cliff top recession north of Tunstall Hope is rapid, owing to the lack of cohesion of the superficial deposits which readily fall on to the beach, and to the general shortage of beach material which allows the waves to attack the cliffs strongly.

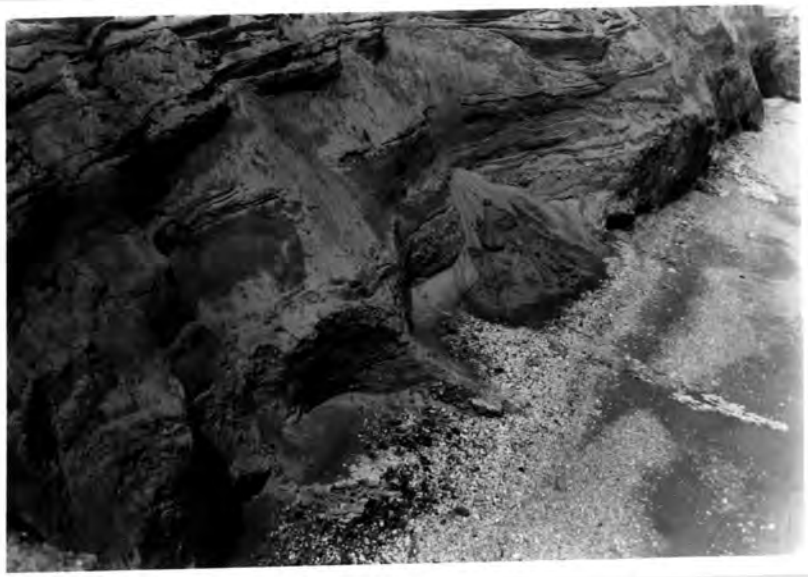


Plate X: Sandy Pleistocene deposits are very susceptible to movement when exposed in the cliff face, and north of Jane Jiveson's Rock almost the whole face is of such deposits. Slumping and wind erosion are quite pronounced, though clayey layers often stand out as more resistant bands.

Plate XI:

The development of the overlying glacial deposits south of Hendon is closely related to the erosion of the limestone 'foundation wall'. Where erosion is rapid, as in this instance, the boulder clay has a steep outer face, but where cliff foot recession is slow the less resistant boulder clay is eroded by atmospheric denuding agents to form a gentle slope, and 'slope over wall' profiles result.

Plate XII: The opening out of fractures by marine denudation is well seen at Trow Point, where the headland is cut by well developed N.S fractures. The fractures are frequently filled by beach shingle and sand.

Plate XIII: Breccias are found along many parts of the Durham coast, and many have been formed by limestone slumping down the seaward side of the 'Shell Reef' The breccia resistance to denudation depends to a great extent on the character of the intervening unbrecciated fragments.

Plate XIV: Salterfen Point from the south. The resistant yellow bedded limestone is covered by a layer of less resistant boulder clay, which is covered by sandy deposits displaying bedding. Cliff top recession is rapid, and the footpath in the foreground has been partly washed away.

Plate XV: On the north side of Frenchman's Bay the well-bedded Lower Limestone is well developed and passes upwards into irregularly brecciated Middle Limestones.

Plate XVI: Souter Point Beach from the south. The old sea cliffs in front of the Rifle Range are quite secure from wave attack at present, and the beach deposits have become covered with vegetation.

Plate XVII: South of Dawdon Colliery the beach is very artificial, as the amount of beach material has been considerably increased by dumped material. The cliffs are safe from marine denudation and the beach has been completely ruined as an amenity.

Plate XVIII: The cliffs at the head of Hawthorn Hive are secure from wave attack and the upper beach is covered with vegetation. The greater part of the accumulated beach material is derived from colliery tips.

Plate XIX: The construction of a new sewer outfall at Whitburn has resulted in much shingle and sand accumulating immediately to the north and a comparative shortage of such material to the south. In places the height difference between north and south beaches is about five feet.

Plate XX: The shortage of beach material at Ryhope resulting fron the retaining of beach material by the sunderland Harbour piers and breakwaters has been further aggravated by the daily removal of beach material for building purposes.

Plate XXI:

Field drainage is responsible for this notch cut in the cliffs near Jane Jiveson's Rock. This particular notch extends to beach level, but many smaller ones extend only a short distance into the limestone 'foundation wall'.

Plate XXII:

A stack of Lower Bedded Limestone topped with Middle Unbedded Limestone stands on the floor of the Tyne Commissioners' Quarry. The Lower Limestone is readily broken along its bedding planes, but the fossiliferous Middle Limestone is eroded by the picking out of the softer materials from the unbedded mass.

Plate XXIII: Trow Point from the south. The overlying glacial material has been eroded by rain wash to form a long seaward slope ending in a vertical face of limestone. Fracturing of the limestonehas influenced the form of the headland, and a structurally guided break through of the headland is illustrated in the photograph.

Plate XXIV: Unbedded Middle Limestones stand out as bare rock features south of Frenchman's Bay. The coastal plain has a thin covering of boulder clay, but this is removed by rain wash and wind erosion near the cliff edge, and the bare limestone is exposed. The cave in the foreground of the photograph has been eroded in an anticlinal structure.

Plate XXV: North of Velvet Beds the Middle Limestones have been eroded into deep caves, and the roofs have often partially collapsed to form natural archways.

Plate XXVI: The importance of structure in guiding marine denudation cannot be overstressed, and the photograph shows slumped Middle Limestone being eroded along fracture planes to form arches and caves. The effect of the picking out of detail by the waves may be clearly noted.

Plate XXVII: Despite the sheltering effect of Velvet Beds to the north-east, the soft white lime silts forming the cliff foot along much of the northern end of Marsden Bay have been rapidly washed away and the overlying more resistant limestone has been undermined.

Plate XXVIII: Lithological and structural variations in the Marsden Rock area have led to the development of many caves and promontories, and there are many cases of resistant beds jutting out from the cliff profile. Fallen clay has often accumulated on these jutting rocks which later become covered by vegetation.

Plate XXIX: The vertical cliffs of Concretionary Limestone near Marsden Village have an extremely variable composition. The cliffs are readily broken by waves and falls are almost continuous. There is only a thin covering of boulder clay.

Plate XXX: Lizard Point has recently been broken through by the sea, and already a large gap has been formed between the stack and the mainland. Erosion has been severe in this area during the past century. In 1871 Souter Point Lighthouse was some 345 yards from the sea cliff, but that distance is now only 267 yards.

Plate XXXI: The bedded limestone cliffs around Potter's Hole are eroded into quite remarkable forms, and the bedding planes are all-important in the fashioning of local details.

Plate XXXII: South of Souter Point the shortage of beach material has allowed the waves to attack the broken Concretionary limestone and erosion has been rapid.

Plate XXXIII: Occasionally the broken Concretionary Limestone rests on an exposure of Bedded Limestone which is more resistant to denudation, and the cliff-line is more stable.

Plate XXXIV: Erosion at Hendon is very rapid, and results largely from wave attack across a poorly developed beach. The presence of fractures in the limestone is an important aid to the waves and many large falls occur from time to time.

Plate XXXV: Falls of limestone are quite commonly noted along the coast south from Sunderland, but the fallen rock is soon removed by the waves.

Plate XXXVI:

Coastal erosion south of Sunderland is so great that cliff top footpaths are frequently removed. The footpath shown in the foreground formerly extended towards the white tin placed in the middle-ground, but three months' erosion was sufficient to cut out the intervening boulder clay.

Plate XXXVII: Seaham Sea Wall has recently been completed, and the sea cliffs have been cut back to a 45° slope. Sand has tended to accumulate in front of the wall and this tendency will increase when the groynes are built.