LATE- AND POST- GLACIAL CHANGES OF SHORELINE ON THE NORTHERN SIDE OF THE FORTH VALLEY AND ESTUARY

by

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PART II

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INTRODUCTION TO PART II

In a study of the relative movements of sea level, the limitations of examining an area in sections are manifest. Unless the area has experienced local tectonic activity the chances are that the changes will be spread over a wide area. The second part of this work looks at the Forth area as a whole in an attempt to define and account for the pattern of shoreline displacement.

The first part ended by concluding that if the pattern of raised shorelines in the Forth area bore any resemblence to the popular schemes of three or four horizontal or tilted raised shorelines, then that was purely coincidental. A comparison of the observations made in the first section now shows that in fact there is no such pattern.

There are no widespread horizontal shorelines in the area. This can be shown in the following way. It was reported above (Chapter VI) that a marked raised shoreline exists at 105.9-108.5 feet O.D. near Kincardine, in association with an ice front there. Yet a meltwater channel at Windygates descends to 89.8 feet O.D., a kame terrace at Largo is as low as 88.3 feet O.D., and an outwash plain at Leven descends at least as low as 86.2 feet O.D. (Chapter VII). These latter features require a considerable body of ice to have remained in the Windygates-Largo Bay area during the formation of the Kincardine raised shoreline if that shoreline is a horizontal feature. Such a distribution of ice masses is highly unlikely.

Furthermore, two kettle holes have been described in the Kilconquhar area as having edges at 55.3 feet O.D. and 56.6 feet O.D. This means that ice was present in these localities until the local sea level dropped below these heights. Yet as far west as Thornhill, seven miles west of Stirling, probable raised shorelines occur up to 69.6 feet O.D. It does not appear feasible that ice retreat could have been so rapid, nor the maintainence of dead-ice in a marine environment so long-lived as to permit bodies of ice to have remained at Kilconquhar while the main ice front lay nearly 50 miles away to the west.

There are not four tilted shorelines throughout the area. This is shown by the following observations. Firstly, a shoreline occurs up to 108.5 feet O.D. at Kincardine, yet west of that place no marine level occurs above 73.6 feet O.D., and there are several kettle holes below 108 feet O.D., not to mention large semi-enclosed depressions which might accomodate such deposits as a sea at 108 feet O.D. might have produced. It has in fact been shown that the shoreline was formed in association with an ice limit at Kincardine. This raises a second objection to the established concept. The highest shoreline at Kincardine was associated with an ice front there; yet the highest shoreline at Anstruther, 90-92 feet O.D., appears to have been a contempory of an ice front at Anstruther. Therefore these two shorelines are not contemporary. A third objection may be raised. In the scheme of four tilted raised shorelines the carse is considered one level. Yet observations have revealed that it is composed of more than one.

It must be concluded that established concepts of three or four horizontal or tilted raised shorelines have no validity in the Forth area. This second part will seek to define an alternative pattern, on the basis of the detailed observations made in the first part of this thesis. First, however, there follows an account of the evolution of present concepts on sea level changes.

CHAPTER X

THE EVOLUTION OF PRESENT CONCEPTS ON SEA LEVEL CHANGES

History records innumerable instances of sea level changes. Some of the earliest observations seem to have been made in Greece, where Aristotle (384-322 B.C.) believed movement of the sea level to be a periodic happening. Straton of Lampascus and Eratosthenes (around 300-200 B.C.) noted that in certain places the sea had once been higher and explained this by saying that the Mediterranean and Black seas had once been dammed by barriers at Istanbul and Gibraltar, and that the breaking of these barriers lowered the sea level. Later, Strabo (54 B.C. - 24 A.D.) recognised that both rises and falls of sea level had taken place, and believed that the reason was to be found in movement of the sea bottom. It is apparent that from early times there was a clear division of opinion on the cause of sea level changes. On the one hand, movement of the sea alone was considered to be the cause, while on the other, movement of the land was advocated.

DEVELOPMENT OF THEORIES ON WORLD SEA LEVEL CHANGE

The belief that it was the sea which moved, not the land, is probably of greater antiquity. A study of the literature on this subject over the last 200 years, however, reveals the principal trends. Early on, opinion was most forcibly expressed by men such as Catcott (1768), who believed strongly in the Deluge of Genesis. Writing of this nature increased considerably in the late eighteenth and nineteenth centuries and had a strong effect on investigators as recently as the early years of the present century. The writers were seeking to explain the presence of marine fossils in solid rocks, as well as the morphological manifestations of sea level changes around the coasts. More moderate opinions, however, were also expressed, as by Frisius (1785). He took notice of the observations made in the Gulf of Bothnia between 1680 and 1731 by Celsius, who had observed that the sea was receding. Frisius was also aware of a rise in the waters of the Adriatic, and cited numerous examples to support this. He concluded that since sea level in the Gulf of Bothnia was falling and that in the Mediterranean was rising, world sea level was rising towards the Equator due to a "slight acceleration in the earth's diurnal motion".

The majority of opinion, especially in Britain, at the beginning of the nineteenth century, was that sea rather than land changes were responsible for raised shorelines. This period saw the heyday of the Drift theory, born of the Deluge beliefs of earlier writers. All the glacial deposits of Britain were seen as deposits laid down in a deep arctic sea on the margin of a great polar ice cap (see Milne-Home, 1838, 1869). The glacial period was termed the Diluvial Period, and, according to the Drift theory, raised shorelines were considered to demonstrate the last stages in the fall of sea level. It received wide currency until late in the century. Works such as Chambers' "Ancient Sea Margins" (1848), in which the author claimed to recognise marine terraces up to 1342 feet in Britain were advanced in support of this theory.

The doctrine of an invariable sea level was first strongly advocated by Hutton in 1785, and elaborated by Playfair in 1802. Opposed by the proponents of the Diluvial Period, it yet attracted opposition on more reasonable grounds. In 1842, Maclaren, who supported Agassiz' views on land ice, remarked on the probable abstraction of great quantities of water by the ice sheets, thus lowering sea level by a considerable amount. In 1853, Tylor emphasised that sea level was not stationary, but was affected by the amount of sediment laid down in it by rivers. In a number of works, beginning in 1866, Croll (1866, 1874, 1875, 1889) advocated the theory that the past submergence of the coasts of Britain and Scandinavia was due to a shift in the centre of gravity of the earth as ice accumulated around the north pole, so raising sea level in the northern hemisphere. When the ice sheet melted, another grew up around the south pole, and the process was reversed. Hence it was claimed that the position today is one of a falling sea level in the northern hemisphere and a rising one in the southern hemisphere. In a reply to Croll in 1866, Heath suggested that an ice sheet at the north pole would attract the sea to it, causing a rise in sea level in the northern hemisphere. This belief, that great ice sheets would attract water towards them and hence produce a variable sea level as they melted, was elaborated by Penck (1882). It was subsequently abandoned by him, though Wright (1914) did not entirely discount it.

Following Maclaren, Croll (1866) and Tylor (1868, 1872) recognised that water would be abstracted from the oceans by the formation of ice sheets, and in 1874 the idea of an invariable sea level was further questioned by Ferrel, who noted differences in the mean level of adjacent seas. A series of levellings between Portishead and Axmouth showed that the mean level of the sea was nine inches higher at the former place. Discrepancies were also found in the mean sea level of various places on the eastern seaboard of the United States. These results confirmed the earlier work of Airy in Ireland (1845). Ferrel concluded in 1886 that the mean level of the sea was not constant, but that it fluctuated according to ocean currents. Trautschold had opposed the uniformitarian doctrine of an invariable sea level in 1879, and the work of Maclaren, Croll, Tylor and Ferrel strongly substantiated his opinions. This, unfortunately, led some opinion to favour sudden, catastrophic events, expressed in the work of Howorth (1894), who believed that raised shorelines were the product of a great "Tidal Wave" or series of "Tidal Waves". Equally improbable suggestions were made by Pearson (1901, 1907) who thought all raised shorelines were of historic age - despite proofs of the considerably greater antiquity of some - and proposed a shift of the earth's ocean currents every 320 years to explain them.

In 1888 Suess introduced the term eustatic movements (eustatische bewegungen) to cover changes in world sea level, and by the beginning of the present century it was generally accepted that raised shorelines in areas formerly occupied by ice sheets were special cases, and could not be accounted for by eustatic change alone. Much consideration was directed to eustatic change in stable areas of the earth's crust. Maclaren's ideas were elaborated by Antevs (1928), Daly (1934), Penck (1934) and others, who tried to calculate the fall in sea level over the world at glacial maxima, when abstraction of water was greatest. Estimates were usually between 85 and 100 metres. Daly calculated that if present glaciers were to melt, sea level would rise 40 to 60 metres. Since proved marine terraces exist above these levels in various stable parts of the world, it was apparent that other factors had influenced world sea level besides glaciation. Daly provided an interesting discussion on this, in which the problems of crustal unloading and loading of water abstracted then released with the growth and decay of ice sheets during the Quatenary, combined with the greater degree of erosion at that time, and the continuation of processes which began in the Tertiary, were considered. It was recognised that the crust was far from being a passive factor in eustatic change.

Several theories attributed changes in world sea level to crustal movements. Haug (1900) believed that uplift and subsidence of geosynclines caused transgressions and regressions. Stille (1924) expressed the view that the earth's history was divided into geocratic and thalassocratic periods. In the former, lands were high and dominant, in the latter the sea was widely transgressive. Penck (1934) extended Tylor's (1853) ideas on sedimentation and calculated possible rises in sea level due to this process. A number of writers suggested movement of ocean basins to cause variations in world sea level. This theory was originally proposed by Darwin (1842) and Chambers (1848). Fairbridge has discussed these theories at length (1961) and indicates serious objections to them.

Changes in ocean volume due to glacial periods attracted most investigators, however, and this theory received the widest approbation. It was further substantiated by the work of Gutenberg (1941) who made the first comprehensive analysis of tide guage records. He showed that a world wide rise of sea level was in progress, and Ahlmann (1953) correlated this with the contemporary glacial retreat.

Recent Work

As Fairbridge points out (1961), there has been no dearth of theoretical material for explaining the cause of eustatic movements. In consequence, recent work has been mainly concerned with refining past theories and testing them by measurement and observation. Using recent information on the extent and thickness of contemporary ice sheets, Fairbridge estimates that should they melt the eustatic rise would be 50 metres. He considers that the maximal lowering of the sea during the Pleistocene would be 100 metres. These figures are not greatly at varience with those of Antevs, Daly or Penck, quoted earlier. The techniques of pollen analysis, varve counting, radio-carbon dating and oxygen isotope temperature determinations of deep sea cores have permitted traces to be attempted of sea level changes during the Würm or Wisconsin glacial period.

Flint (1957) has provided a valuable summary of factors affecting sea level during glacial periods, and these must be superimposed on the simple abstraction-fall melting-rise pattern if the correct picture is to be obtained. Besides crustal movement, he mentions temperature change, pointing out that a rise in sea temperature of 1° C. would raise the level by 60 cms. He also indicates the importance of the return of water from lakes impounded by isostatic crustal warping during the Pleistocene.

Much work has been done recently on eustatic change in late and post-glacial time, particularly in the U.S.A. and Holland. An excellent summary of work in the Gulf of Mexico is provided by Leblanc and Bernard (1954). Here, a rise of sea level until 5,000 B.P. and a stationary period since has been recognised. Van Weelden (Leblanc and Bernard, 1954) has questioned this. In Holland, Jelgersma's observations (1961) show a rapid rise between 8,300 B.P. and 7,000 B.P., gradually levelling off thereafter. Shepard and Suess (1956) consider that sea level has continued rising to the present day, but this view is opposed by Godwin, Suggate and Willis

(1958), who state that the oceans attained their present level around 5,500 B.P. Schofield (1960) believes that world sea level has fallen seven feet since 4,000 B.P. Fairbridge (1961) records a rapid rise until 5,700 B.P., when sea level was 3-4 metres higher than now, and fluctuations since. Many writers disagree with Fairbridge's post 5,700 B.P. oscillations. Several writers are agreed that a rise in sea level is taking place at present, due to the contemporary wastage of ice sheets. Their estimates of the rate of rise range between 7 and 16 centimetres per century.

While the importance of ice-sheet fluctuations in affecting eustatic changes is now recognised, there has been no dearth in recent years of theories of crustal and geodetic movement affecting world sea level. Theories have been advanced which would have world sea level affected by changes in the earth's motion and shape. Normally the geoid swells at the equator and shrinks at the poles under the effect of centrifugal force. Changes in the velocity of the earth (Munk and Révelle, 1952) or movement of the poles (Jardetzky, 1957) could produce considerable eustatic change. Fairbridge has shown how a sudden shift of the pole of 1^{o} would cause a eustatic rise of 245 metres at the equator, and a fall of the same amount at the 90^{o} antipodes. Rock palaeomagnetic studies (Runcorn, 1956) show that changes have occured in the position of the poles, but for great eustatic movements to be produced these changes have to be sudden, causing the hydrosphere to change before the lithosphere has time to adjust. Nevertheless this may be one explanation, according to Fairbridge (1961), of the flat topped seamounts or guyots which are now more than 8,000 feet below sea level, but which require intertidal marine erosion to produce their form.

More recently, another theory has been published affirming the importance of crustal movement in eustatic change. Hallam (1963) has suggested that progressive oceanic subsidence since the close of the Cretaceous has caused a world wide regression of sea level independent of events in the Quaternary period.

Summary

In the history of theories of world sea level change, the development of the glacial eustatic theory of Maclaren, sometimes called the glacial control theory, is the most important happening. Maclaren's theory undoubtedly accounts for the major sea level changes which occurred during the Quatenary. The importance of certain other theories developed more recently, concerning movement of the crust or the geoid, however, is not known as yet.

DEVELOPMENT OF THEORIES ON LOCAL SEA LEVEL CHANGE

In 1785, against the then prevailing interpretations of the earth's structure and morphology in terms of catastrophic events, Hutton published his "Theory of the Earth". This work included the view noted above that the sea never changed in volume, but that the land had been subjected to considerable elevations and depressions over long periods of time. About this period, numerous observations on former sea levels, particularly in Scotland, were being made, and in anelaboration of Hutton's views, his disciple, Playfair, sought in 1802 to explain raised shorelines and depressed areas in terms of a movement of the land. This movement was thought to be due to the "pressure of heat" in the earth's interior.

Although the climate of opinion at the time strongly favoured eustatic change to explain rasied marine phenomena, Playfair had supporters. An article on raised shell beds near Barrowstowness (near Grangemouth) in "The Scotsman" of November 1st. 1834 concluded:

"Now the sea cannot sink at one place, without sinking at every other; and as there are many parts of our coasts where no indication of a change of level can be discovered, we are led to conclude, that the bed of the Firth, in whole or in part, has undergone an elevation to the extent of 30 feet. It does not follow that this elevation has been equal over the whole district affected".

In the following year, Hamilton (1835), describing the bed of marine shells above high water mark at Elie in Fife, (referred to in Chapter VII) supposed a "subsequent elevatory movement" to account for their present position. In 1837, Murchison explained shell beds in south-west England similarly.

In 1838, Bravais, an officer on a French naval expedition to the North Cape noted terraces of gravel and marks of marine erosion above sea level on the sides of a fiord by Hammerfest. He levelled these at six points, using the high water mark left by the sea weed Fucus vesiculosus as his datum, and later relating this to the approximate mean tide level. He found that the terraces rose from 46 and 92 feet near the mouth of the fiord to 90 and 221 feet respectively at its inland extremity; that they presented a concave profile, and that they were not parallel. Bravais described the terraces as being marine. Beaumont, commenting on this (Murchsion, 1846) observed that "..... great terrestrial movements only can be admitted as explanatory of the facts observed".

Though some claimed uplift of a catastrophic nature to explain raised shorelines, the main trend of thought is shown in the very pertinent article by Martins

(1851) referred to in Chapter II, who in a study of the glacial features around Edinburgh, declared himself strongly in favour of land ice, and suggested that during the glacial period the area had been depressed, but on the retreat of the ice an uplift had taken place. When A. Geikie, in 1861, proposed a rise of the land to explain shell beds well above high water mark at Portobello, near Edinburgh, he was aware of differential elevation, saying that "it by no means follows that the east coast of Scotland generally, has been elevated to the same amount." None of these writers, however, suggested a cause for the elevations they had described.

The Theory of Isostasy

The theory of isostasy belongs to the science of geophysics rather than geology, and its inception took place outside the spheres of the latter science. Its origins are surprisingly early, and cogent summaries of its historical development have been made by Lyustikh (1957) and Heiskanen and Vening Meinesz (1958). The word "isostasy" was coined by Dutton in 1889. Beaumont had suggested in 1848 (Nansen, 1922) that accumulation of load "depressed the discs of the crust", and its removal caused their upheaval. But the first clear statement of the theory of isostatic equilibrium was made in 1855. By that year the arc measuring of India had progressed so far that it became possible to measure the latitudes of some triangulation points both by astronomical observations and by measurement along the triangulation chains. A comparison of the results showed a latitudinal difference of 5" 24" in the triangulation measurements between two points that were on the same latitude according to astronomical observations. Pratt (1855) thought that this was due to the greater attraction of the Himalayas on the plumb line at the more northerly position, but found the reverse to be true. He concluded that the mountain mass was of lighter density, being like "fermenting dough" rising from its base, and exerting less gravitational attraction than the plains area.

Airy (1855) explained this anomoly in a different way. He believed the crust of the earth to be composed of two layers, an inflexible, but light outer layer and a more mobile, heavier, inner mass. The enormous mass of the mountains, which was an extension of the outer layer, would by its weight break through and form a root inside the heavier layer. Thus the consequent deeper area of rocks of lighter density would have a negative influence on the plumb line. Airy's theory was subsequently to become the basis for theories on isostasy, and the rest of the nineteenth century saw much work in this branch of geophysics.

It is not clear whether Jamieson, when he wrote in 1865, was aware of Airy's theory, for he made no reference to it. Jamieson's contribution in the field of isostasy was that he was first to propose the idea that the earth's crust responded to the weight of an ice sheet by attempting to maintain and equilibrium, thus explaining the deductions of Martins, Geikie, and Bravais. He was first to apply the principle of isostasy to glaciated areas, yet he never used the term in his publications, even when it had become everyday usage with Scandinavian investigators.

The observations which led Jamieson to propose his theory of crustal movement in response to ice loading and unloading were described in Chapter II. The history of the theory will now be described more fully. It will be recalled that sections in central and eastern Scotland which showed -

(1) Till (2) Arctic marine clay with shells (3) Peat, containing birch and alder remains (4) Carse clay, with marine shells similar to those of today, and (5) Peat, led Jamieson to conclude that (a) During glaciation the land was depressed and that as the ice retreated the sea invaded the depressed areas depositing clay sometimes with arctic shells. (b) Next, while the final retreat of the glaciers was taking place the land was elevated, and subsequently peat grew upon the surface of the arctic clays. (c) Then a depression of the land occurred, submerging the peat and allowing the carse clays to be deposited. (d) Finally another elevation took place, raising the carse to its present position above sea level and allowing the peat to accumulate. To account for these movements he proposed depression beneath the weight of the ice sheet first, then recovery as it melted.

Jamieson's theory was based on a wide knowledge of Scottish glacial features. His sequence of events gradually gained acceptance, though his explanation of crustal warping was less readily appreciated, for it did not satisfactorily explain the sequence. He elaborated his views in a number of papers, beginning in 1874 (1874, 1882, 1887, 1905, 1906, 1908) and expressed them most fully in his paper of 1882. Here, after answering the opinion of Croll (1866) by indicating the great local variations in the heights of shorelines, as well as the lack of evidence for a large polar ice sheet, he considered the theoretical aspect of the size and weight of ice sheets. He believed the thickness of ice over northern Europe to have been 1,000-3,000 feet, and quoted estimates of 11,000 feet for New England and 6,000 feet for Norway. Assuming the specific gravity of ice to be 875, he calculated that an ice sheet 4,000 feet thick would exert a pressure of 1,500 lbs.

per square inch. Pointing out that ice sheets probably existed for many thousands of years he suggested that a depression of one inch per year or 500 feet in 6,000 years would be small indeed compared with the earth's diameter of 7,900 miles or 500 million inches. Citing instances of far travelled earthquake shocks as examples of a flexible crust, he considered that the crust was elastic enough to be depressed and to recover during and after an ice age.

In 1887, Jamieson further elaborated his theory in order to account for unequal uplift. In a series of levellings along three old shorelines of Lake Agassiz, Upham of the United States Geological Survey had shown how the shorelines rose in different degrees towards the north end of the lake, which was supposed to have been occupied by the edge of a large ice sheet. Upham supposed the rise in height of the shorelines to have been due to the attractive power of the ice mass, gradually diminishing as it melted, but Jamieson suggested that as the ice melted the land was warped up towards the area where the ice sheet was as the ice sheet melted. Land uplift would be greatest beneath the ice sheet. In 1886, Gilbert had in fact suggested differential uplift in the case of Lake Bonneville, for the abandoned shorelines of that former lake are higher on the inlands in the centre than around the periphery. Therefore depression and consequent elevation of the crust on evaporation of the water, had been greatest where the lake was deepest. Jamieson drew the analogy between the weight of water in the case of Lake Bonneville and the weight of ice in the case of Lake Agassiz.

In 1908, Jamieson applied the idea of differential uplift to Scotland, though not in the same glacial connection. Noting that the lowest raised shoreline, supposed to have been formed in post-glacial times, appeared to decrease in height north-eastwards from the Forth, he suggested that this slope was related to the degree of erosion of the land in the area. Precipitation being least on the north-east coast both glacial and post glacial erosion would be less and in consequence isostatic rise less.

Jamieson's theory of shoreline displacement spread to America in 1867 and 1874 when first Whittelesey and then Shaler took it up. In Sweden, De Geer accepted the theory in 1888, and in Norway Hansen accepted it in 1890.

While Jamieson was developing his views, geophysicists were clarifying their ideas on isostasy. As noted above, the term was first used by Dutton (1889), who considered the earth's crust to be always trying to reach equilibrium between its various elements. This state of equilibrium he termed isostatic and the movement he called isostasy. Isostasy seems to have been used in a glacial connection soon afterwards, for Nansen used it freely in his report (1904) on the Norwegian North Polar expedition of 1893-96. The term "isobase" to denote a line joining points of equal uplift was first used in 1892, by De Geer.

While A. Geikie (Nansen, 1905) remained convinced that no amount of ice loading could distrub the balance of the crust (despite the implications of his 1861 paper), speculation by geologists on isostasy proceeded apace. In a discussion in 1905 of a paper by Nansen, Owens cited evidence of a startling kind for a flexible crust. Using a "delicate nadirane" sited a quarter of a mile from the shore of the Bay of Biscay, a M. d'Abbadie had observed how the pool of mercury was tilted towards the sea at high water and away at low water. Similar observations in Japan and Germany combined with this to indicate that the earth's crust reacted to the loading of the sea bed at high tide and the unloading at low tide.

Among those who were convinced of the importance of isostatic movement in glaciated areas, argument began as to the degree of flexibility of the crust. Owens' report suggested a high degree of flexibility. Jamieson (1887) had supposed less, and had thought that permanent depression might take place if there were an outpouring of lava at the periphery of the depressed area. Daly brought forward a very different interpretation in 1925, in which he claimed the crust to be much more rigid, so that it would fracture along shear planes under the weight of ice, forming a graben-like depression. Recovery on the melting of the ice would be due to the compensating force of the movement of more plastic basal material at great depth thrusting the depressed block back into place. Gunn (1949) supposed a strongly elastic crust; that is to say one in which no flowage takes place in any layer. A consensus of present day opinion would probably recognise some flowage in the basal material (Vening Meinesz, 1954), but also some crustal fracture. Hinge lines in Scandinavia and North America argue in favour of some modified form of Daly's theory, while it is probable that loading and unloading and the consequent isostatic response create or extend faults. In Finland, Härme (1961) has noticed that the most marked faults radiate from the northern end of the Gulf of Bothinia, which is accepted as the centre of crustal uplift.

Considered alone, however, the theory of isostatic uplift in glaciated areas is inadequate to account for the succession of movements of level. Both in Britain, as Jamieson showed in 1865, and in Scandinavia, periods of transgression interrupted the slow emergence of the land. In Scotland, the carse clays represent a period of transgression, while in Scandinavia a more complex system of transgressions is recognised. These observations led Wright in 1914 to the view mentioned in Chapter II that there was an interaction between rising sea level as the ice melted and rising land as the movement towards isostatic equilibrium took place. Jamieson (1887) had already hinted at the possibility of a rise in sea level complicating the picture, but with a lack of information as to the present size and former extent of ice sheets, he declined to speculate. Wright saw that at the time at which the earth's crust was recovering from the ice load world sea level itself would be rising, and he believed that shorelines would be formed only when the rise of the sea level and the rise of the land balanced each other. When the eustatic rise overtook the isostatic, transgressions would take place. When the isostatic rise was more rapid, regressions would occur. Both Wright and Nansen (1922), who followed him, believed the eustatic rise to be the variable factor. Wright later (1928) called this theory the "isokinetic theory".

Wright was also concerned (1925) with the details of crustal movement during recovery. Brogger (1900) had deduced that as the front of an ice sheet retreated, a wave of uplift moved from the periphery of the depressed area towards its centre. Wright expanded this, envisaging a series of concentric waves passing from the periphery to the interior, each wave carrying the land higher until recovery was complete. Antevs had in fact suggested this in 1917, and Born in 1925. Jamieson had suggested in 1882 that there would probably be a bulge around the periphery of an ice sheet caused by the flow of magma at depth. Kendall (1923) and Daly (1934) had elaborated this, the latter citing the reversal of streams as evidence, but Wright considered the evidence to be inconclusive.

That the recovery of the crust from depression beneath an ice load was not immediate has been apparent since the idea of crustal response to ice loading was developed. Scandinavia is still rising in its central portion at least, and Jamieson believed that uplift in Scotland was still going on after the last glaciers disappeared. Wright (1925) explained this by suggesting that the more fluid basal part of the crust was at present solidifying after having been very mobile during the Tertiary, when much mountain building activity took place. Therefore, according to him, the crustal response was becoming less sensitive.

Wright and his contemporaries had by the early thirties established the principles of crustal movement in glaciated areas as geologists saw it. This work has been the basis for studies in Scandinavia and North America since. It is important to record, however, that subsequent developments in geophysics have an important bearing on these principles.

In 1930, modified forms of Pratt's and Airy's theories were current in geophysics. But in that year, Joly raised serious objections to Pratt's theory, and subsequent years saw a gradual acceptance of two modified forms of Airy's theory. On the one hand, support was given to the Airy-Heiskanen system (Heiskanen and Vening Meinesz, 1958), which assumes local compensation beneath mountain, masses, while on the other the Vening Meinesz system of regional compensation (Heiskanen and Vening Meinesz, 1958) was popular. The system of local compensation envisages a downward projection of the lighter crustal rocks immediately beneath a mountain mass, while the system of regional compensation means a more general and less deep downward projection. Both Meinesz and Heiskanen agree on a brittle crust of low density "floating" in a layer of higher density which is more mobile. The difference between the two systems may perhaps be expressed as a difference in degree of sensitivity of the crust and its denser base. Meinesz, and Heiskanen agree that the areas of recovery from depression beneath ice sheets are compensated regionally.

According to Meinesz and Heiskanen, measurement of gravity anomalies strongly supports the isostatic theory, which requires the denser basal layer to be nearer the surface in the oceans than in the continents; for in general, anomalies are strongly negative in mountain areas and more strongly positive in the oceans. Measurement of Bouger gravity anomalies, in which the sea is assumed to be of equivalent density to the light crustal rocks shows an even clearer picture. The continued postglacial uplift in Scandinavia and possibly Canada is adduced in support of the isostatic theory by both Meinesz and Heiskanen.

Recently, however, objections have been raised to the importance of isostasy. In 1954, Walker and Walker noted that the isostatic hypothesis fails to explain adequately the lack of relationship between large areas of offshore oceanic sedimentation and the areas of volcanic eruptions. In 1957, Luystikh said "We may state in a general way that in studying the structure of the earth's crust, the influence of isostasy becomes less impressive the greater the area we study and the longer we investigate the problem". In a noteworthy chapter, he remarks on the universal acceptance of isostatic uplift due to crustal unloading in Scandinavia, noting that Arkhangels'kii had proposed in 1933 that uplift here was due to the continuation of processes which began before the Quatenary. In fact, von Post in 1948 accepted that the uplift of Scandinavia was not entirely due to glacial unloading.

In 1959, Jeffreys cast further doubt on the efficacy of isostasy. He states that he believes the hypothesis of viscous flow in the basal region of the crust to produce exact isostasy contradicts the evidence at present available. He strongly distrusts the use of the phrase "isostatic equilibrium", contending that it is not proved that areas of positive anomolies are always sinking nor areas of negative anomalies always rising. There could be important non-isostatic vertical movements due to differences in cooling of the crust, for he considers that some of the movement recorded could be attributed to changes taking place spontaneously in the lower layer, with the outer layer conforming to this instead of the other way about. He concludes:

"The use of the term 'isostatic movement' as if there were no vertical movements except those that tend to establish isostasy is equally objectionable. Non-isostatic vertical movements are not fully understood, but it seems probable that many of them are due to differences in cooling".

While due regard should be paid to these opinions, it should not be inferred that the importance of isostatic uplift in glaciated areas is much diminished. All the geophysicists mentioned, even Luystikh, affirm its importance in Scandinavia. It is simply evident that with the progress of geophysics, other movements of the crust are being recognised which cannot be explained by isostasy. Studies of raised shorelines in glaciated areas must, take note of them. Before concluding this section, it is important to record that Wright's (1914) use of the term "the theory of isostasy" to mean the theory of the warping of shorelines due to glacial loading and unloading is misleading, for it has been seen that that term has a much wider meaning.

Other Theories of Local Crustal Movement

The most important developments in the investigation of local sea level change have concerned isostasy. Yet other theories have been advanced, generally with little success. One suggestion was that the ice sheet cooled the ground beneath and that this caused depression; on the melting of the ice the temperature rose and thus so did the ground (Nansen, 1922). Nansen (1922) pointed out, however, that in far northern latitudes, the upper strata would actually be warmer when covered by ice, yet depression was evident. Another suggestion was that uplift was due to some kind of tangential pressure similar to that involved in folding (Sieger, 1893; Nathorst, 1894) - but uplift has been shown to be too extensive and regular in glaciated areas. Fairbridge (1961) records two hypotheses which have received some attention. One, called the continental flexure hypothesis proposes marginal uplift of continents paralleling marginal downwarp of continental shelves. Jesseri (1943) described evidence for this in south Africa. Variations of this have been proposed by Boucart (1938) and Umbgrove(1946). Fairbridge points out the deficiencies of this theory, in particular that it views the last few million years in isolation, with no regard to former ages. Another hypothesis, called by Fairbridge 'the oscillating margin hypothesis" conceives of a "slow pulsating oscillation of the coastal regions of the earth", and was proposed by Lewis (1937). It is opposed by Fairbridge on the grounds that the continental shelf shows no evidence of such a movement.

King (1949) suggested that with the development of peneplains, the interior of a continent will rise due to erosion and its offshore regions sink due to the deposition of sediment, the hinge line being parallel to the coastline. This is an application of the theory of isostasy, and has received some attention from those interested in erosion surface interpretation.

Barrell had remarked in 1915 that emergences and submergences might be part of a larger diastrophic cycle than mere glacial loading and unloading, and Hallam extends this view (1963). As partly noted above, he believes that since the Cretaceous the ocean floors have been deepened and stretched, while the continents have been uplifted due to transfer beneath them of sialic matter. In consequence, some of the uplift in Scandinavia may be explained in this manner.

Summary

The theories of isostasy and glacial isostasy developed independently of one another. Subsequently crustal reaction to glacial loading and unloading came to be recognised as the most evident manifestation of isostatic movement. Recently opinions have been expressed suggesting that some movement described as isostatic may not in fact be due to this cause. Some other theories of crustal movement remain unfavoured but unopposed.

Conclusion /

Conclusion

Present concepts on sea level change recognise a multiplicity of factors which must be appreciated. There is no lack of theories to account for sea level fluctuations over long periods of time. Yet while due regard should be paid to long term effects in the geological sense, the dominance of events in the Pleistocene period is evident. Present concepts on sea level change in glaciated areas represent a combination of the theories of two distinct schools of thought. The eustatic and glacial-isostatic theories developed during the nineteenth century in opposition to each other. It was left to Wright to show their compatibility in his isokinetic theory. Recent work in geophysics has indicated that other factors may have some effect.

CHAPTER XI

SHORELINE DISPLACEMENT ON THE NORTH SIDE OF THE FORTH

This chapter is concerned initially with an analysis of the shoreline height data collected in this study. Following this, the pattern of shorelines revealed is found to support the isokinetic theory of Wright. Various aspects of the theory are then considered and applied to the shoreline pattern. Finally, the sequence of formation of displaced shorelines is described.

CONTENTS

(ii) Conditions necessary for the formation of shorelines in areas experiencing isostatic uplift.

(iii) Continuity of shorelines

(iv) Time-transgressive shorelines

(v) Net result of continuous isostatic uplift.

c. Application of the isokinetic theory to the displaced shorelines in the area under study.

(i) The East Fife late-glacial shorelines

(ii) The Perth Readvance shorelines

(iii) The post-glacial shorelines

(iv) The pattern of isostatic movement

(v) The pattern of eustatic movement

(vi) The pattern of isokinetic movement

(vii) Other forms of land movement

(viii) Uncorrelated terraces

(ix) Conclusions

3. The sequence and formation of displaced shorelines on the northern side of the Forth valley and estuary.

1. SHORELINE HEIGHT ANALYSIS

a. Accuracy of the data

In Chapter III, the methods used in this study were described and the degree of accuracy of the measurements discussed, both from the point of view of the instrumental error and as regards location of the location of the former shoreline. A maximum error of 2 feet was claimed for most measurements, and it was believed that in the case of many it was less than this. In making comparisons between different shoreline fragments, however, several additional sources of error are involved:

(I) The tidal range

In an estuary, the tidal range normally increases towards the head. The present tidal range in the Forth reaches a maximum of 17.8 feet at Alloa (Admiralty Tide Tables, volume 1). The normal effect of an increasing tidal range in an estuary is to cause deposits laid down near the head to be greater in altitude than those laid down towards the mouth. While it is therefore possible that the present inclination of raised shorelines in the Forth valley and estuary is in part due to tidal effects, no reliable estimate of the tidal range during late and post glacial time can be obtained, since such factors as former wave fetch and depth of water are not known. It should be noted, however, that the present increase in tidal range towards the head of the estuary is small (see Fig. 38).

(II) Terrace aspect

Little is known of the effects of difference of aspect on the height of a terrace. In extreme cases it has been described as important (Bartrum, 1926). Most of the area studied experiences a similar sheltered estuarine environment, but no important conclusions are based on comparisons between very sheltered areas,

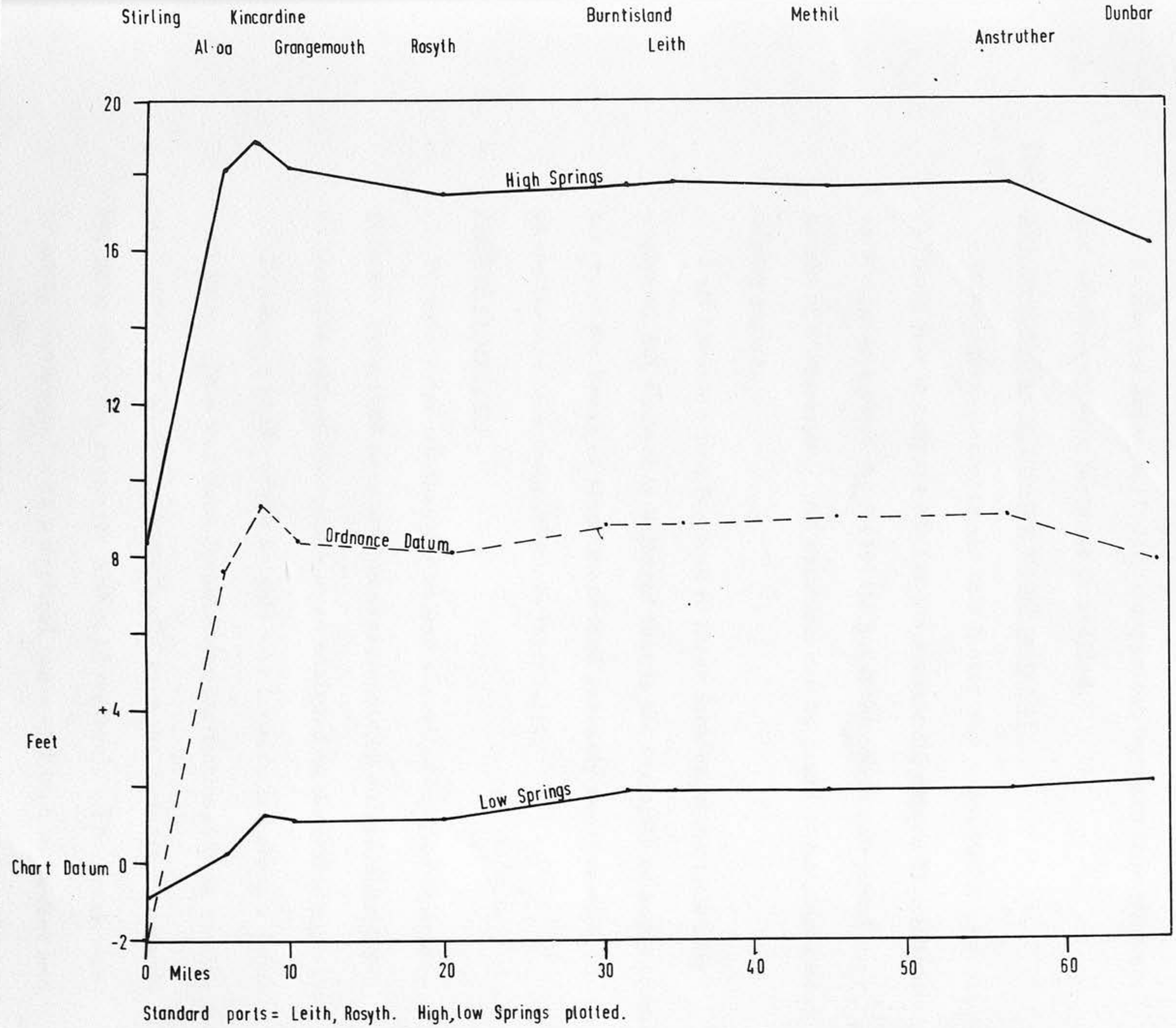


FIGURE 38 Tidal range between Stirling and Dunbar.

such as the carse, and more exposed localities, such as East Fife.

(III) Terrace composition

Following Johnson (1931), comparison between depositional and wholly rock-cut features is avoided.

(IV) The availability of constructional material

During late-glacial times this factor was undoubtedly important. Not only was it responsible for the spasmodic nature of a shoreline, as Wright has pointed out (1914), but it may have affected the height of a shoreline. No estimate can be made of the importance of this factor.

Full consideration is given to these factors in the following analysis, but since it is believed that in the majority of depositional terraces the break of slope measured probably represents a similar state of the former tide, comparison is legitimate.

b. Method of analysis

To determine whether the raised shoreline heights show any pattern, over 1000 accurate measurements on raised shorelines or possible raised shorelines were analysed in the following way:

Firstly, a graph of the heights was constructed along a west-east axis. This was done by obtaining the National Grid easting for each point, which then automatically gave the distance eastwards of the point along the graph (to within 10 metres). The graph was initially constructed with a vertical scale of 1 inch to 10 feet and a horizontal scale of 1 inch to 1 kilometre. A reduced copy of it appears in Figure 39. The graph shows two striking features. A line of points slopes down to the east from circa 110 feet O. D.

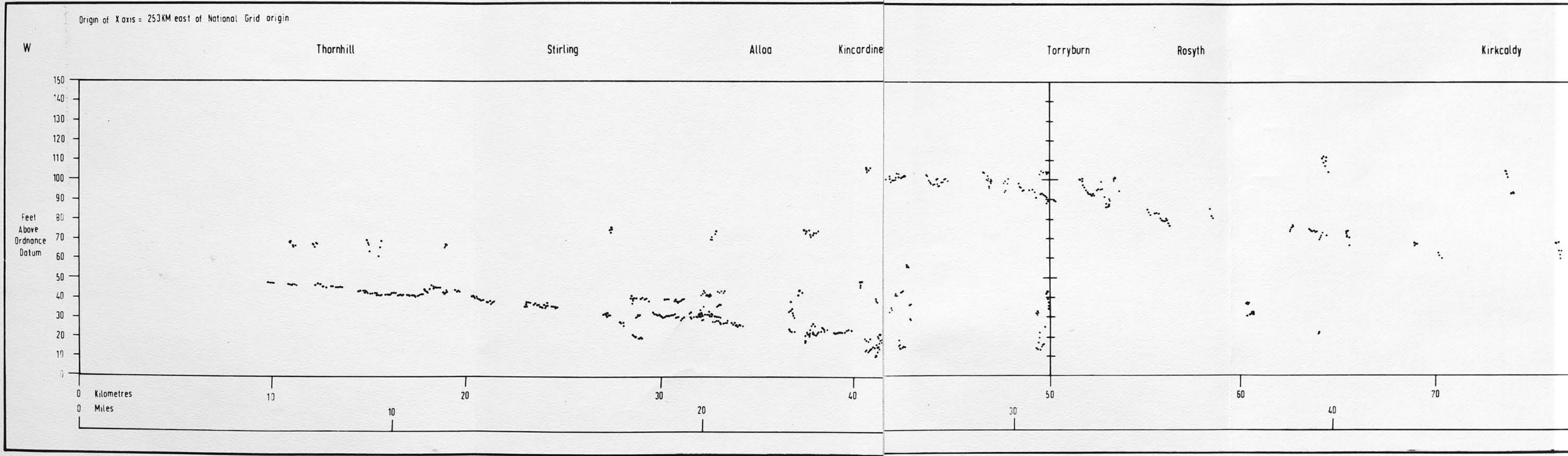
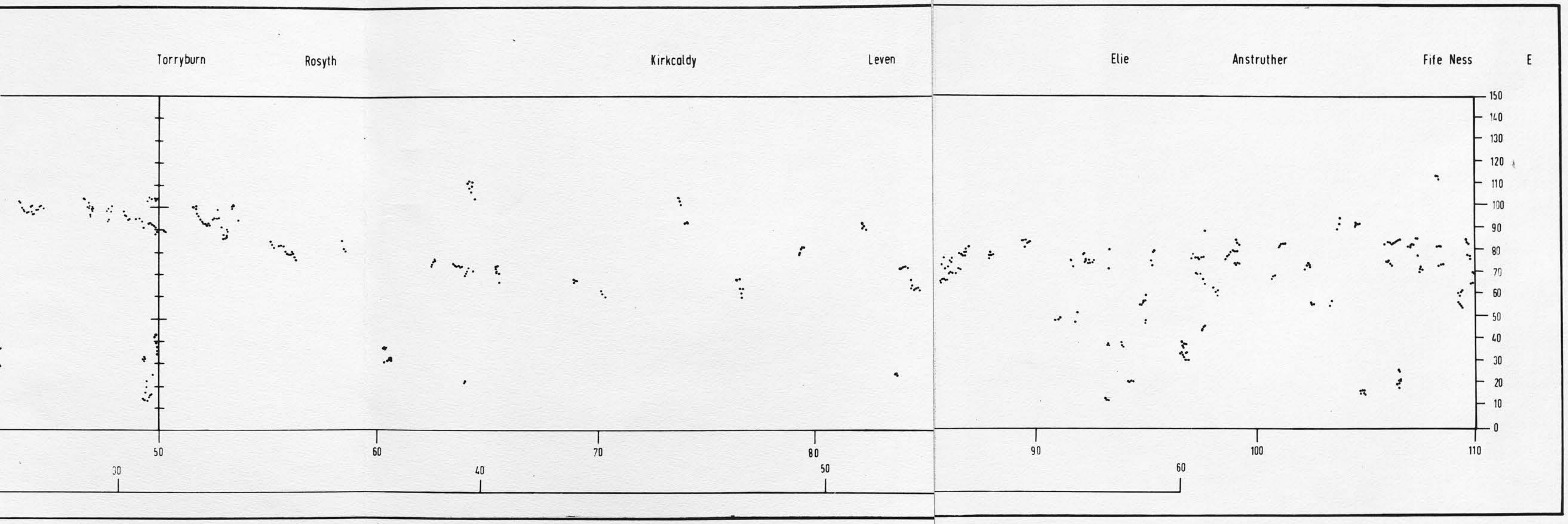


FIGURE 39 Graph of all the raised shoreline and possible raised shoreline heights along a W-E axis.



Torryburn
Rosyth
Kirkcaldy
Leven
Elie
Anstruther
Fife Ness
E
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
50
60
70
80
90
100
110
30
40
50
60

to circa 65 feet O. D. near the centre of the graph, while a second, thicker line appears at the western end sloping eastward from circa 50 feet O. D. to circa 20 feet O. D. Elsewhere occur only scattered groups of points, but near the eastern end of the graph a cluster of points in a band between 50 feet O. D. and 100 feet O. D is evident.

The graph suggests that shoreline displacement increases towards the west. Since the graph is only in two dimensions, however, the precise direction of maximum displacement is not known. It could in fact lie anywhere westward of due north and due south. Therefore it was decided to attempt to locate the direction of maximum displacement more accurately.

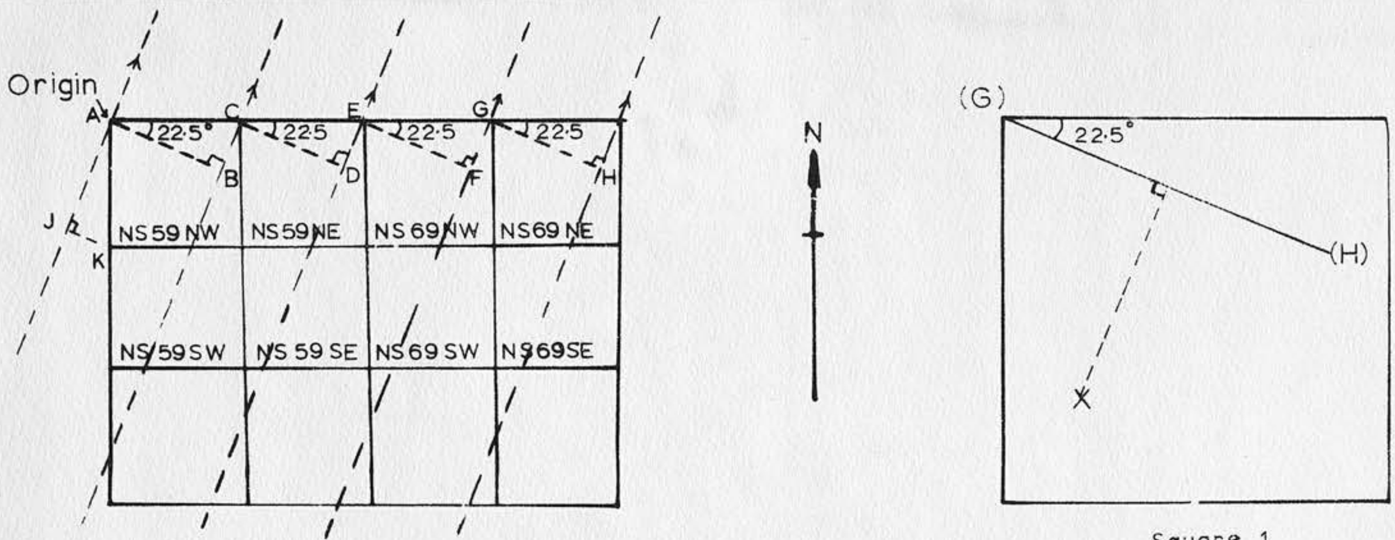
To this end, since some of the points showed a remarkably linear arrangement, the assumption was made that the shorelines on the ideal graph (the x axis of which would be a line pointing towards the area of maximum displacement) would be deployed in straight lines. Accordingly, the clearest shoreline was selected, and the height data for this were employed to locate the direction of maximum displacement, the assumption being made that the direction of maximum displacement for the other shorelines would not be very different.

The shoreline selected was the one sloping from circa 110 feet O. D. near Kincardine to circa 65 feet O. D. west of Kirkcaldy. Throughout its length, the feature is the most conspicuous element of the present coast-line, and there are only two gaps of over a mile in length. 116 measurements were used; doubtful measurements, such as on possible outwash or areas affected by subsequent movement of the regolith were excluded. The points analysed are thus on a feature which is depositional, clear cut, and as far as can be seen unaffected by important subsequent modification at the points measured.

The 116 measurements were plotted on graphs with base lines running NW to SE, WNW to ESE, WSW to ENE, and SW to NE. The graphs were constructed by the following methods: First, a point of origin was chosen. For the NW - SE and WNW - ESE lines this was the NW corner of the most north-westerly six-inch Ordnance Survey sheet of the area. For the WSW to ENE and SW - NE lines the south-west corner of the most south-westerly six-inch O.S. sheet was chosen. Lines were then drawn from the NW and SW corners of each map sheet at 45° and 22.5° from the horizontal, and kilometre lengths from the particular corners marked off along the lines. Following this, the distance of each point along the line (projected at right angles on to the line) was read off (to the nearest 10 metres) with the aid of a set-square graduated in tenths of a kilometre. Finally the distance of the NW and SW corners of the individual map sheets from the respective origins along lines at 45° to the horizontal and 22.5° to the horizontal was added on, this being computed by trigonometry. This latter operation was facilitated by the fact that all the relevant map sheets were of the same size, and square. All these calculations are set out in diagrammatic form below (Fig. 40).

With the distance of each point from each of the four origins to hand, in addition to its levelled height, four graphs were constructed. The patterns of dots revealed by the graphs are very similar and are very like the pattern of the same measurements on the west-east graph. Inspection was found inadequate to distinguish accurately between the various patterns.

FIGURE 40 The method of calculating the distance of each point from the origin point.



Square 1

WNW origin. Others similar in principle.

Example A

To calculate the distance of point X from the origin point, when square 1 = NS 69 NE.

(1) Calculate the distance of the NW corner of NS 69 NE from the origin =

(i) $AC = CE = EG$ (ii) $\angle B\hat{A}C = \angle E\hat{C}D = \angle F\hat{E}G$ (iii) $\angle C\hat{B}A = \angle E\hat{D}C = \angle G\hat{F}E$. $\therefore AB = CD = EF$

Calculate AB; AC is known, $B\hat{A}C = 22{\cdot}5°$, $C\hat{B}A = 90°$, $\therefore AB = \frac{AC}{\text{Cos.}\, B\hat{A}C}$

$\therefore$ NW corner of NS 69 NE = $3\left[\frac{AC}{\text{Cos.}\, B\hat{A}C}\right]$

(2) Project point X on to GH. Measure distance from G

(3) Add result of (2) to result of (1).

Example B

To calculate the distance of point X from the origin point when square 1 = NS 69 SE

Procedure as for example A except JK added. $JK = AK\ \text{Sin.}\, J\hat{A}K$, in ΔAJK, since $A\hat{J}K$ is 90°.
AK is known, $J\hat{A}K = 90° - (90° - B\hat{A}C) = B\hat{A}C = 22{\cdot}5°$

Therefore it was decided to employ statistical methods.

The technique of linear regression analysis has recently been used to effect by Sissons (1963) in an analysis of some raised shoreline heights on the south side of the Forth. It is advocated by Gregory (1963) in similar studies. The technique seeks to pass a straight line through a group of dots so that the sum of the squares of the differences of the individual observed values from the line is at an absolute minimum. In every case where this technique was used in this work, a significance of better than .001 was obtained.

The graphs of the heights along the four different axes, together with the west-east graph of these heights appear below (Figs. 41-45) while superimposed upon them are the regression lines. The regression analyses gave the following results:

No. of Points	Direction of X axis	Standard Error	r	Regression equation	Slope ft/km	ft/ml
116	NW-SE	0.0030	-0.9850	$X = \frac{Y-49.33+(0.575 x 88.25)}{0.575}$	1.83	2.95
116	WNW-ESE	0.0032	-0.9885	$X = \frac{Y-56.60+(0.703 x 88.25)}{0.703}$	1.42	2.29
116	W-E	0.0038	-0.9841	$X = \frac{Y-52.22+(0.717 x 88.25)}{0.717}$	1.39	2.24
116	WSW-ENE	0.0043	-0.9739	$X = \frac{Y-53.09+(0.625 x 88.25)}{0.625}$	1.60	2.57
116	SW-NE	0.0041	-0.9498	$X = \frac{Y-42.90+(0.425 x 88.25)}{0.425}$	2.35	3.78

From this it will be seen that the NW-SE, WNW-ESE, and W-E axes give the better result, since they give a lower standard error and higher value of r than the other axes. NNW-SSE and SSW-NNE axes were not

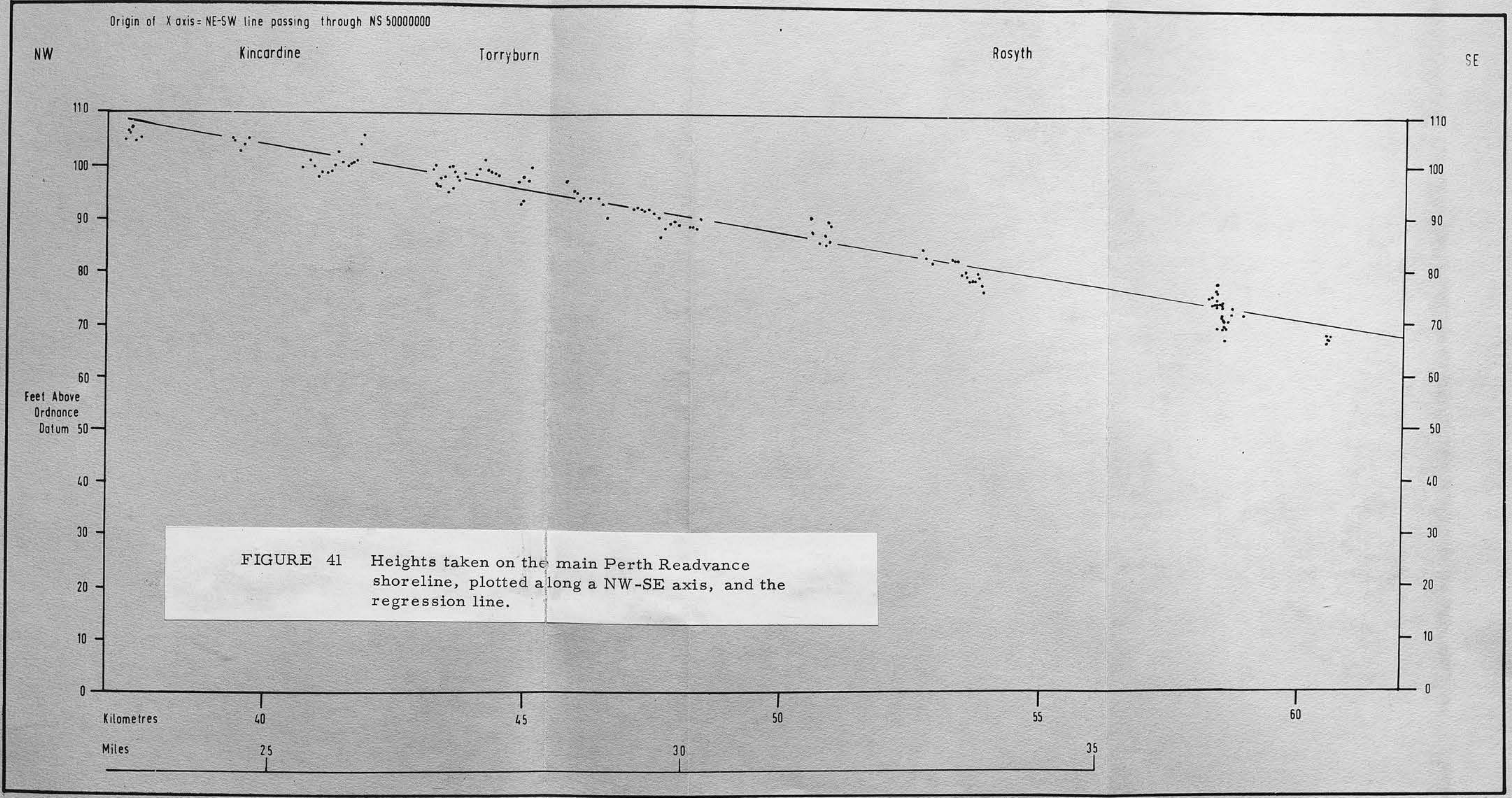


FIGURE 41 Heights taken on the main Perth Readvance shoreline, plotted along a NW-SE axis, and the regression line.

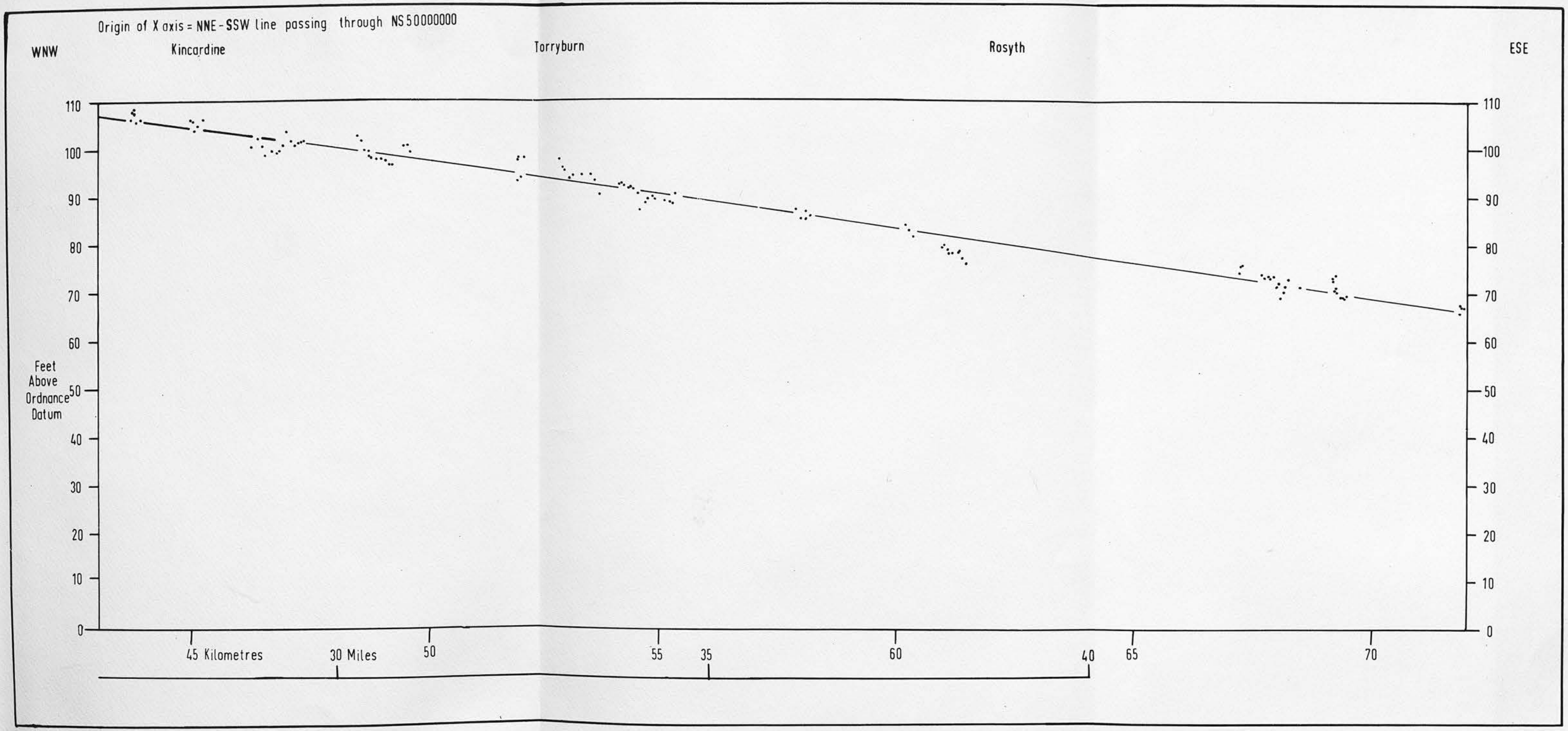


FIGURE 42 Heights taken on the main Perth Readvance shoreline, plotted along a WNW-ESE axis, and the regression line.

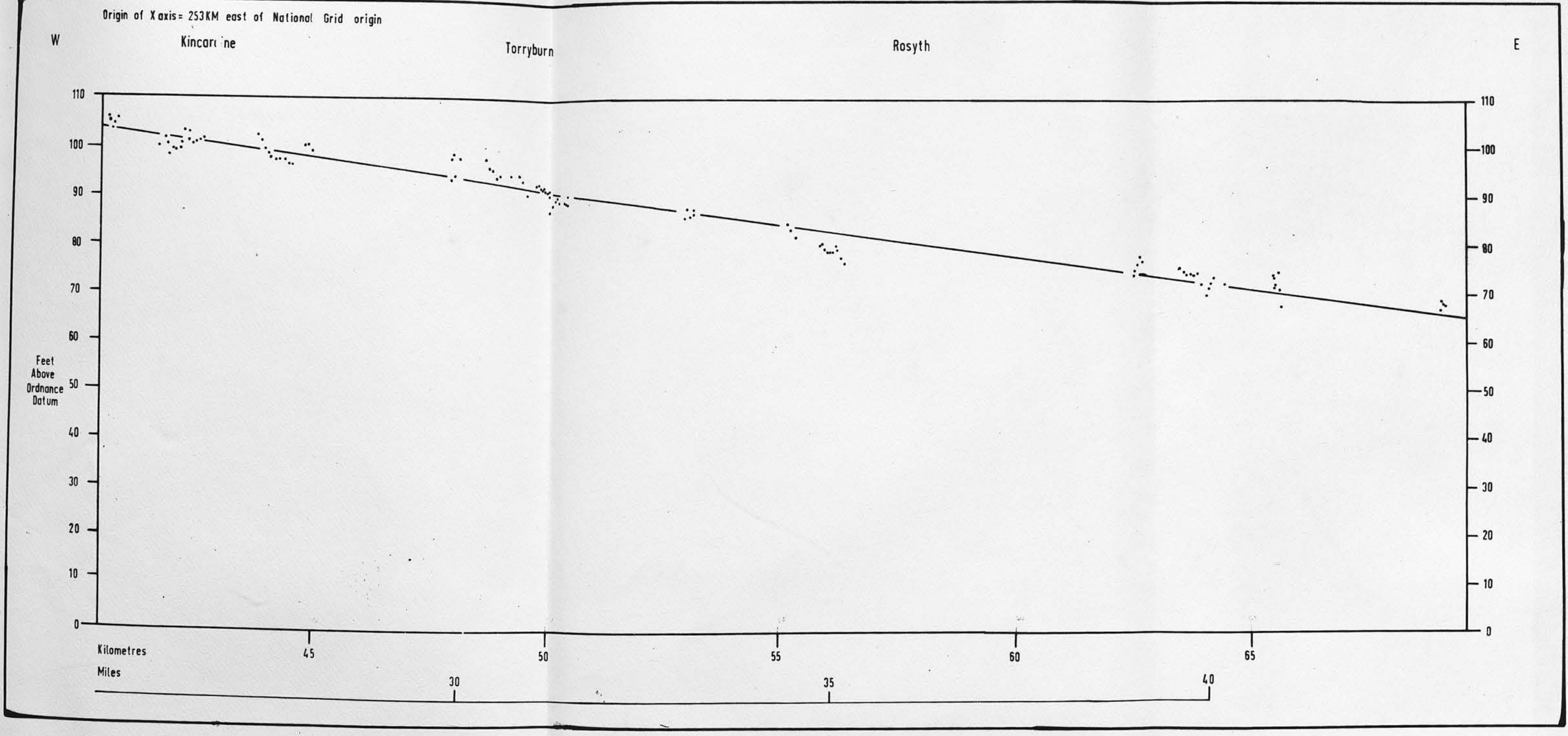


FIGURE 43 Heights taken on the main Perth Readvance shoreline, plotted along a W-E axis, and the regression line.

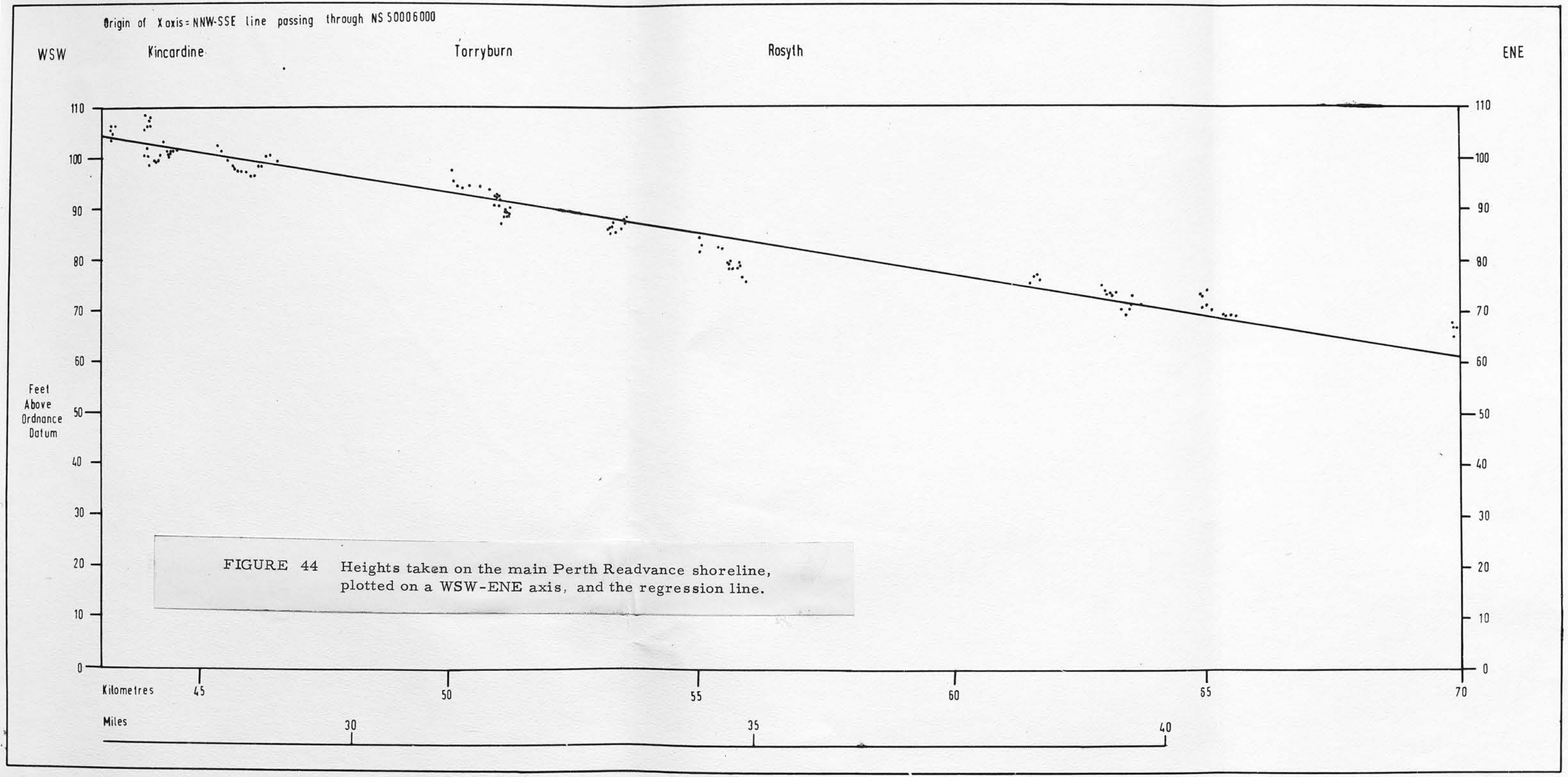


FIGURE 44 Heights taken on the main Perth Readvance shoreline, plotted on a WSW-ENE axis, and the regression line.

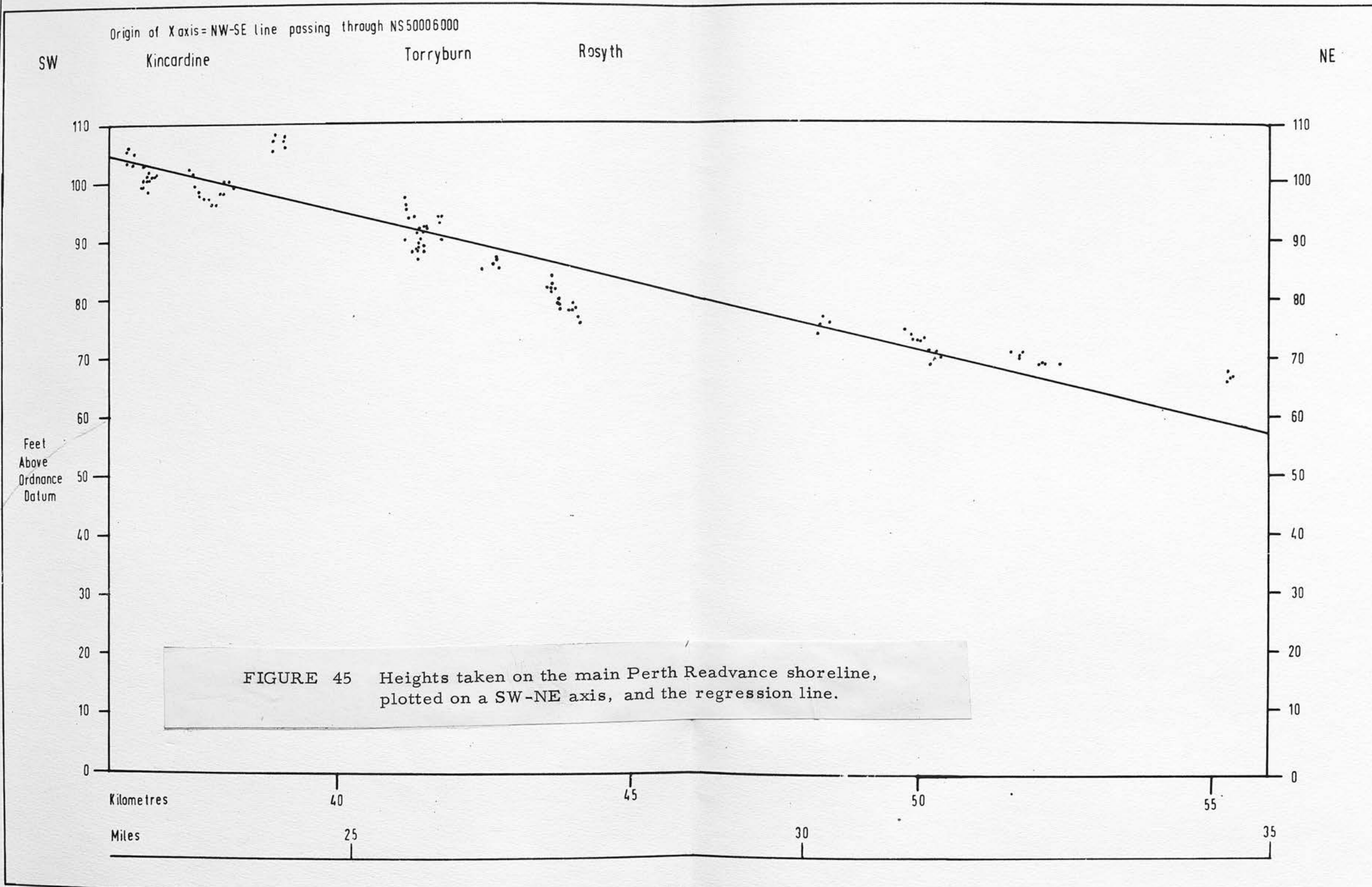


FIGURE 45 Heights taken on the main Perth Readvance shoreline, plotted on a SW-NE axis, and the regression line.

tried because from the nature of the above results it would seem that the most likely direction of displacement lies within the sector embracing the NW-SE, WNW-ESE, and W-E directions. Finer angles were not tried because it was felt that the nature of the data did not warrant this, the area being so restricted in its north-south extent.

The result of applying linear regression analysis to the measurements on what is a major shoreline was therefore to show that (I) the pattern of shoreline measurements lies very close to a straight line: in every case the value of r is very high, and that (2) the most likely direction of maximum displacement lies in the sector embracing NW, WNW and W provided the pattern of shoreline measurements grows closer to a straight line the nearer the direction of the x - axis of the graph is to the actual direction of maximum displacement.

Assuming that NW - SE, WNW - ESE, and W - E are the closer directions to the direction of maximum displacement, the 1000 measurements were then plotted on graphs with WNW - ESE and NW - SE axes (scale, y-axis: 1 inch equals 10 feet and x - axis 1 inch equals 1 kilometre), reduced facsimilies of which appear below (Figs. 46. 47). Inspection of these two graphs, together with the W - E one, aided by linear regression analysis and checked by reference to field notes and maps was then employed to see if a shoreline pattern could be deduced.

c. <u>Results</u>

(1) The East Fife Pre-Perth Readvance Shorelines

It has been observed that there are many well developed terraces, often in association with dead-ice features, along the coast of East Fife,

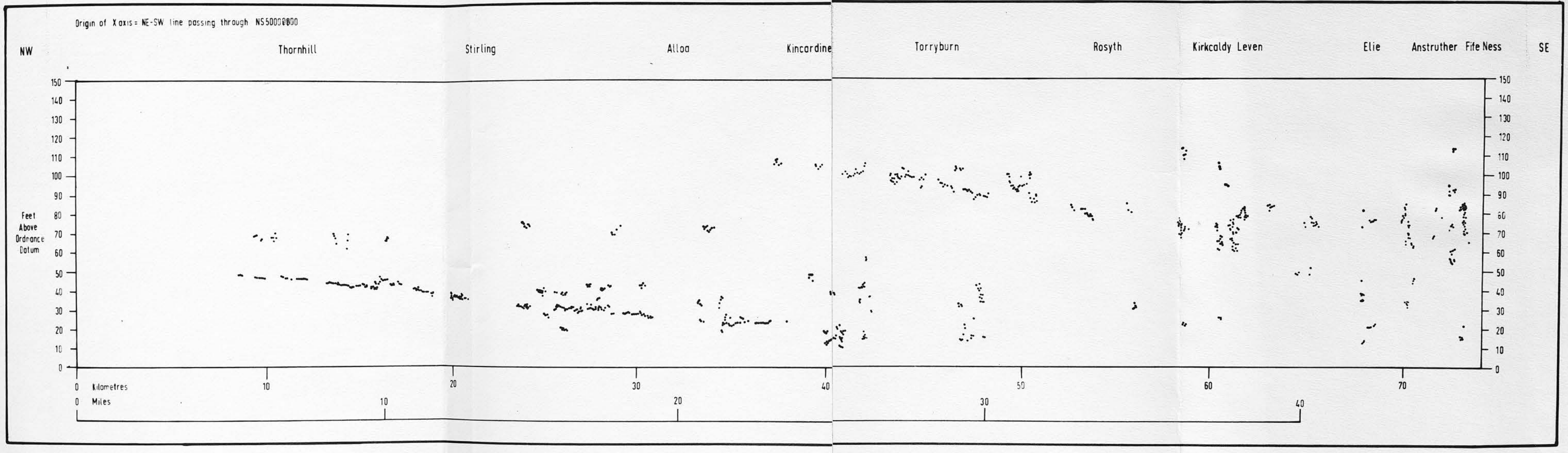


FIGURE 46 Graph of all raised shoreline and possible raised shoreline heights along a NW-SE axis.

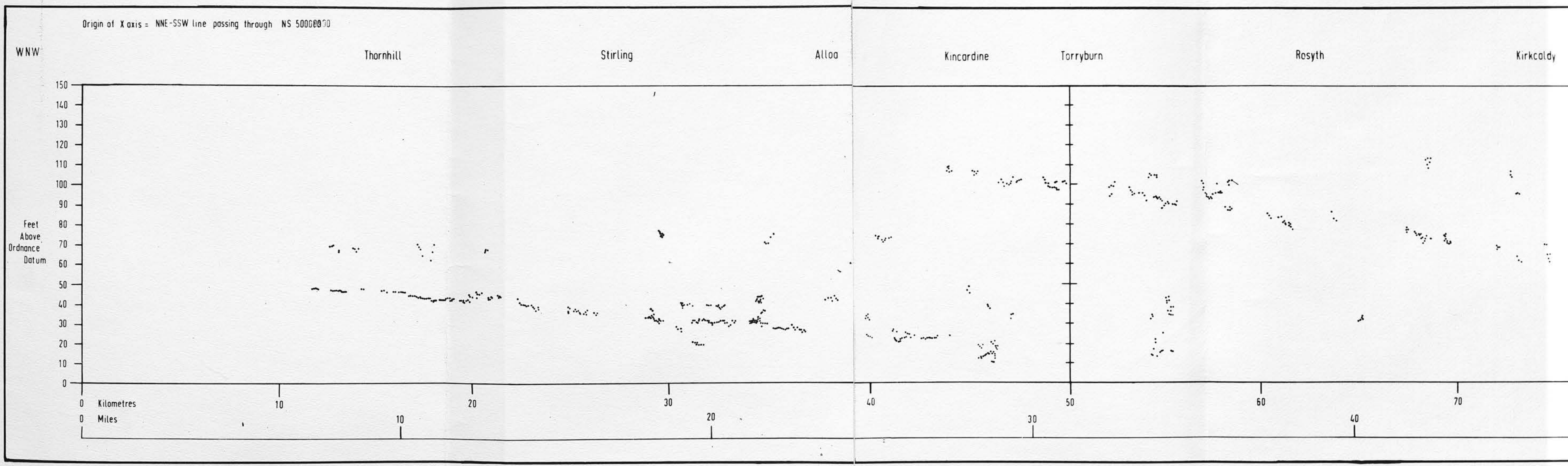
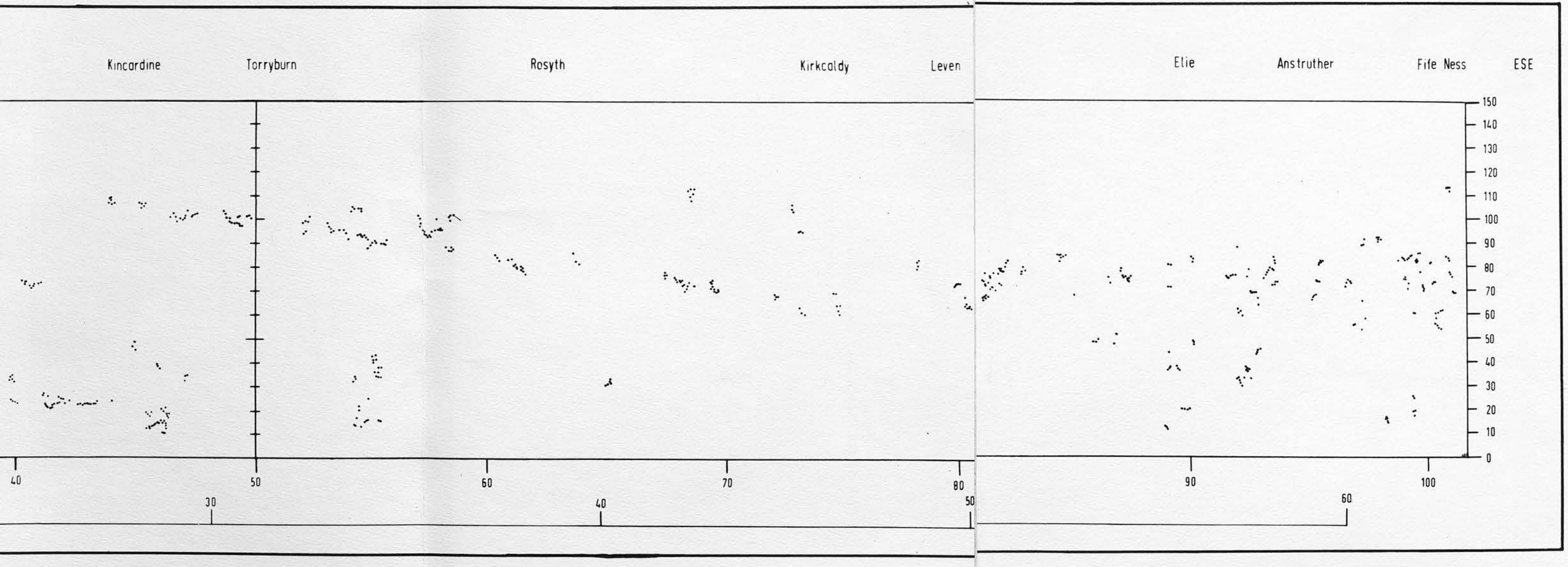


FIGURE 47 Graph of all raised shoreline and possible raised shoreline heights along a WNW-ESE axis.


Kincardine
Torryburn
Rosyth
Kirkcaldy
Leven
Elie
Anstruther
Fife Ness
ESE
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
40
50
60
70
80
90
100
30
40
50
60

from Leven to Fife Ness. In addition, it has been noted that only within very local areas can a correspondence in terrace heights be observed. If these terraces bear any straight-line relationships as remnants of former marine surfaces, they must be inclined.

On the NW - SE graph, the East Fife measurements are confined within a small area, and no relationship can be deduced. The WNW - ESE and W - E graphs, however, indicate a pattern. This is seen best on the larger scale graphs of the East Fife heights, (Figs. 48, 49). The pattern is most clearly shown on the WNW - ESE graph.

At the eastern extremity of the area a thin band of points may be recognised sloping down sharply towards the east from a height of circa 92 feet O. D. to one of circa 75 feet O. D. These measurements were taken on a terrace which is almost continuous between Anstruther and Fife Ness and which, in that area, is the best developed terrace (see Chapter VII). Linear regression analysis of the measurements was made for both the WNW - ESE and W - E axes:

No. of Points	Direction of X axis	Standard Error	r	Regression Equation	Slope ft/km	Slope ft/ml
33	WNW-ESE	0.0044	-0.9351	$X = \frac{Y - 99.00 + (0.205 \times 84.75)}{0.205}$	4.87	7.84
33	W - E	0.0079	-0.9212	$X = \frac{Y - 106.78 + (0.331 \times 84.75)}{0.331}$	3.02	4.87

The measurements were also plotted on a graph with a WSW - ENE axis, and regression analysis gave the following result:

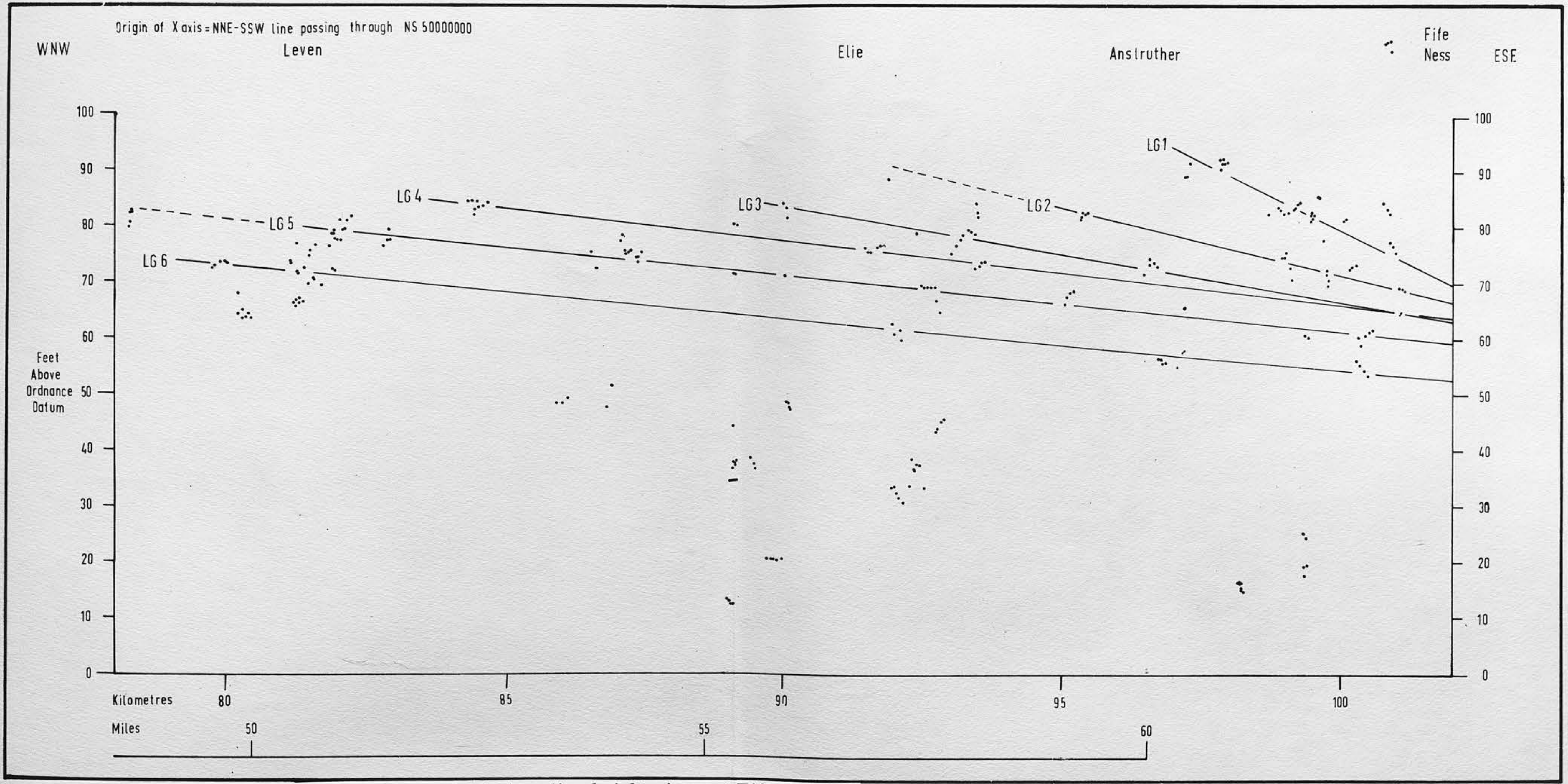


FIGURE 48 All raised shoreline and possible raised shoreline heights in east Fife, from Leven to Fife Ness, plotted along a WNE-ESE axis, with regression lines.

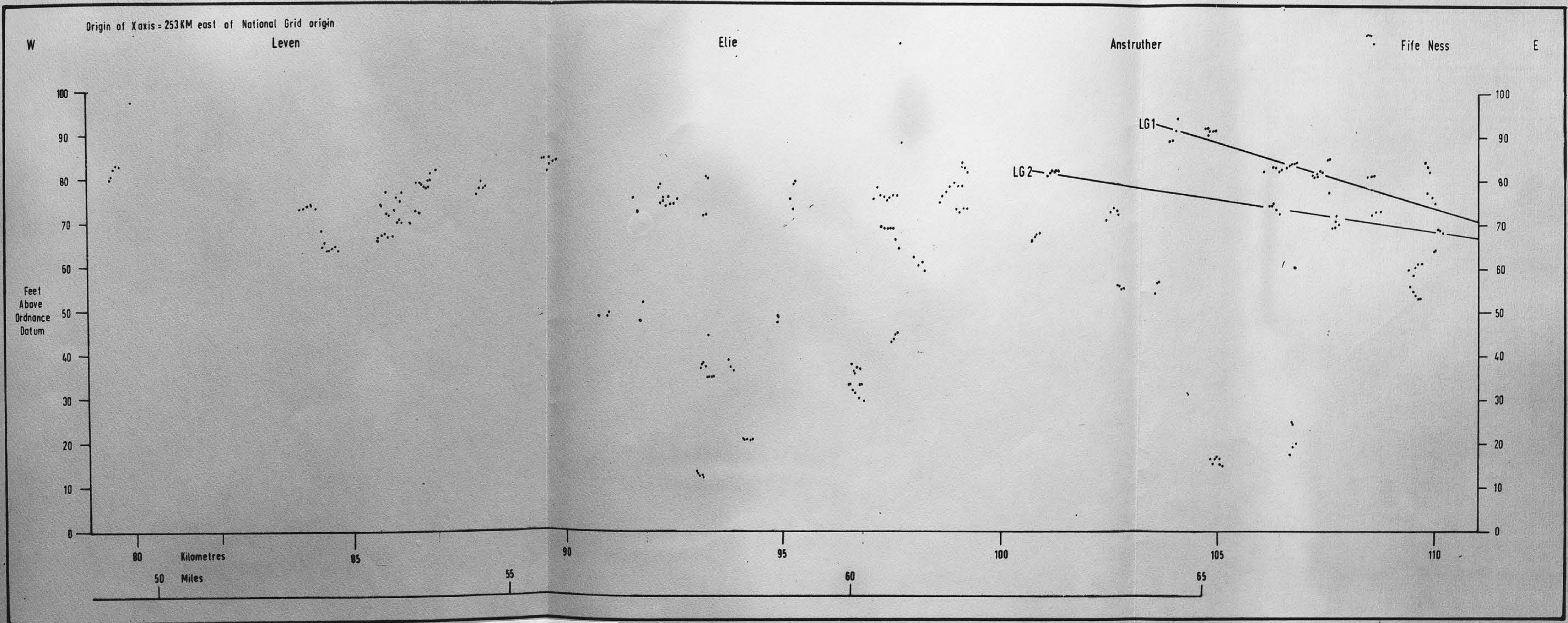


FIGURE 49 All raised shoreline and possible raised shoreline heights in east Fife, from Leven to Fife Ness, plotted along a W-E axis, with regression lines.

No. of Points	Direction of X axis	Standard Error	r	Regression Equation	Slope ft/km	ft/ml
33	WSW-ENE	0.0106	-0.9075	$X = \frac{Y-111.51+(0.4032x84.76)}{0.4032}$	2.48	3.99

Comparing this result with the previous ones, it appears that the WNW - ESE axis may be slightly the better one.

In support of this regression line, it is noticeable that in the area of this terrace there are only three terrace features above these measurements. One, near Bansmuir, lying at circa 92 feet O.D. has been described as being unlike a marine feature (Chapter VIII). A second, near Kirklands, at circa 113 feet O.D. in a very small feature in isolation, while the third, at circa 84 feet O.D. near Fife Ness, is very poorly developed. It is interesting to note that although the terrace nowhere shows evidence of former dead-ice, it merges into kame-like mounds behind Anstruther. Furthermore, west of its most westerly point, at circa 90 feet O.D., there is no marine terrace above 84 feet O.D. until west of the Forth Bridge. This strongly suggests that it is an inclined displaced shoreline formed in association with an ice front at Anstruther. Hereafter it will be referred to as LG1.

LG2

Below LG 1 there occurs a terrace that is well marked and easily recognisable in several localities. Between Fife Ness and Barnsmuir, this is very extensive at between 64.6 feet O.D and 75.3 feet O D., but west of the latter place first high cliffs exclude it from the coastline then the town of Anstruther is built over the land below the higher terrace. North-west of Anstruther, however, a break of slope can be recognised at circa 75 feet O. D., and near Pittenweem this becomes a well defined terrace at circa 82 feet O. D. Analysis of these measurements plotted on three axes gave the following results:

No. of Points	Direction of X axis	Standard Error	r	Regression Equation	Slope ft/km	ft/ml
22	WNW-ESE	0.0077	-0.9685	$X = \frac{Y-98.63+(0.417x74.75)}{0.417}$	2.40	3.86
22	W - E	0.0127	-0.9640	$X = \frac{Y-106.24+(0.645x74.75)}{0.645}$	1.55	2.50
22	WSW - ENE	0.0150	-0.9610	$X = \frac{Y-110.90+(0.740x74.75)}{0.740}$	1.22	1.96

Again the inference is that the WNW - ESE axis is the most favourable. It is interesting to note that if the regression line is extended westwards on the WNW-ESE plot, it comes within two feet of measurements on two poorly developed terraces north of St. Monance. However, whether these latter measurements are valid or not, it is believed that here again is evidence of an inclined displaced shoreline. The presence of a deep dead-ice hollow in the most easterly fragment (see Chapter VII) shows that the shoreline was formed in the presence of ice. At its westerly extremity there occurs a large lake flat at circa 57 feet O. D. (near Balkaskie House). This lies in a depression, the rim of which is circa 5 feet below the shoreline. It seems likely that when the shoreline was being formed, this depression was occupied by ice. Thus while there is no indication of a definite ice front in association with the shoreline, there is considerable evidence of the presence of bodies of dead-ice.

The other shoreline measurements in East Fife do not show an obvious pattern, although the individual terraces are very well developed. Assuming that they represent fragments of displaced shorelines and have a straight-line relationship, several combinations of measurements were tried in order to get the most likely regression lines. Only the WNW - ESE axis was considered, since it would appear that it may be the best axis for this area. The most probable sequence will be described first and the regression lines are shown in Figure 48. The alternatives (Fig. 50) will follow.

LG 3

Below LG 2 there occur four quite well defined terraces at 71.3 - 74.3 feet O D., 76.8 - 79.8 feet O.D., 78.5 feet O D., and 81.5 - 84.3 feet O.D. At one point, one of these terraces lies directly below a terrace probably belonging to LG 2 (one of the "poorly defined" terraces north of St. Monance). This strengthens the case for it being a separate shoreline. The four terraces lie in line, and a regression line passed through the measurements gives:

No. of Points	Direction of X axis	Standard Error	r	Regression Equation	Slope ft/km	Slope ft/ml
14	WNW-ESE	0.0179	-0.9489	$X = \frac{Y-93.45+(0.594x77.96)}{0.594}$	1.71	2.75

One of the terraces at Pittenweem (at 76.8 - 79.8 feet O.D) lies over 10 feet higher than the lip of the large enclosed lake basin by Balkaskie. The only way in which the depression could be preserved without any trace of the terrace inside would be for it to have been occupied by ice while the sea was at this level. It is likely therefore that if these terraces represent one shoreline, it was formed in the presence of ice.

LG 4

At Largo an extensive flattish area has been described and measured at circa 84 feet O. D. North of St. Monance two very well developed terraces have been measured at circa 76 feet O. D. and 73 feet O. D. A regression line taken through these points, giving the following result:

No. of Points	Direction of X axis	Standard Error	r	Regression Equation	Slope ft/km	ft/ml
17	WNW-ESE	0.0136	-0.9825	$X = \frac{Y-88.17+(0.885 \times 78.72)}{0.885}$	1.13	1.81

Also passes close to the highest Kincraig rock bench at 81 feet O. D. The St. Monance terraces lie on the lip of a large enclosed lake basin, suggesting that the basin was occupied by ice during their formation.

LG 5

Between Leven and Fife Ness there frequently occurs one particularly well developed terrace. Near Fife Ness it belongs to the shoreline now referred to as LG 1, but further west a very well developed terrace occurs at a lower altitude. Well marked terraces at circa 78 feet O. D. near Leven are here linked with features at circa 75 feet O. D. and 73 feet O.D. near Largo, an especially marked feature at circa 69 feet O.D. near St. Monance, a clear feature at circa 67 feet O. D. by Pittenweem and one at circa 61 feet O. D. at Fife Ness. All these measurements are in line, and regression analysis gives a good result.

No. of Points	Direction of X axis	Standard Error	r	Regression Equation	Slope ft/km	ft/ml
39	WNW-ESE	0.0034	-0.9787	$X = \frac{Y-88.46+(1.012x72.83)}{1.012}$	0.99	1.59

The resultant line passes very close to the second Kincraig Point rock bench at circa 71 feet O.D.

Projected westwards (see Fig. 48) the line comes within one foot of the graph of heights on the terrace at Wemyss described in Chapter VII, and it is thought possible that this belongs to this shoreline. Yet the fragments of the shoreline by Leven lie above a deep dead-ice hollow, and moreover, the lack of a connection between the shoreline and the Leven river terraces suggests that the site of the terraces was covered by ice. It may be that while the shoreline was being formed, the Wemyss coast was ice-free, but that a lobe of ice occupied the site of Leven.

Next to LG 1 and LG 2 this combination of terraces is held most likely to represent an inclined displaced shoreline.

LG 6

There is little evidence for a shoreline below LG 5. Locally, however, five extremely well developed terrace fragments occur. Though they occur in line, the considerable distance separating them makes the analysis only a tentative proposition. Terraces of circa 73 feet O.D. and 70 feet O.D. at Leven are linked with terraces of circa 57 feet O.D. and 56 feet O.D. at Pittenweem and Anstruther and one at circa 54 feet O.D. at Fife Ness to give the following result:

No of Points	Direction of X axis	Standard Error	r	Regression Equation	Slope ft/km	Slope ft/ml
25	WNW-ESE	0.0095	-0.9906	$X=\frac{Y-87.37+(1.047x65.94)}{1.047}$	0.96	1.54

The first Leven terrace lies around the eastern margin of a prominent dead-ice hollow, described in Chapter VII.

This scheme accounts for all possibly marine terraces in East Fife except two at circa 65 feet O. D. by Leven. Considerable doubt as to the validity of these features has already been raised, however (Chapter VII). In confirmation of this, on the diagram the measurements stand apart, showing no likely relationship to any other group.

Excluding LG 1 and LG 2, which appear to be definite features, an alternative pattern of shorelines may be interpreted as follows: (see Fig. 50).

<u>LG 3a</u>

This regression line joins the three well marked features at 76. 8 - 79. 8 feet O D. and 78. 5 feet O. D. ; 71. 3 - 74. 3 feet O. D. ; and 58. 9 - 61. 9 feet O. D. , at St. Monance, Anstruther and Fife Ness respectively.

No. of Points	Direction of X axis	Standard Error	r	Regression Equation	Slope ft/km	Slope ft/ml
16	WNW-ESE	0.0016	-0.9724	$X=\frac{Y-96.27+(0.391x71.59)}{0.391}$	2.56	4.11

As in LG 3 the St. Monance terrace was formed in association with a body of ice.

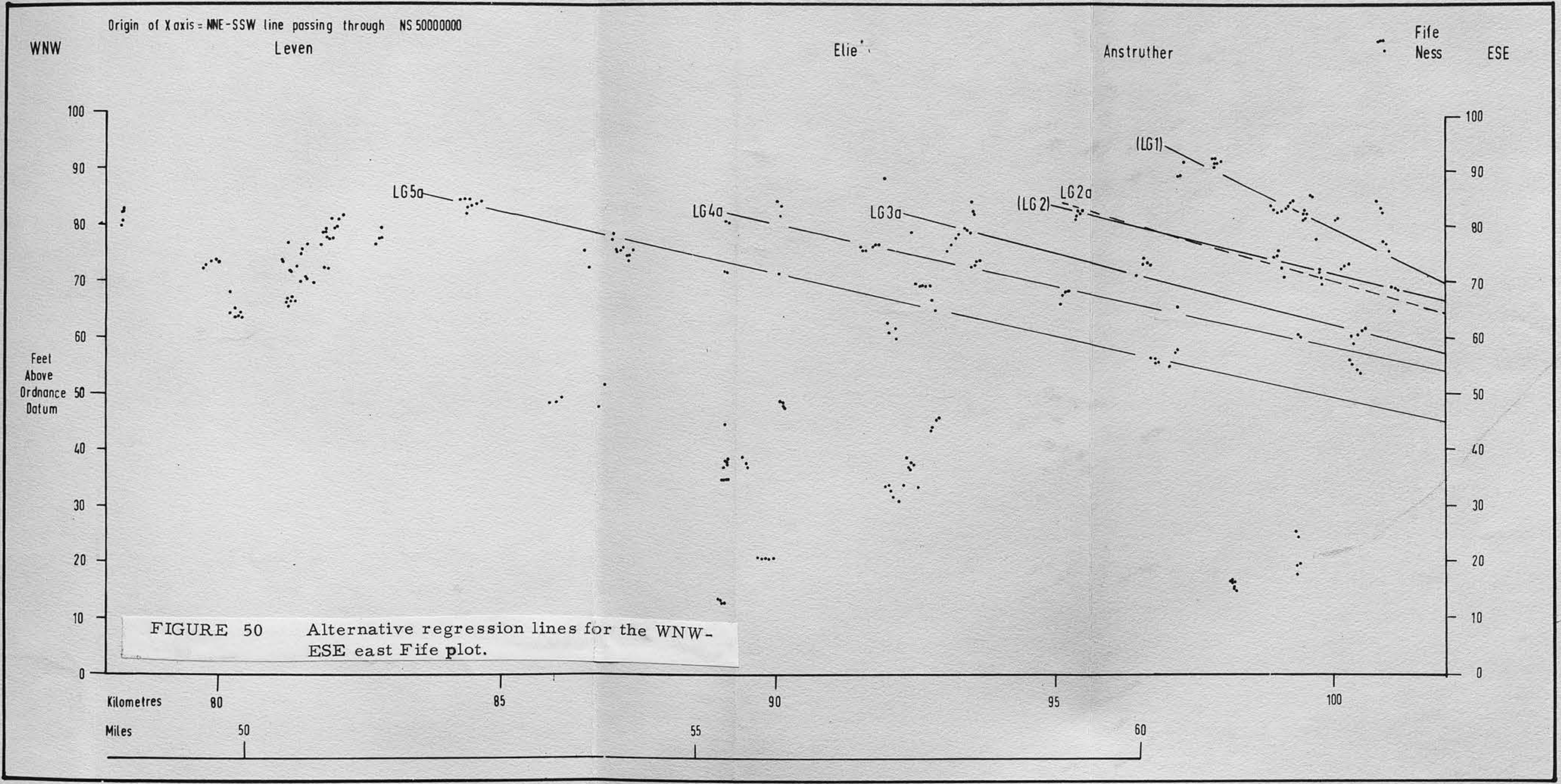


FIGURE 50 Alternative regression lines for the WNW-ESE east Fife plot.

LG 4a

A more likely line, this connects terraces near Kincraig (81.5 - 84.3 feet O.D.), St. Monance (76.2 - 76.9, 72.8 - 74.0 feet O.D.), Pittemweem (66.3 - 68.2 feet O.D.) and Fife Ness (53.5 - 56.2 feet O.D.)

No. of Points	Direction of X axis	Standard Error	r	Regression Equation	Slope ft/km	Slope ft/ml
22	WNW-ESE	0.0037	-0.9899	$X=\frac{Y-94.37+(0.472x70.17)}{0.472}$	2.12	3.41

It has been shown that the St. Monance terraces were formed while ice lay there.

LG 5a

This possible shoreline would include three terraces at Largo (81.7 - 84.7 feet O D., 74.0 - 75.8 feet O.D., 72.5 - 75.5 feet O.D., one at St. Monance (69.0 - 69.8 feet O.D.), and one between St. Monance and Pittenweem (55.4 - 56.4 feet O.D.).

No. of Points	Direction of X axis	Standard Error	r	Regression Equation	Slope ft/km	Slope ft/ml
26	WNW-ESE	0.0082	-0.9615	$X=\frac{Y-88.91+(0.465x72.17)}{0.465}$	2.15	3.46

There is no field evidence for contemporaneous ice in the case of these terraces.

In addition to omitting the measurements at circa 65 feet O.D. by Leven referred to earlier, this scheme does not account for the terraces at 73 feet O.D. and 70 feet O.D. at that place.

Numerous other regression lines were tried. A particularly suitable line is LG 2b. This line based on the measurements of LG 2 excluding the Pittenweem group is seen to pass through or close to several important groups of measurements when extended westwards. Although it gives a satisfactory result:

No. of Points	Direction of X axis	Standard Error	r	Regression Equation	Slope ft/km	ft/ml
27	WNW-ESE	0.0889	-0.8137	$X = \frac{Y - 98.25 + (0.376 \times 74.42)}{0.376}$	2.66	4.28

it isolates the Pittenweem measurements between it and LG 1. Since the Pittenweem terrace is very well defined, this is unsatisfactory.

Similar lines may be drawn through other groups of measurements but in addition to having the same fault as the last line, they do not have such a high value of r as the lines of the first scheme. The point in favour of the first scheme is that in it, all the terrace measurements (excepting the two poor ones by Leven) are accounted for by a minimum number of regression lines with a high value of r and a low standard error.

The result of this analysis of possible shoreline heights in East Fife is that all the measurements can be accounted for as lying along only six lines. Two strongly suggest shorelines, and all lines slope down towards the east. Comparisons between WNW-ESE, W - E and WSW - ENE graphs suggest that the most favourable direction of the area of maximum displacement may be towards the WNW.

(ii) The Perth Readvance Shorelines

LG 7

In Chapter VI, a well developed raised shoreline stretching from Kincardine eastwards to Burntisland was described as having been formed while glacier ice of the Perth Readvance extended as far as the site of Kincardine. This is the shoreline which was used to calculate the probable direction of maximum displacement, and the details of regression lines through the five plots of the measurements have already been described. It will be recalled that the following best results were obtained:

Direction of X axis	Standard Error	r	Regression Equation	Slope ft/km	Slope ft/ml
NW-SE	0.0030	-0.9850	$X=\frac{Y-49.33+(0.575x88.25)}{0.575}$	1.83	2.95
WNW-ESE	0.0032	-0.9885	$X=\frac{Y-7.56+(0.703x88.25)}{0.703}$	1.42	2.29
W - E	0.0043	-0.9841	$X=\frac{Y-52.22+(0.717x88.25)}{0.717}$	1.39	2.24

In Chapter VI, it was suggested that this shoreline represents a transgression because of the relationship it displays with certain outwash terraces. This relationship is shown for the WNW - ESE plot, the mean of the three best results, in Figure 51.

In view of the good development of LG 7 between Kincardine and Burntisland, it would seem apparently surprising that there is no evidence, apart from two small terraces by Kirkcaldy, for this shoreline between Burntisland and Leven. The coast here is in fact mainly composed of high cliffs. In Largo Bay and near Kincraig Point, however, there are

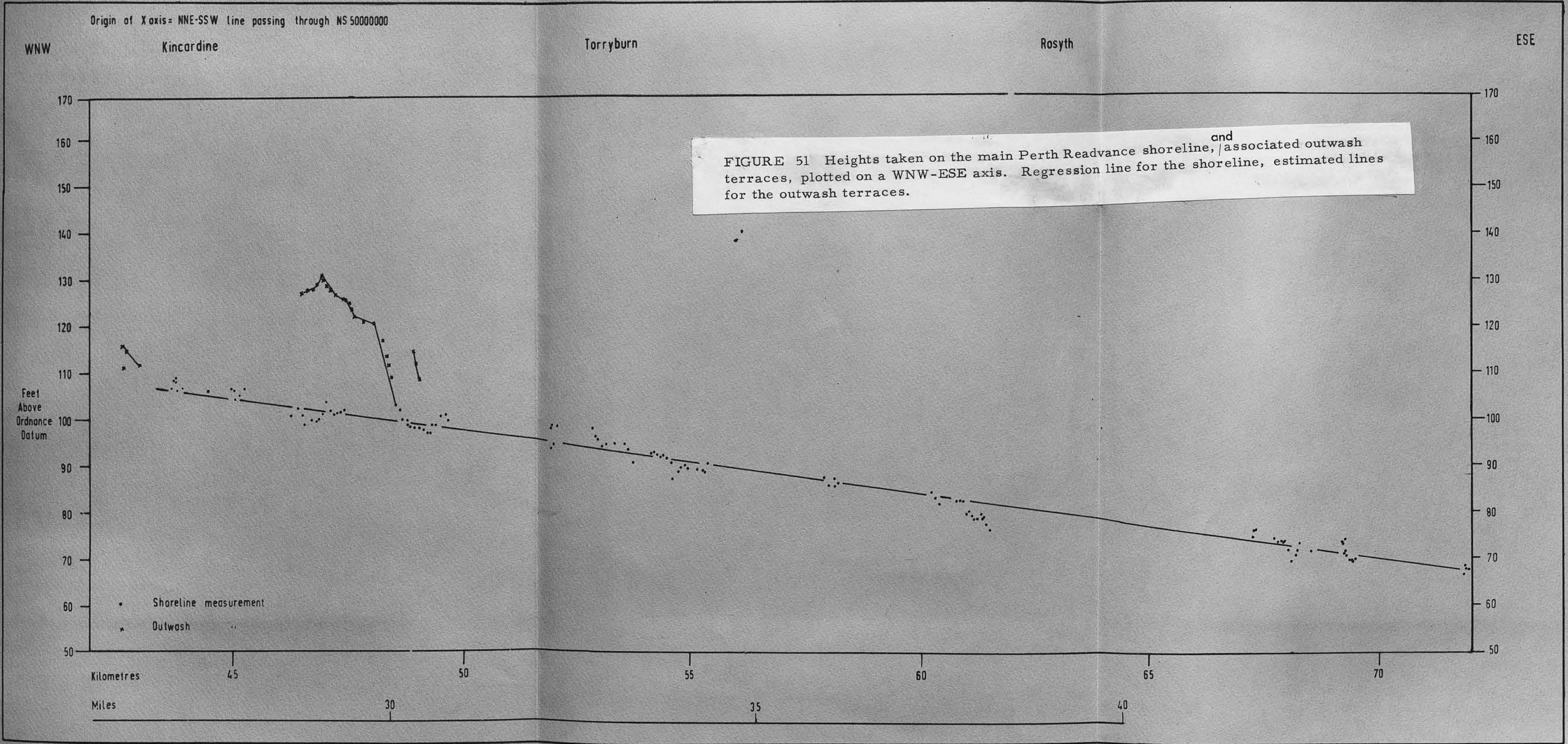


FIGURE 51 Heights taken on the main Perth Readvance shoreline, and associated outwash terraces, plotted on a WNW-ESE axis. Regression line for the shoreline, estimated lines for the outwash terraces.

several terraces and rock cut features which lie very close in height to a projection of the regression line in those areas (see Fig. 57). There is other evidence that they may represent remnants of the shoreline. The Kincraig benches lie at about the same height (circa 38 feet O.D.) as the marine fossiliferous clays nearby at Elie. The marine shells in the clays were believed by Brown (1867) to be diagnostic of an arctic habitat. Therefore it may be that the benches lying at a similar height were also the product of that same arctic sea. If it is a fact that the Kincraig 38 foot bench was formed in such an environment, then its extraordinarily extensive development suggests that it was cut during a particularly long-lived arctic sea level. It has already been suggested that the Kincardine-Burntisland shoreline was the product of a relatively stable sea level in terms of late-glacial shorelines.

LG 8

It has been observed that west of Stirling, in a distance of some six miles, there occur seven terraces at similar heights of around 65 feet O.D. On the whole the features are poorly developed and no positive assertion of marine origin was made. The figures were analysed by regression analysis using a WNW-ESE axis only, and a good result was obtained, but shoreline LG 8 remains only a tentative proposition:

No. of Points	Direction of X axis	Standard Error	r	Regression Equation	Slope ft/km	ft/ml
25	WNW-ESE	0.0010	-0.9815	$X = \frac{Y - 16.47 + (0.260 \times 77.99)}{0.260}$	0.45	0.72

Although tentative however, it is interesting to note that if the line is projected eastwards (see Fig. 57) it comes within 2 feet of a clear terrace (Fig. 57) in a sheltered locality at Kincardine lying at circa 47 feet O.D. Since this feature also stands apart from the others in its locality, it may be a remnant of the hypothetical shoreline LG 8.

Terraces probably belonging to the late-glacial period have been described at above 69 feet O.D. at Stirling, Alloa, Aberdour and Kirkcaldy. These do not fit into the sequence outlined above. Some are well developed and none have been described as other than marine. Their possible origin will be considered later.

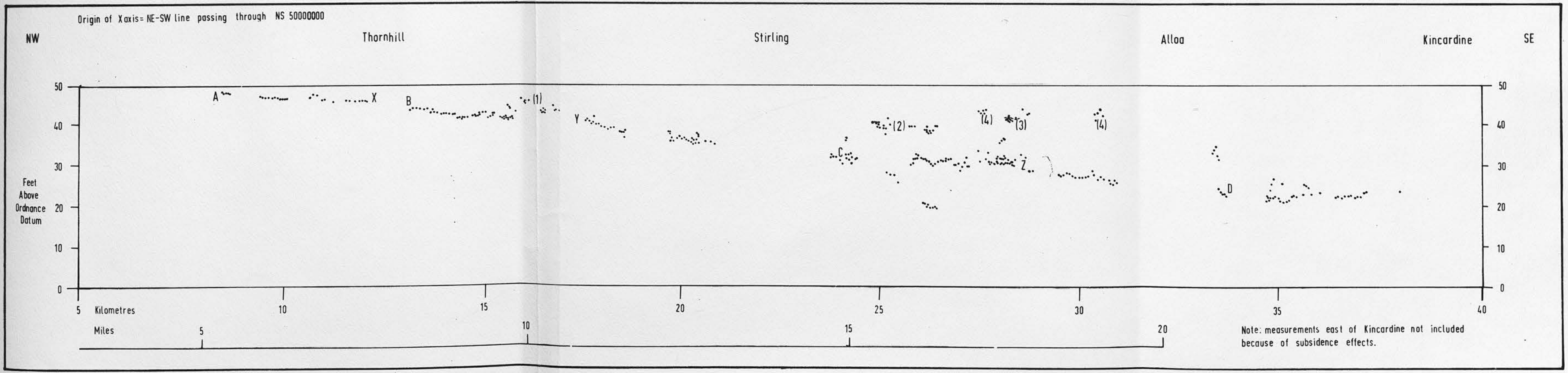
Three distinct late-glacial shorelines have been defined with the aid of regression analysis, and have been called LG 1, LG2 and LG 7. All slope down towards the east.

Five other late-glacial shorelines have been suggested, LG 3 - 6 and LG 8, though less validity is attached to these. It is interesting to note, however, that in every case the supposed displaced shorelines slope downwards towards the east. The pattern for all shorelines real or supposed suggests a common cause.

(iii) Post-Glacial Displaced Shorelines

At the eastern end of each graph there appears a thick line of points sloping eastwards, representing what would seem to be the most convincing single displaced shoreline. Larger scale graphs appear in Figures 52-54. Regression analysis using a WNW - ESE axis gives in fact a very good result.

FIGURE 52 The carse shoreline heights, plotted on a NW-SE axis.



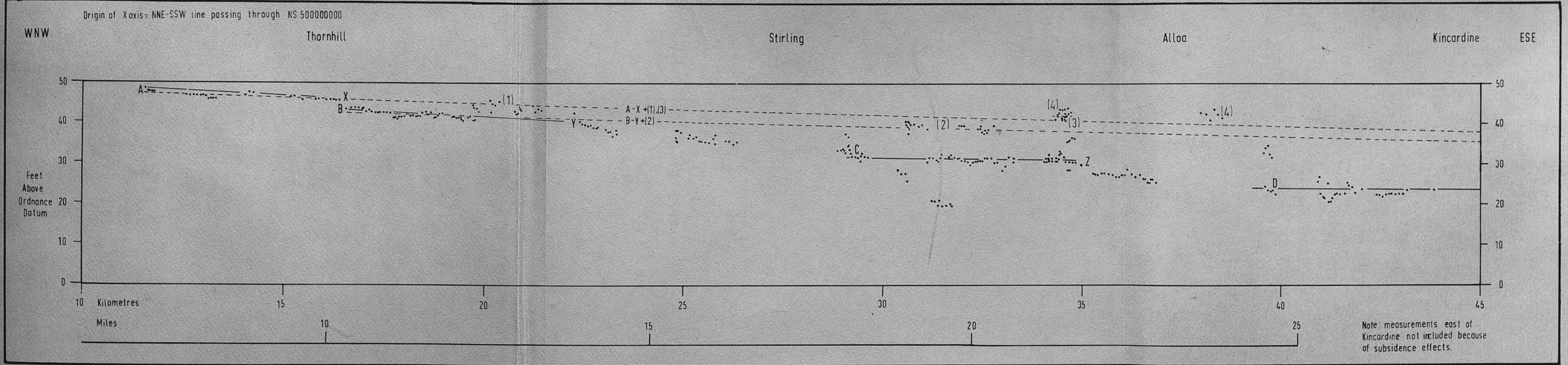
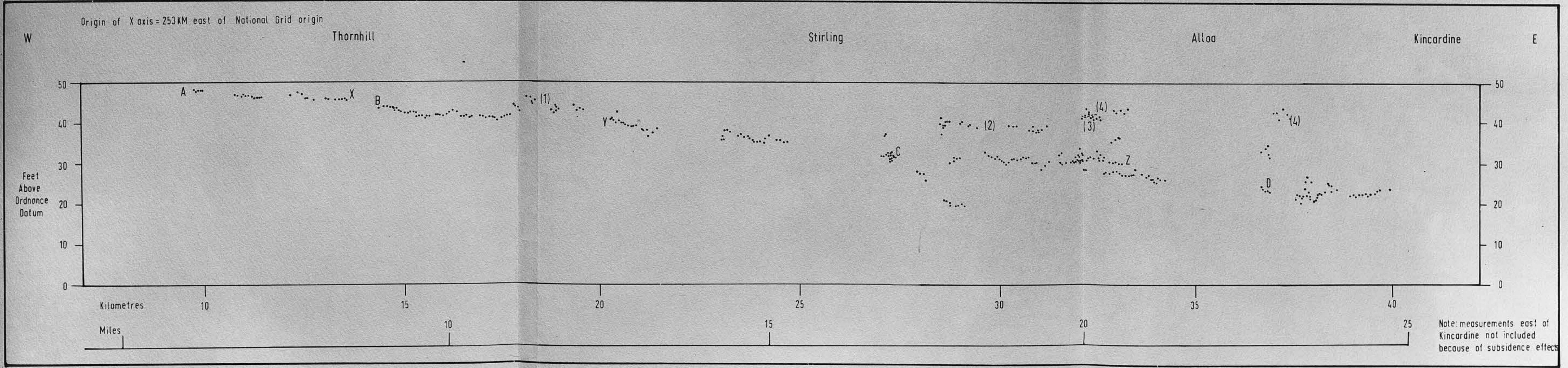


FIGURE 53 The carse shoreline heights, plotted on a WNW-ESE axis, and regression lines. (see text).

FIGURE 54 The carse shoreline heights, plotted on a W-E axis.



No. of Points	Direction of X axis	Standard Error	r	Regression Equation	Slope ft/km	Slope ft/ml
183	WNW-ESE	0.0043	-0.9881	$X = \frac{Y - 29.29 + (1.202 \times 39.82)}{1.202}$	0.83	1.34

These points, however, represent the carse, where at least two levels have already been described (see Chapters IV, V). In fact, a closer inspection of the graphs shows that the line is much more complex. This complexity is seen to best advantage on the WNW - ESE graph (see Fig. 53). Here, it is apparent that the line of points does not slope uniformly down towards the east, but is in reality composed of alternate gentle and steep segments. Four gently sloping segments may be recognised, sloping from A, B, C, and D in Figure 53, while three steeper segments separate them, beginning at X, Y, and Z. Regression analysis of the gently sloping areas gave:

Group	No. of Points	Direction of X axis	Standard Error	r	Regression Equation	Slope ft/km	Slope ft/ml
A - X	25	WNW-ESE	0.0019	-0.9990	$X = \frac{Y - 13.97 + (0.192 \times 59.76)}{0.192}$	0.45	0.72
B - Y	40	WNW-ESE	0.0011	-0.9934	$X = \frac{Y - 18.39 + (0.177 \times 49.05)}{0.177}$	0.49	0.79
C - Z	56	WNW-ESE	0.0015	-0.9965	$X = \frac{Y - 32.50 + (0.194 \times 44.42)}{0.194}$	0.17	0.27
D	29	WNW-ESE	0.0016	-0.9903	$X = \frac{Y - 38.42 + (0.195 \times 43.29)}{0.195}$	0.13	0.21

Thus a WNW - ESE profile of the carse based on regression lines would be as shown in Figure 55, and it is apparent that there are breaks of

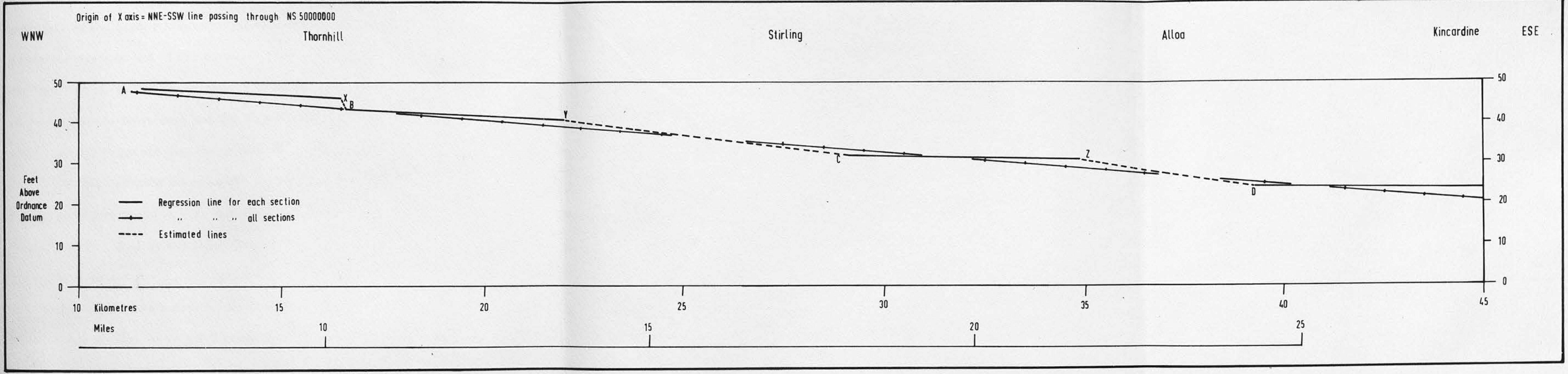


FIGURE 55 A regression line profile of the carse, along a WNW-ESE axis. The alternative regression line through all the sections is shown.

slope running north-south across the carse lands at B, C, and D, as well as the break at the head, A.

If it is supposed that the less steeply sloping sections represent remnants of former marine levels, then it might be expected that occasional remnants of the higher levels might be found above the lower levels towards the eastern end of the carse. This is what appears to happen. If the "line" is examined there appear to be two "off shoots" at (1) and (2). At these places, Burnbank and the Ochil Hills, cross valley levelling (see Figs. 10, 21) suggests that there may be more than one level. Thus, at Burnbank, the remnant there might probably belong to the marine level which formed segment A - X, one level above the marine level at that place, B - Y. And by the Ochil Hills, the remnant there might probably belong to segment B - Y, one level above the main level at that place, C - Z. Regression lines including these offshoots with the groups A - X and B - Y respectively, show good results:

Group	No. of Points	Direction of X axis	Standard Error	r	Regression Equation	Slope ft/km	Slope ft/ml
A-X+(1)	41	WNW-ESE	0.0067	-0.9987	$X = \frac{Y-16.52+(0.185 x 45.94)}{0.185}$	0.60	0.97
B-Y+(2)	81	WNW-ESE	0.0140	-0.8634	$X = \frac{Y-22.98+(3.17 x 40.77)}{3.17}$	0.32	0.51

causing little modification to the original A - X and B - Y lines.

There remains an anomaly. Near the mouth of the Devon part of the carse lands there is a terrace at 41 feet O.D. (3). By Alva and Tillicoultry the carse is 42 - 43 feet O.D. (4). The Alva and Tillicoultry heights may be explained possibly by normal estuarine effects. The other cannot. In the prevailing interpretation, however, it may be assigned to the A - X level, which here is only about 2 feet higher than the C - Y level. Inclusion of the heights within the A - X level heights therefore gives:

No. of Points	Direction of X axis	Standard Error	r	Regression Equation	Slope ft/km	ft/ml
50	WNW-ESE	0.0190	-0.9228	$X = \frac{Y - 19.62 + (3.15 \times 44.66)}{3.15}$	0.32	0.51

On reflection, the regional morphology of the carse is exactly what one would expect if it were formed by the deposits of several marine levels. Near the mouth of this former estuary, breaks of slope would be clear: the break at 30 - 31 feet O.D. between Stirling and Cambus (near Alloa) is particularly so. Yet near the head of the former estuary the junction between levels would be particularly gradual, in view of the shallowing that might be expected towards the head and the calmer waters: the Burnbank cross-valley profile of Chapter IV suggests this gradual junction. The various stages in the evolution of the present general carse morphology are illustrated in the diagram below (Fig. 56).

Below the lowest point of the line of measurements, there occur several measurements in the range 13 - 20 feet (see Fig. 57). Unfortunately, they do not permit detailed analysis, since the majority have been affected by subsidence, and the groups are scattered. Possibly, they represent one or more lower marine levels.

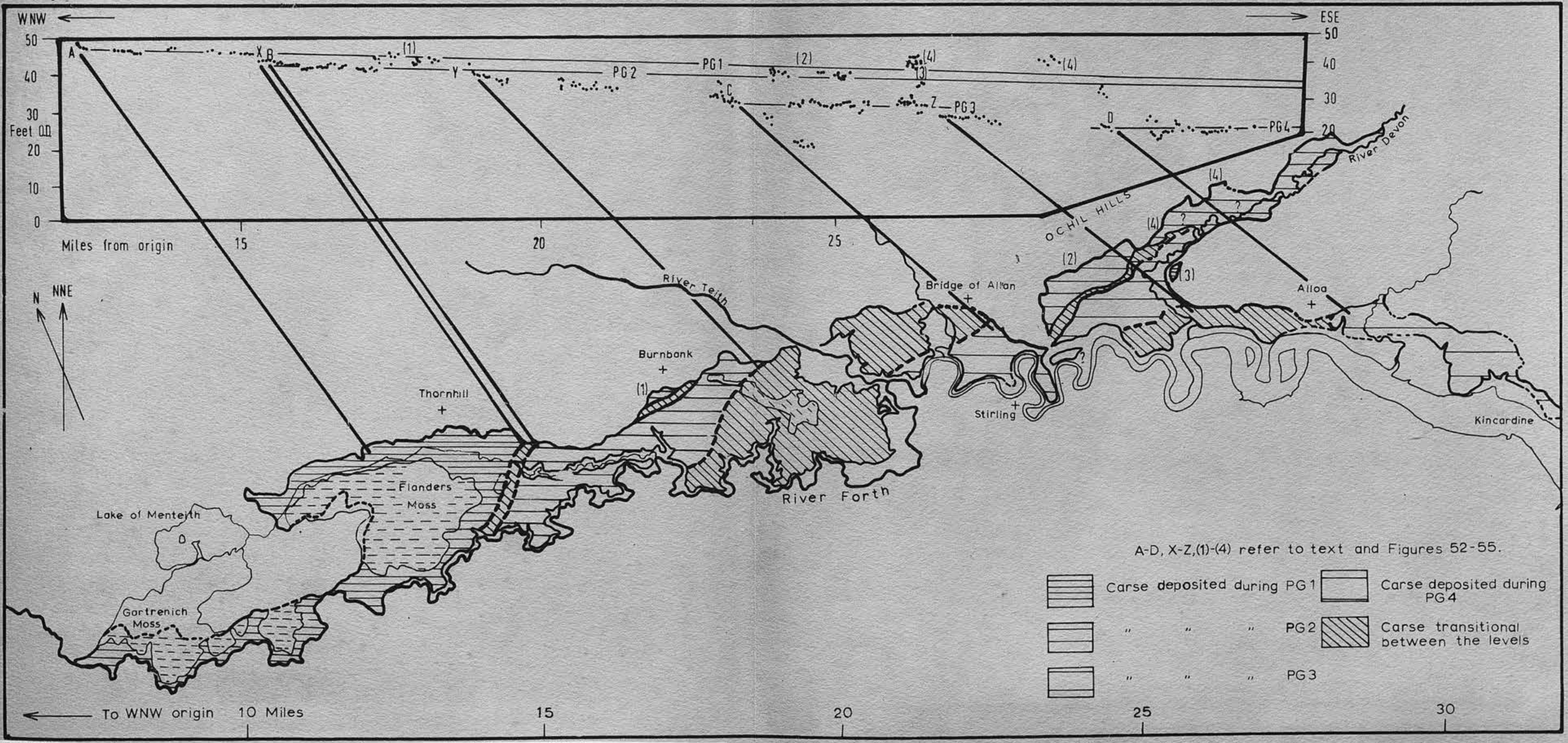


FIGURE 56 The relationship of the steps in Figure 53 to a map of the carse, and stages in the evolution of the carse.

Four post-glacial displaced shorelines have been defined with the aid of linear regression analysis. Each shoreline declines in height towards the east. It will be noted that apart from the regression line through the "line" of measurements at the beginning, no alternative pattern has been suggested. This is because no other scheme can satisfactorily account for all the features. A greater accuracy is claimed, however, for PG 1 and 2, which are based on a wide scatter of measurements, than for PG 3 and 4, which are based only on restricted areas of measurement. A projection of the regression lines for PG 1 and 2 eastward comes close to several isolated low terraces further east in the estuary (see Fig. 57).

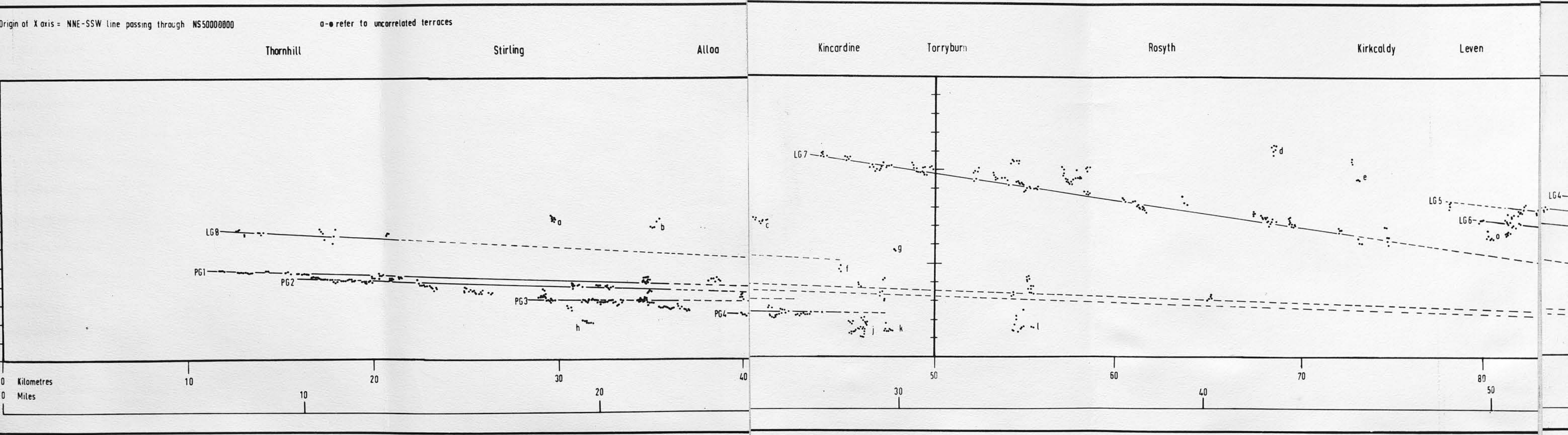
The general pattern of probable late and post-glacial displaced shorelines along a WNW - ESE axis is shown in Figure 57.

2. SHORELINE PATTERN ANALYSIS

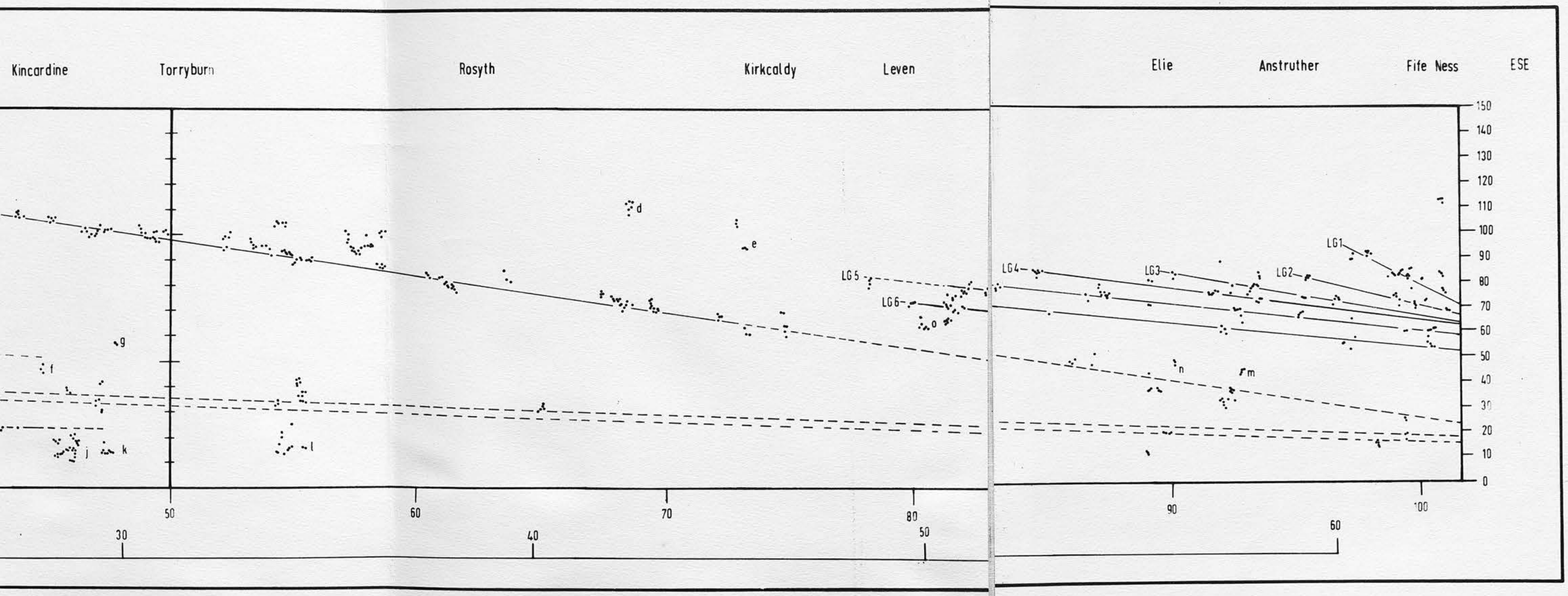
a. The Cause of the Displacement

(i) The Age of the shorelines

It has been established that the shoreline features were formed during and after withdrawal of the ice sheet which covered the area. The least is known about the East Fife shorelines, but it seems reasonable to place them within the late-glacial period in view of the relative extent of the ice. The best developed shoreline in the whole area, LG 7, and the one below this, LG 8, have been identified as contemporaneous with stages in the retreat of the Perth Readvance. This major readvance has unfortunately not yet been dated absolutely, and consequently these shorelines also can only



Late-and post-glacial shorelines as defined by regression lines for the northern side of the Forth valley and estuary.



Kincardine
Torryburn
Rosyth
Kirkcaldy
Leven
Elie
Anstruther
Fife Ness
ESE
LG1
LG2
LG3
LG4
LG5
LG6
d
e
f
g
j
k
l
m
n
o
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
50
60
70
80
90
100
30
40
50
60

be termed late-glacial. More is known of the carse shorelines. The Carbon 14 date of the buried peat at Airth, 8,421 ± 157 B.P., gives a maximum date for all the carse shorelines, while the date of 5,492 ± 130 B.P. for the base of Flanders Moss gives a minimum date for the highest post-glacial shore-line, at that place (Flanders Moss lies on the highest post-glacial shoreline, PG 1).

(ii) <u>The Eustatic Factor</u>

Much work has been done on changes in world sea level during the Würm glaciation, especially during late-glacial times, while considerably more has been done on post-glacial changes. Several graphs are available, many based on Carbon 14 dating, and a number are shown below (see Figs. 58, 59). Most investigators recognise a rapid rise of sea level during the late-glacial period, interrupted by two falls consequent upon two readvances, and a less rapid rise in the post-glacial period, falling off particularly after 8 - 6,000 B.P. Such fluctuations of sea level are assumed in the following discussion. As already observed, opinion is divided on whether sea level is rising or is stable at the present day.

If, however, there has been a net rise in world sea level since at least the beginning of the late-glacial, shorelines formed during this period and now elevated above present sea level in the Forth must owe their formation to a different agency. Since it has also been shown that some shorelines, and probably all, have been displaced unequally, it follows that movement of the land has taken place.

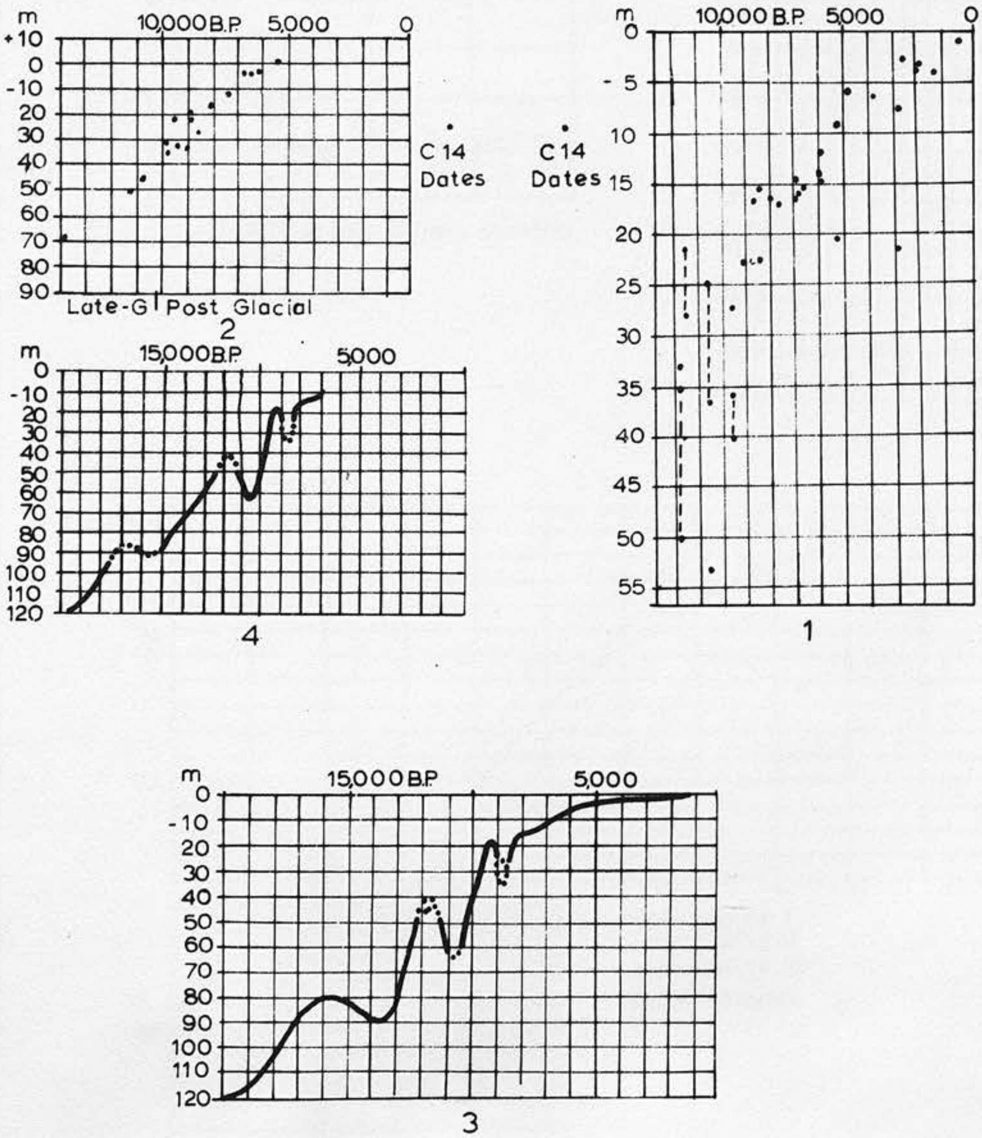


FIGURE 58 Eustatic change during late-and post-glacial time according to
(1) Shepard and Suess (1956).
(2) Godwin, Suggate, and Willis (1958), and
(3) Shepard, 1960; and (4) eustatic change before 7,000 B.P. according to Curray (1960). (Taken from Jelgersma, 1961).

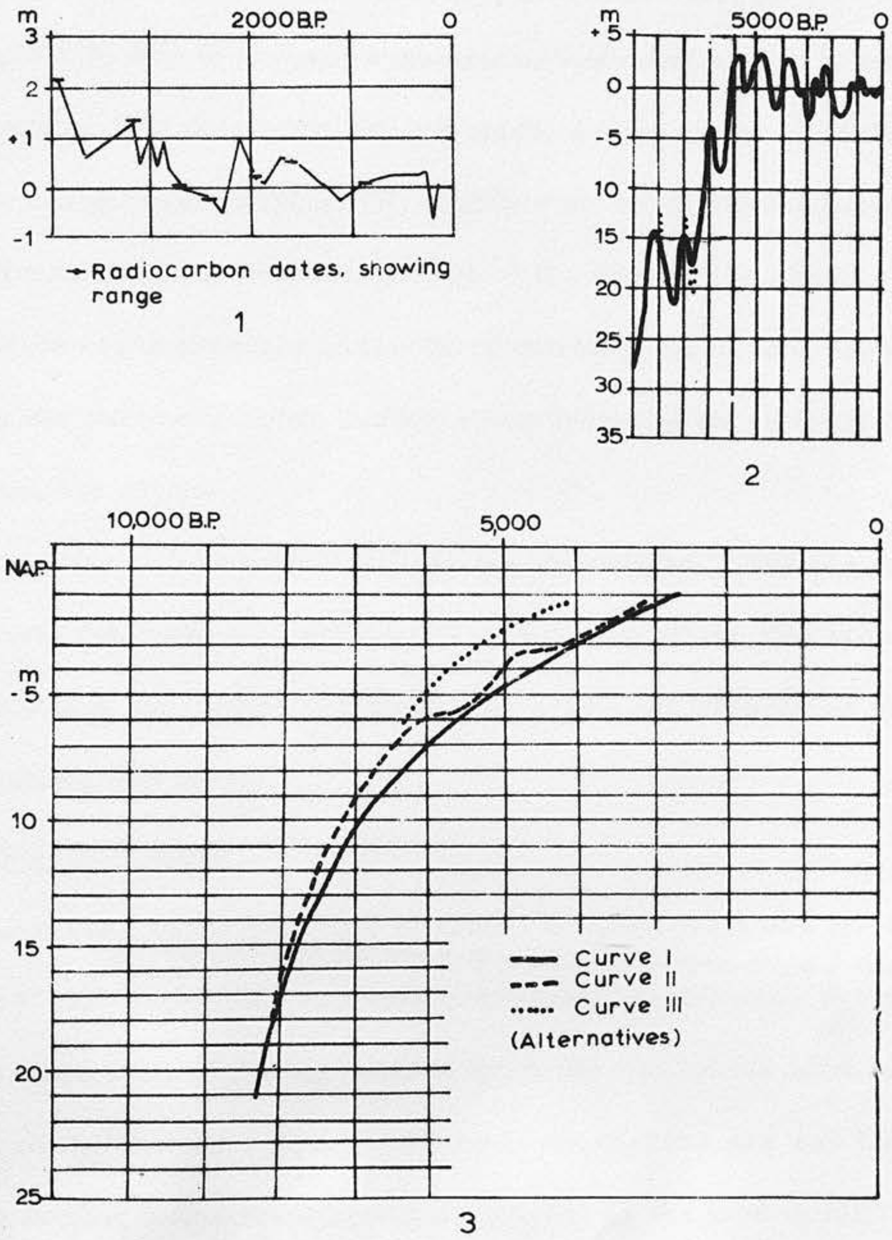


FIGURE 59 Eustatic change during the post-glacial period, according to (1) Schofield (1960) and (2) Fairbridge (1961). Relative sea level change in the Netherlands. (3) According to Jelgersma (1961).

(iii) The Isostatic Factor

The shorelines were formed and displaced at the end of a time when a considerable thickness of ice had covered the land. Moreover, since sea level has been rising, the inclination of the shorelines cannot be due to unequal subsidence, but must be due to unequal uplift. The displacement, or uplift, increases in intensity in every carse towards the WNW, a direction which approximates to the direction of the probable centre of the former ice sheet. These facts argue strongly in favour of isostatic movement brought about by the recovery of the earth's crust from the exceptional load of the ice sheet.

But isostasy alone cannot explain the shorelines. Studies in Scandinavia (Meinesz and Heiskanen, 1958) have shown that isostatic movement is a steady and continuous process - yet shorelines suggest a halting movement.

(iv) The Isokinetic Theory

As observed in the previous chapter, Wright (1914) was first to suggest that shorelines in areas recovering isostatically from an ice load were formed during periods when the rise of the land and the rise of the sea were equal. He believed that the sea was the variable factor, sometimes rising as quickly as the land to form shorelines, sometimes rising less quickly or falling and thus allowing the shorelines to be elevated, and sometimes rising faster than the land, thus transgressing and destroying shorelines. This theory may be applied with success to the Forth area.

b. Aspects of the Isokinetic Theory

(i) The Nature of Isostatic Uplift in Glaciated Areas

It is generally held that isostatic movement in glaciated areas results in a slowly expanding dome during the later stages. There are different views on how this form is attained, however. Some (Antevs, 1922) maintain that the uplift consists of a series of waves passing outwards from the centre. Others contend that the movement of waves is in the opposite direction (Daly, 1934). It is agreed that isostatic uplift, once relatively rapid, is now slowing down, but that this progress has occasionally been irregular, and has reflected late-glacial "fluctuations of the ice margin" (Ramsay, 1924).

(ii) Conditions Necessary for the Formation of Shorelines

There are in theory seven different states which either the land or the sea can be in:

A - Accelerating rise

B - Decelerating rise

C - Steady rise

D - Stable

E - Accelerating subsidence

F - Decelerating subsidence

G - Steady subsidence

Therefore there can be 49 different land-sea relationships possible at any time during the late and post-glacial periods. In theory, however, there can be only one condition when the land and the sea are in equilibrium, namely,when both sea level and land are stationary. For during all other times, theland undergoing isostatic movement is moving at different rates in different places, while the moving sea level, being basically an equipotential surface moves the same amount everywhere.

If the rate of movement is sufficiently slow two conditions may produce a shoreline:

1. Steady rise of the land (C) and decelerating rise of the sea (B). In Figure 60, a stretch of coastline on a radius from the centre of uplift is experiencing maximum uplift near the centre of the isostatically-affected area. Sea level is falling to match the variable uplift and a shoreline is gradually emerging. Three graphs trace the land and sea movement at three points along the coast, and the fully emergent shoreline is shown below the graphs. Were maximum rise to have taken place at the peripheral part, the conditions would be the same except that the diagram would be reversed (Fig. 61).

2. Decelerating subsidence of the land (F), and steady subsidence of the sea (G). The same relative movement would prevail during this condition as during the previous one, and the same result would take place in both central and peripheral movement cases (Fig. 62).

Provided the radius of curvature of the dome surface is sufficiently great six other conditions may produce a shoreline in part

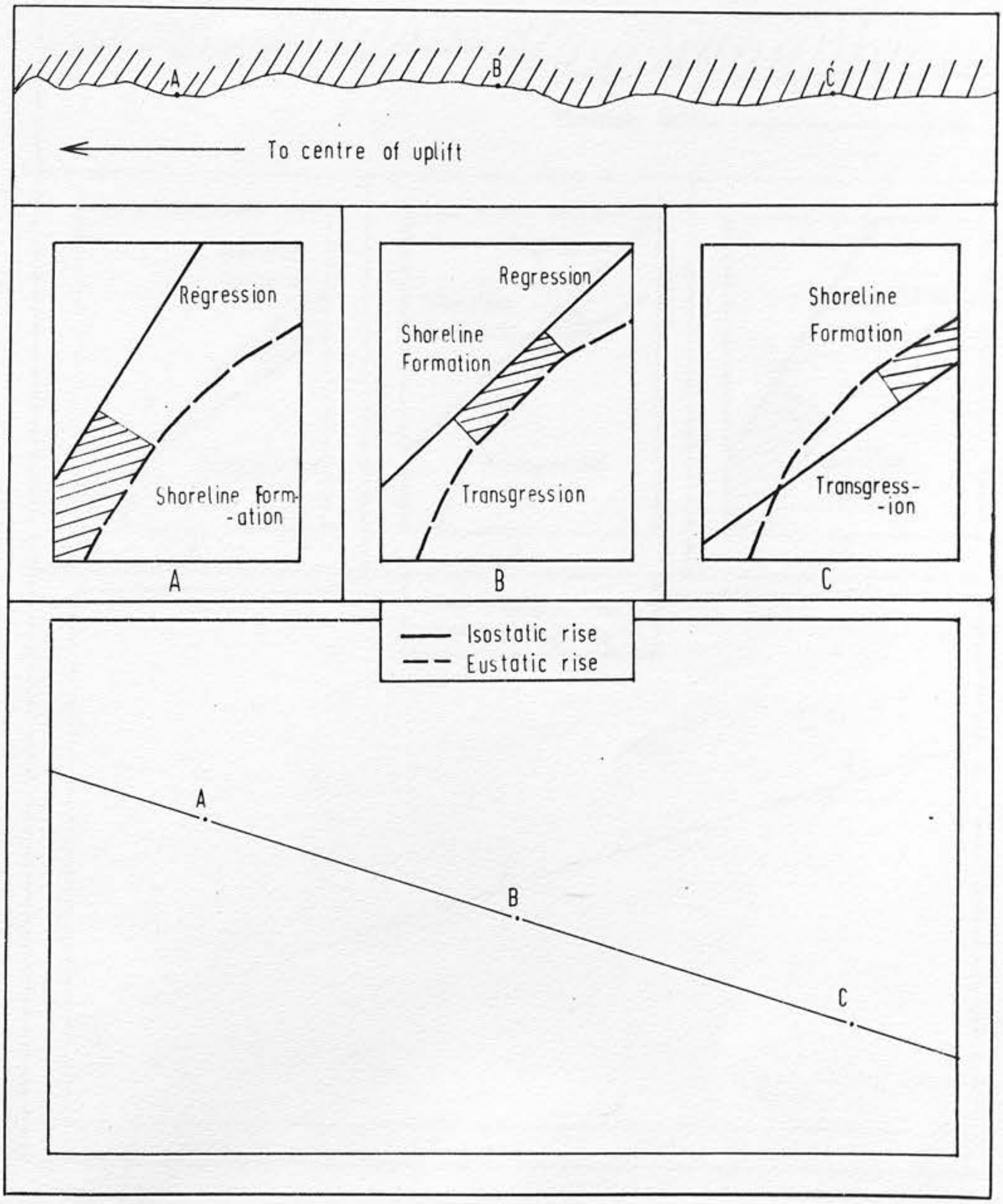


FIGURE 60 The formation of a raised shoreline during a steady rise of the land and decelerating rise of the sea, assuming central uplift.

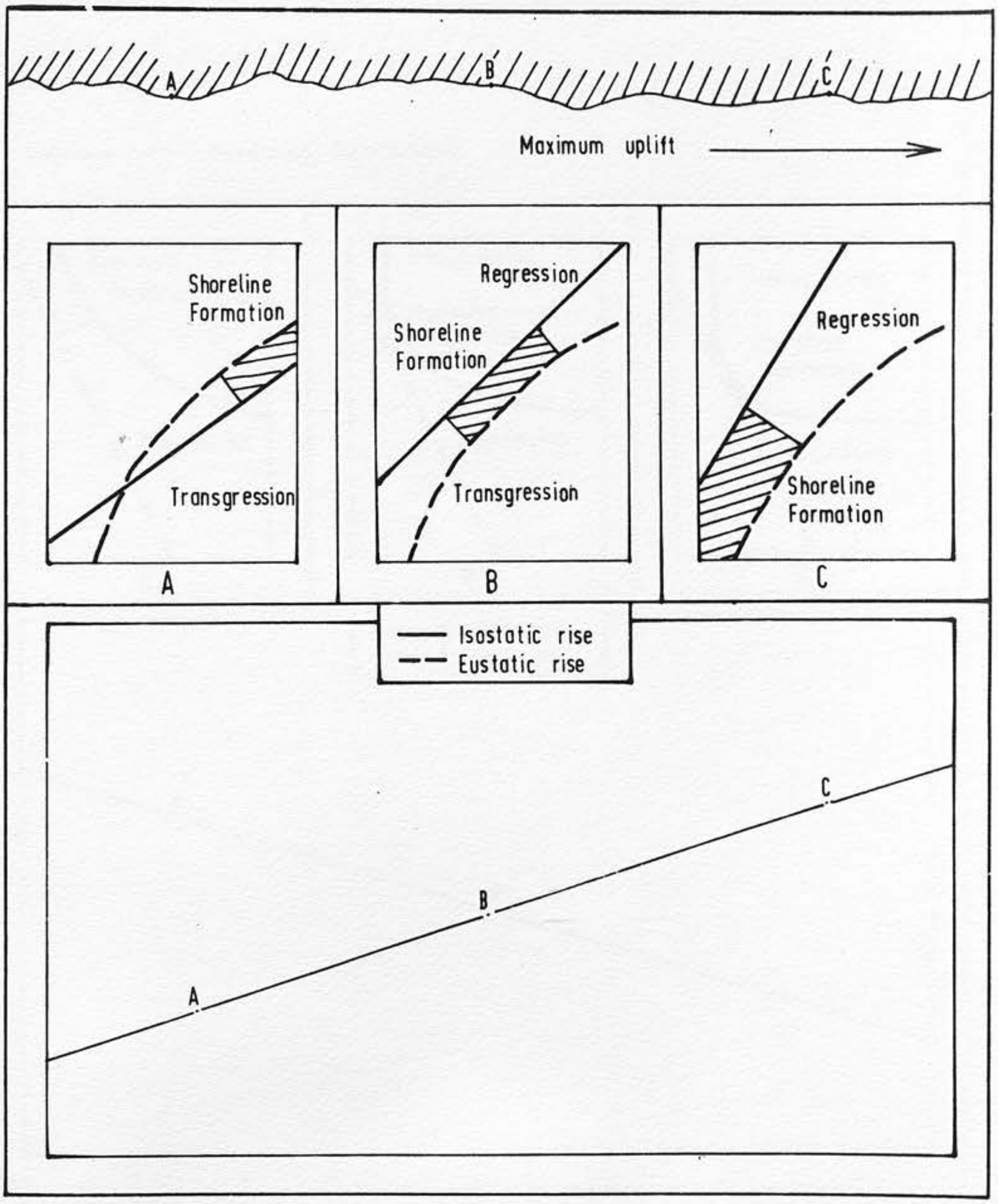


FIGURE 61 The formation of a raised shoreline during a steady rise of the land and decelerating rise of the sea, assuming peripheral uplift.

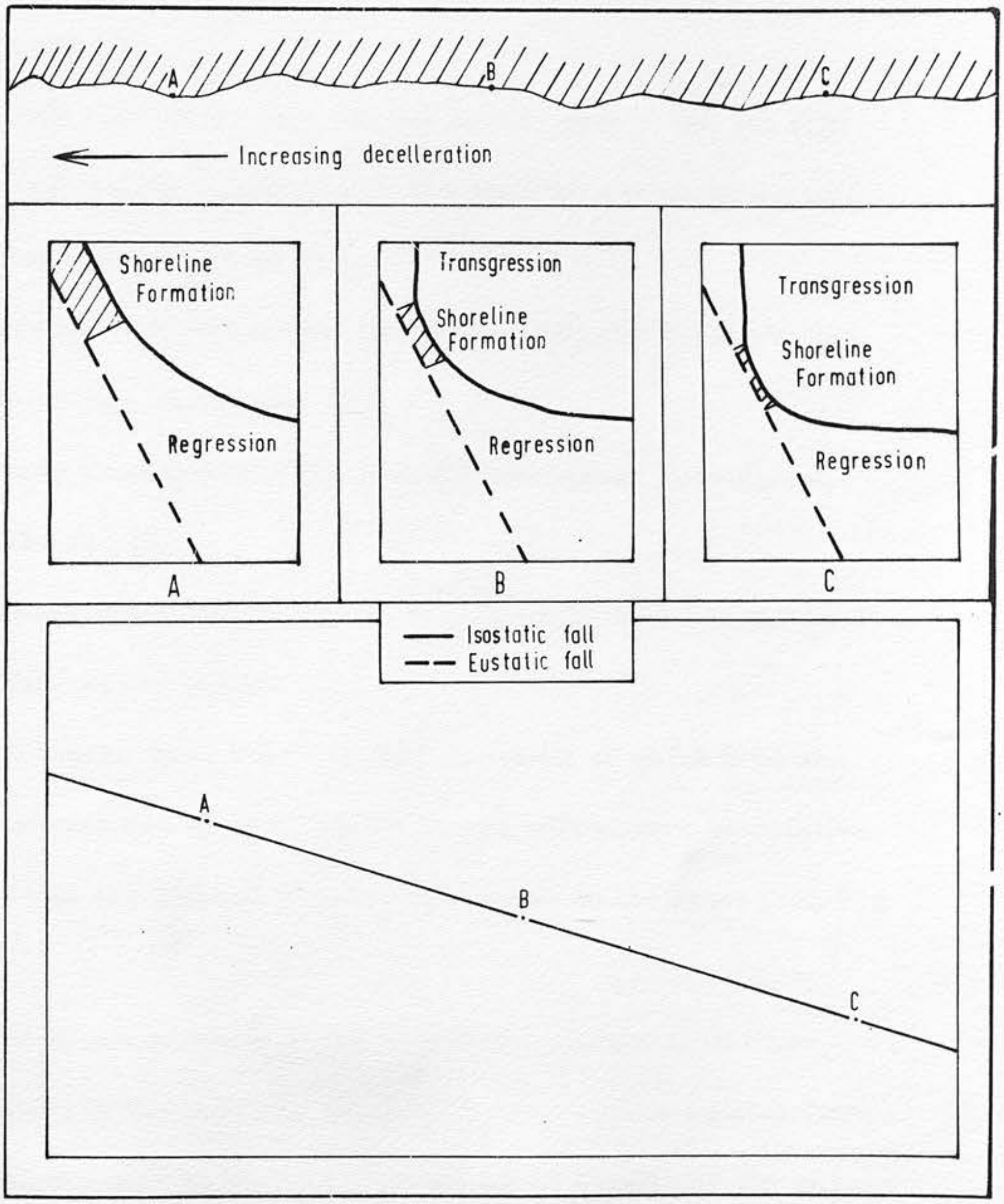


FIGURE 62 The formation of a raised shoreline during decelerating subsidence of the land and steady subsidence of the sea.

of the area:

3. Accelerating rise of the land (A), accelerating rise of the sea (A).

4. Decelerating rise of the land (B), decelerating rise of the sea (B).

5. Steady rise of the land (C) and steady rise of the sea (C).

6. Accelerating subsidence of the land (E) and accelerating subsidence of the sea (E).

7. Decelerating subsidence of the land (F) and decelerating subsidence of the sea (F).

8. Steady subsidence of the land (G) and steady subsidence of the sea (G).

All are cases where the sea level rise (or fall) matches the land rise (or fall) at one place.

But in theory when there is only one point at which land and sea movements are in equilibrium, there will always be relative subsidence to one side of it and relative rise to the other (see Fig. 63).

Provided circumstances are favourable however, in these eight conditions the land and sea are in approximate equilibrium, and shorelines may be formed. In all other conditions the curves for land and sea movement are in opposition and either continuous transgression or continuous regression will result.

Wave Uplift. During progressive wave emergence, shorelines can be only formed under one condition:

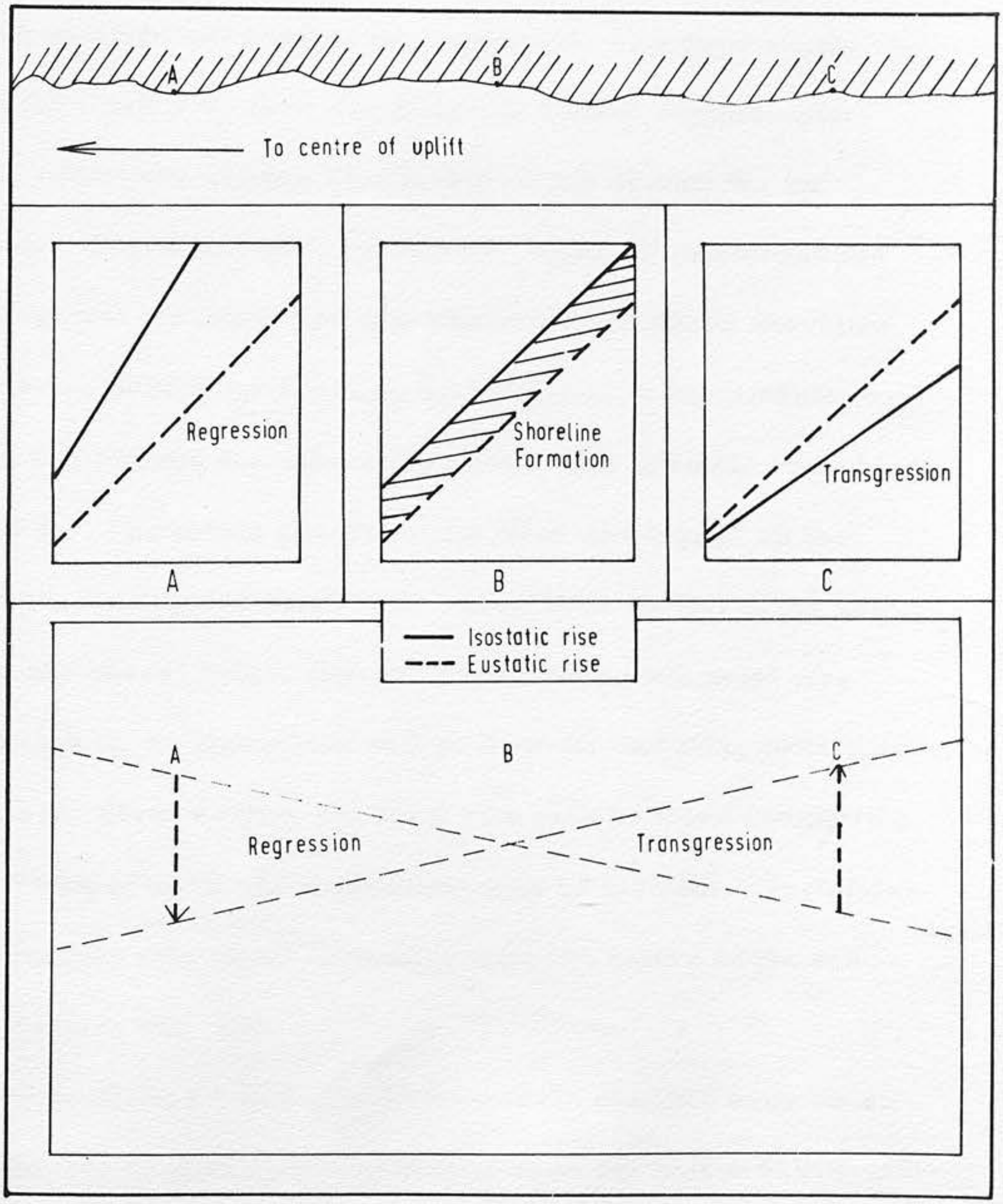


FIGURE 63 Figure to illustrate that in theory during isostatic and eustatic movement there is only one point along a radius from the centre of uplift where the land and sea can be in equilibrium.

1. Steady rise of the land (C) and decelerating rise of the sea (B) (see Fig. 64).

(iii) Continuity of Shorelines

In the case of a stable land and a stable sea, there is no reason - barring an abnormal aspect, ice conditions, or a poor supply of material - why a terrace should not be formed continuously along the coastline, given a reasonable period of time for its formation. But in the other conditions, separate considerations militate against the formation of a continuous displaced shoreline. In the case of conditions 1 and 2, the land and sea movements may not be in equilibrium throughout the area. For example, consider condition 1. The extent of a shoreline here will depend on the range of decreasing sea level rise. If uplift is so fast at the centre or at the peripheral bulge, that the decelerating sea level rise cannot match it, no shorelines will be formed; but away from these rising areas, decelerating sea level rise may be more compatible with the rates of uplift and a shoreline may be formed. Variations of this condition may occur depending upon the nature of the sea level curve (see Fig. 65).

Where conditions 3 to 8 are concerned the distance over which a shoreline can be developed will depend upon the radius of curvature of the dome at the particular time concerned (see Fig. 66).

Apart from these considerations, the length of a shoreline on the completion of its formation is dependent upon the length of time during which land and sea remained in approximate equilibrium.

(iv) /

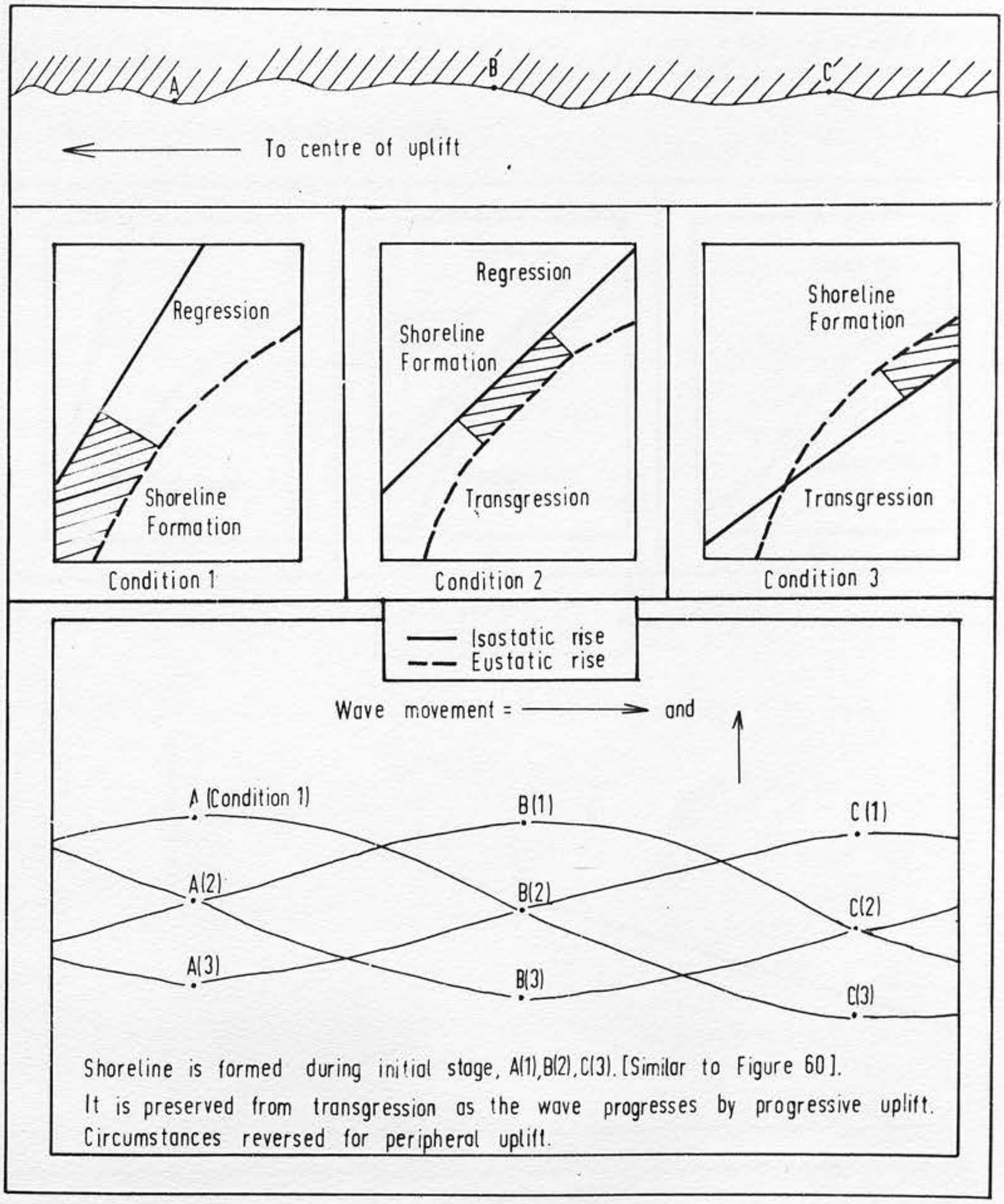


FIGURE 64 The formation of raised shorelines during wave uplift.

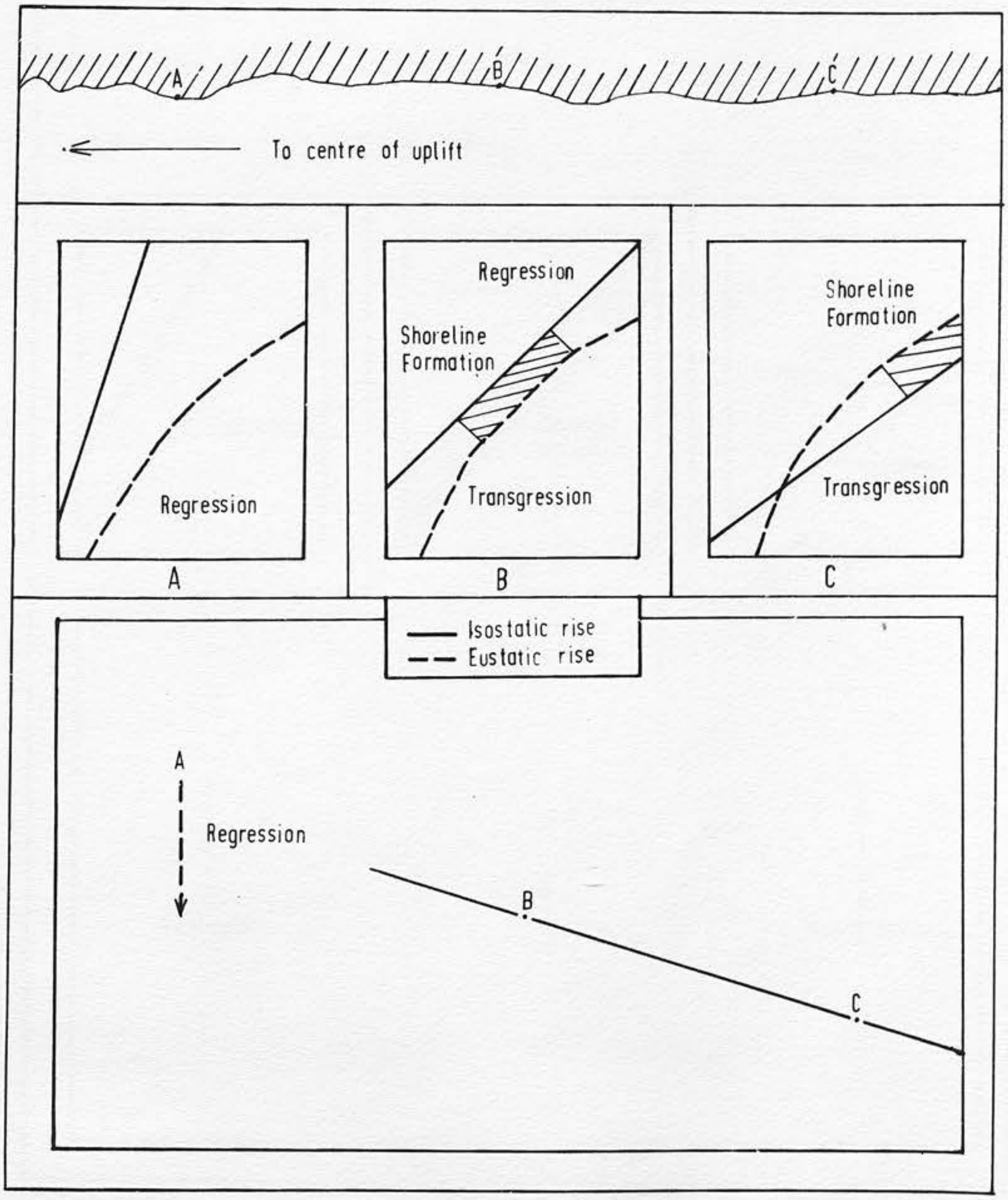


FIGURE 65 Theoretical limits to the area over which a shoreline may be formed during steady rise of the land and decelerating rise of sea level.

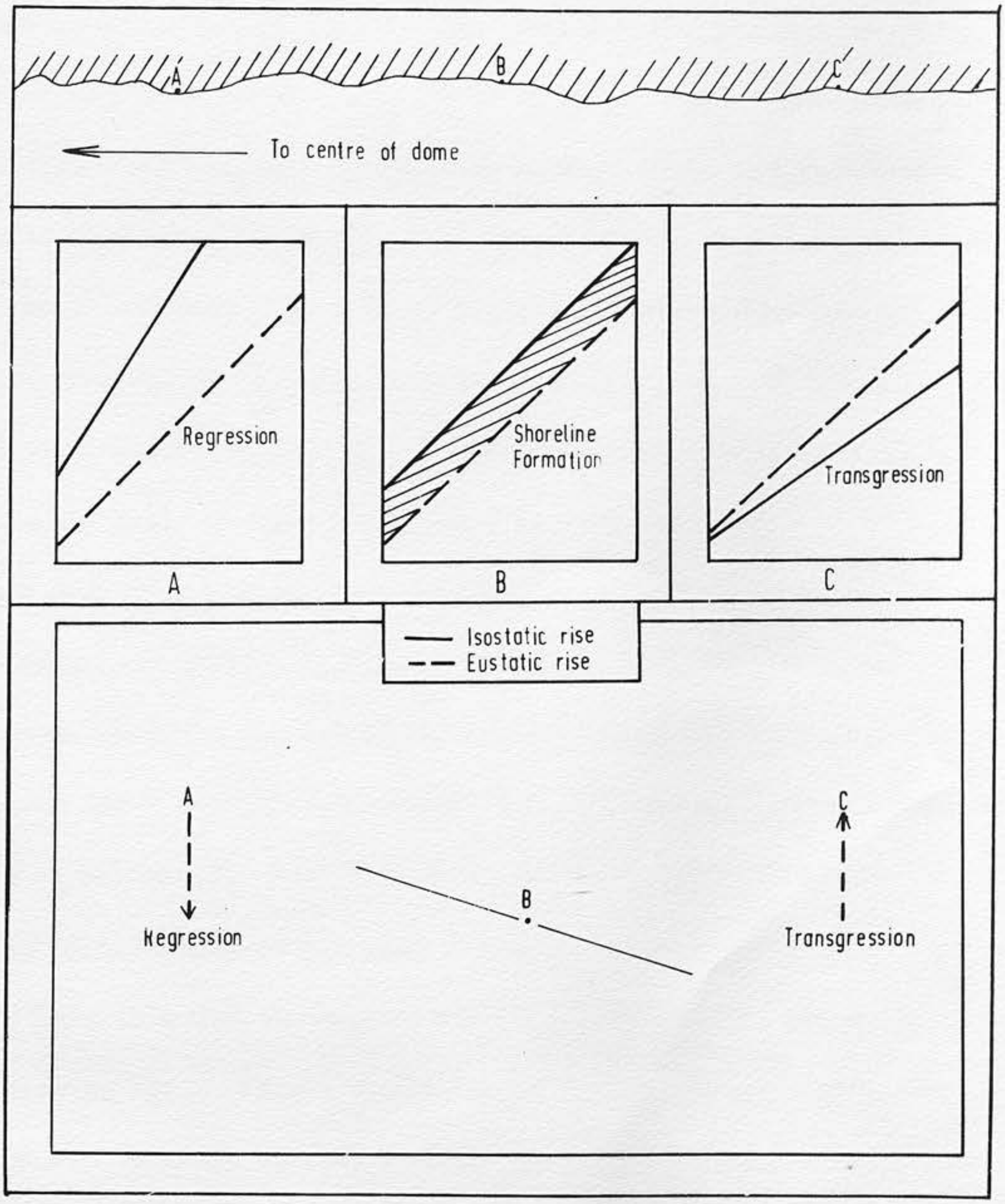


FIGURE 66 Theoretical limits to the area over which a shoreline may be formed during dome uplift.

(iv) Time Transgressive Shorelines

With the exception of shorelines formed during a fortuitous halt in both land and sea movements, no shoreline formed under conditions of isostatic or eustatic movement can be formed at the same time along its length, but instead while one point is emerging the next is still being formed. Such shorelines are metachronous. Scandinavians have sought to distinguish between these and successive positions of the higher marine limit during the formation of several shorelines (see Fig. 67), by referring to the shorelines as synchronous and the marine limit as metachronous. The difference is however only one of degree, and both marine limit and shorelines are more properly described as metachronous.

(v) Net Result of Continuous Isostatic Uplift

Authorities are generally agreed that isostatic uplift has been slowing down since the late-glacial, and Sissons (1962) has calculated figures for it at Stirling (see Fig. 68), based on Fairbridge's (1961) curve for late and post glacial sea level changes compared with the present heights of terraces assigned to various periods. It follows from this that shorelines will have a decreasing slope with decreasing age. Thus a shoreline formed during the Perth Readvance will be more steeply inclined than one formed during the post-glacial period. This pattern will hold whether uplift is in the form of an expanding dome or by wave movement outward from the centre or by wave movement inward from the periphery. But should there have been subsidence and renewed uplift at any time, the pattern will be different (see Fig. 69). The present inclination

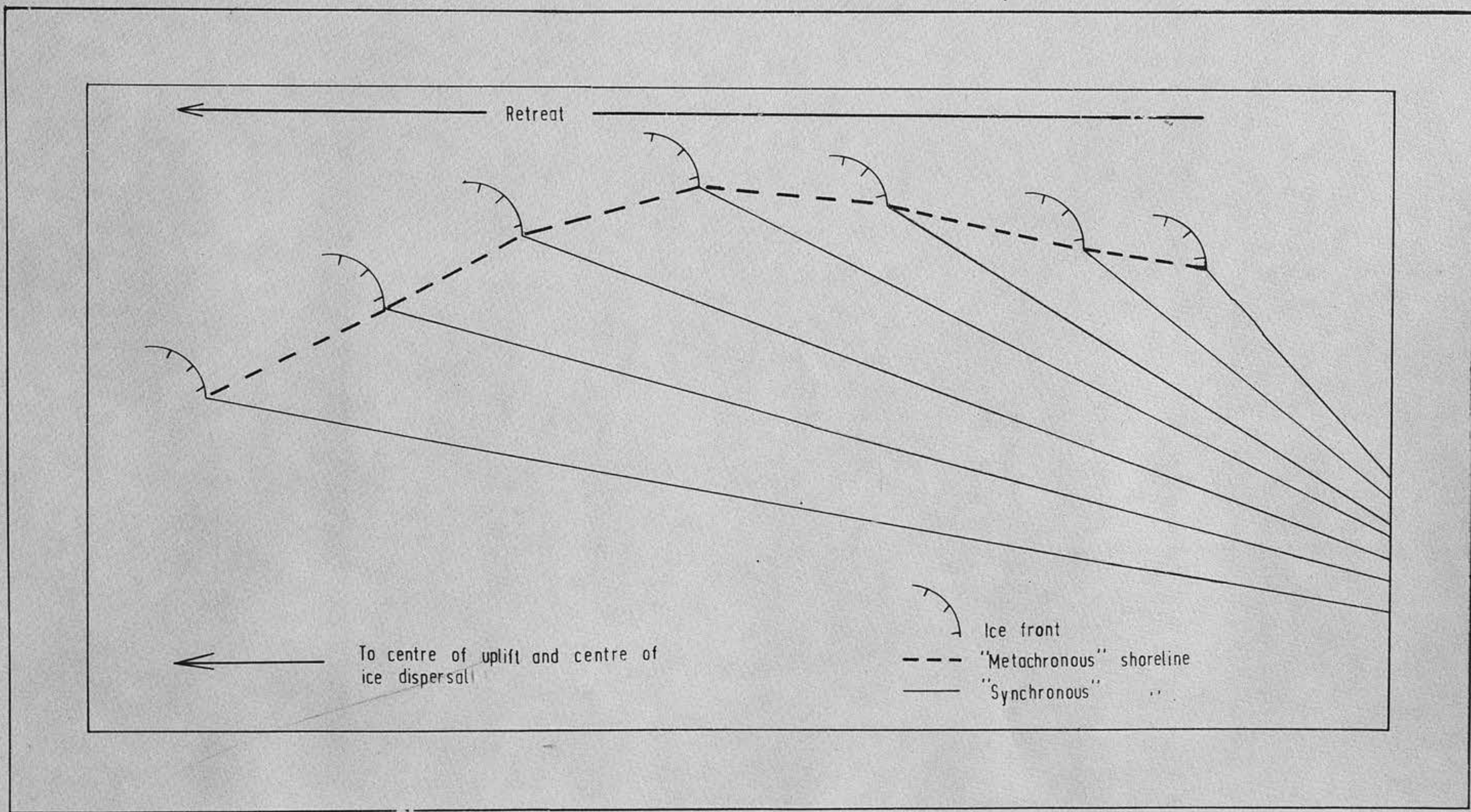


FIGURE 67 Metachronous shorelines ad deduced from the successive positions of the highest marine limit.

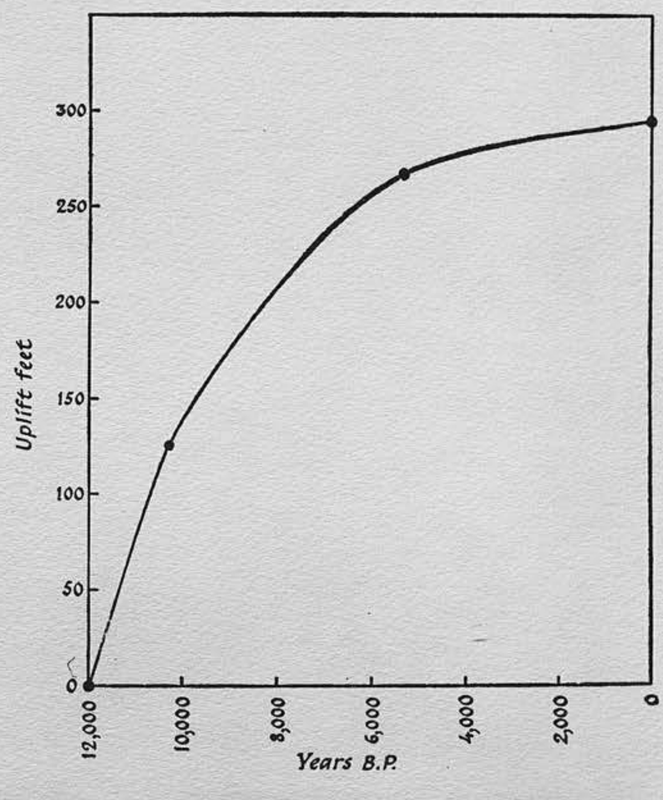


FIGURE 68 Isostatic uplift at Stirling since 12,000 B.P. according to Sissons (1962).

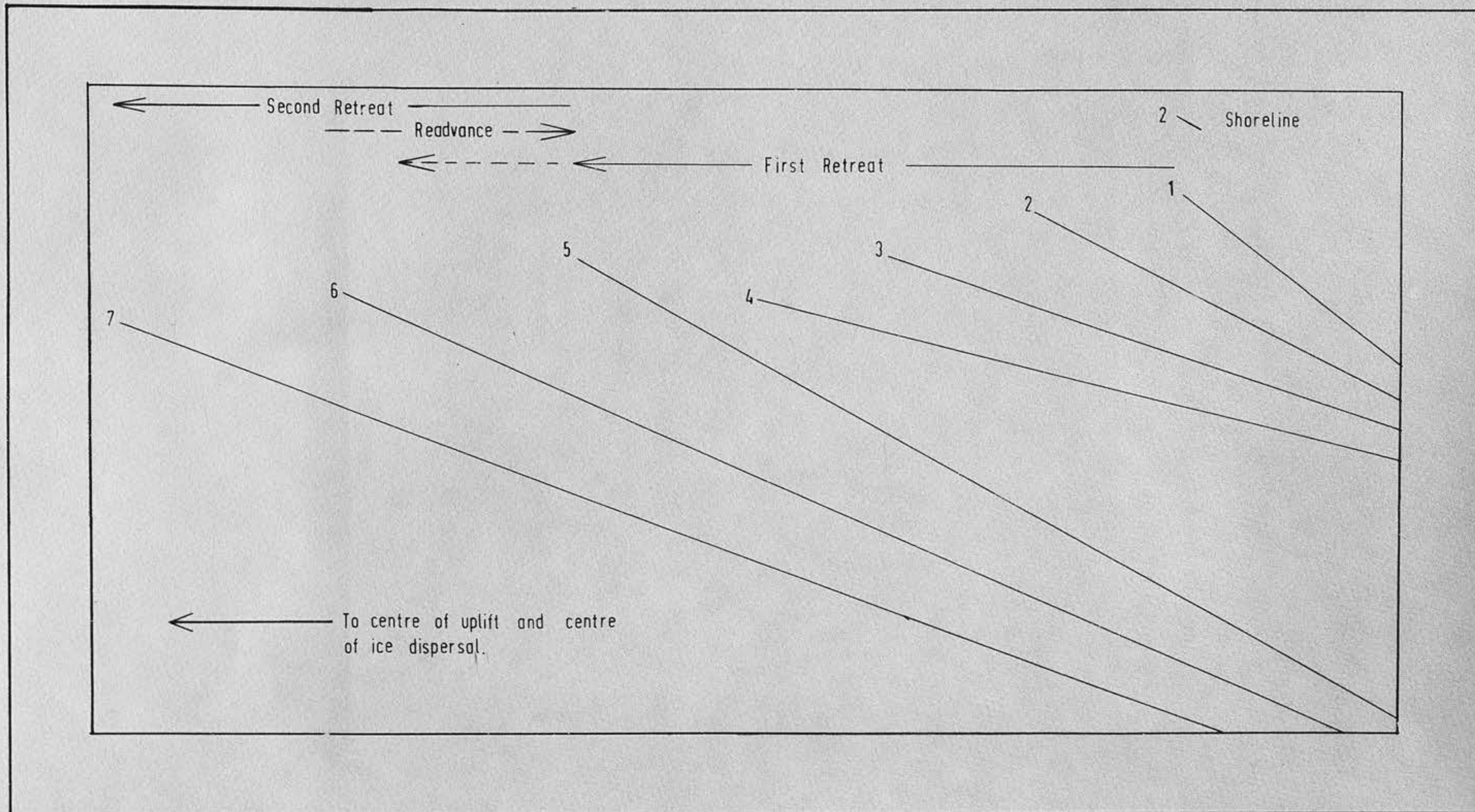


FIGURE 69 Interruption of the shoreline pattern caused by a readvance.

of a shoreline, however, is not solely due to the uplift which took place during its formation but is also a product of the uplift which has taken place since.

c. Application of the Isokinetic Theory to the Displaced Shorelines in the Area under Study

Figure 70 shows the most likely regression lines, representing the most likely shorelines, taken from Figure 57. There are eight probable and four possible shorelines. For this discussion they are divided into two groups;

(i) The East Fife Late-glacial Shorelines.

The pattern of the shorelines LG 1 - 6 matches very well with what might be expected. Ice retreat appears to have been continuous during the formation of the shorelines, and accordingly the lower (and the more recent), the shoreline, the further it extends westward. (Except in the case of LG 6, which is the least convincing shoreline). In agreement with this, there is no indication of an irregular uplift, and each shoreline is more gently inclined than the one above it.

In the light of the previous discussion on theory, it may be that the poor development of LG 3 - 6 is due to one of two causes:

(a) The shoreline was never developed continuously because land and sea were only in equilibrium at a few places along the coast.

(b) Sea level and land movement were only in equilibrium for a relatively short time, which was insufficient for

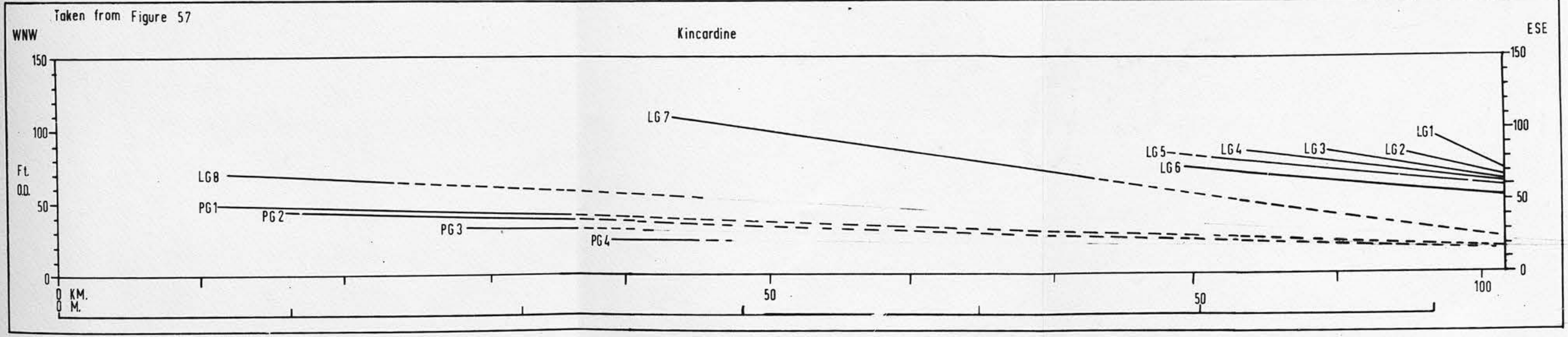


FIGURE 70 Regression lines for late-and post-glacial shorelines on the northern side of the Forth valley and estuary (WNW-ESE axis).

the formation of a well marked shoreline, and terraces were formed only where large amounts of constructional material were available, such as near the mouths of rivers or near an ice front.

In addition it could simply be that

(c) Subsequent erosion has destroyed much of the shorelines. From the observed nature of isostatic uplift in other regions it is considered unlikely that condition (a) could apply, since the length of coastline is probably too small for the necessary variations is isostatic movement. The issue therefore lies between conditions (b) and (c). In support of (b) it may be recalled that several well marked shoreline remnants occur near the former ice fronts at Leven and Largo; on the other hand well developed features occur in a locality near Fife Ness where there is no obvious source of supply, but where some protection is afforded from wave attack. On balance it would therefore appear that a combination of (b) and (c) is the most likely explanation of the fragmentary shorelines LG 3 - 6.

The alternative shoreline pattern proposed, LG 3a - 6a is not in sympathy with the probable nature of isostatic uplift in the area. The "shorelines" do not decrease in inclination downwards, and LG 3a is more steeply inclined than 2, while LG 4a is steeper than 3a. No evidence has been found for glacial readvances which could cause a fluctuation in the pattern of isostatic recovery such as the "shorelines" suggest.

(ii) <u>The Perth Readvance Shorelines</u>

Shoreline LG 7 is the best developed in the area under study. It also shows a remarkable change in the pattern of shoreline inclinations, for though it was formed later, it is more steeply inclined than LG 3 - 6, so that these shorelines are depressed relative to LG 7 This suggests that before or during its formation, the land was depressed. Since this shoreline is contemporaneous with a retreat stage of the Perth Readvance, it is believed that the extra weight of ice of the readvance occasioned the exceptional tilting of the shoreline.

Shoreline LG 8 may be explained by three conditions. It could be a result of either of conditions (b) and (c) quoted in connection with the East Fife shorelines, or it could be a metachronous shoreline of Scandinavian terminology, being composed of successive marine limits in front of a retreating glacier. A combination of conditions (b) and (c) is favoured because the inclination of the shoreline is less than LG 7 and more than the post-glacial shorelines, in accordance with the general pattern of decreasing slope. Moreover, there is little evidence in the area of a successively retreating ice front.

(iii) <u>The Post-Glacial Shorelines</u>

These show the same decreasing slope that has been evidenced above, but although being the more recently formed features, give no hint of a wave-like progress of uplift. No suggestion is given of any retarding effect on isostatic recovery such as may have been caused by the Loch Lomond Readvance.

(iv) The Pattern of Isostatic Movement

It has been assumed, following investigations elsewhere, that the end product of isostatic uplift is a dome-like feature. How this is achieved is a matter of speculation. In the Forth area the evidence provides some suggestions.

During the formation of the East Fife shorelines, ice lay over the area to the westward. It might appear that in such a situation, areas relieved of their ice burden would rise initially faster than areas still covered by ice and that consequently a peripheral uplift would take place. The shoreline pattern allows of no such explanation, however. Consider the inclination of the shorelines at the end of the formation of LG 6 (see Fig. 71). The western ends are uplifted more than the eastern, and it appears that uplift in the west is greater. Such a pattern can be brought about only in the case of uplift in the west always having been predominant.

For similar reasons the main Perth Readvance shoreline, LG 7, cannot have owed its formation to any condition involving peripheral uplift. Its relationship to shorelines LG 3 - 6 shows that whether it was formed during a period of subsidence or a period of upheaval, relative uplift at its western end was greatest.

L. G. 8 and the post glacial shorelines also indicate an area of maximum uplift in the west during their formation.

Within this pattern there is a certain trend apparent. If the shorelines are projected eastward it will be seen that within the

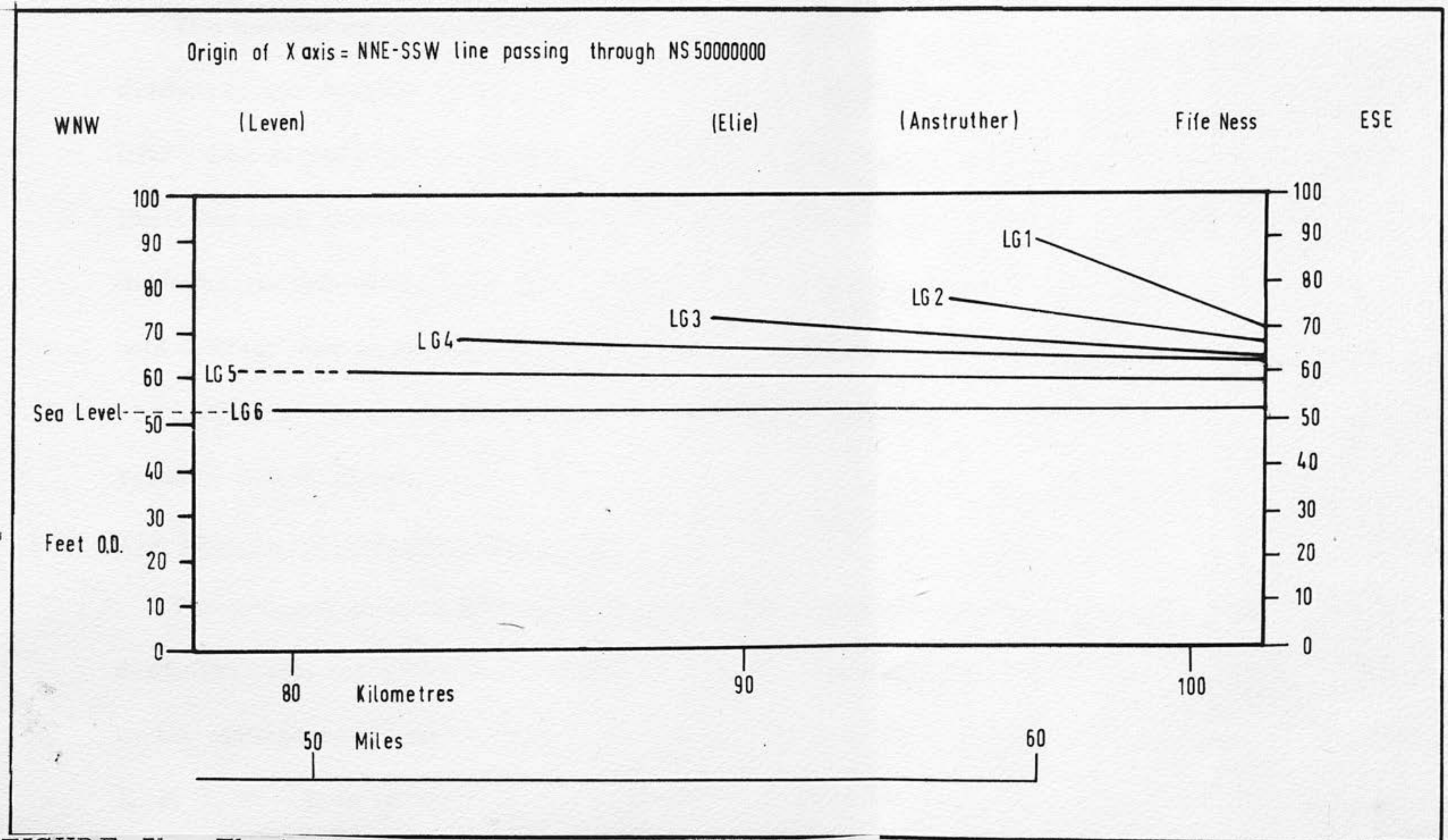


FIGURE 71 The inclination of the supposed east Fife late-glacial shorelines on the formation of LG6.

two groups, LG 1 - 6 and LG 7 - PG 4, the lower the shoreline the further east it intersects a common base line (see Fig. 72) This indicates that the area of isostatic uplift is increasing. Hence the dome is expanding.

(v) <u>The Pattern of Eustatic Movement</u>

The movement of world sea level, as revealed by the Forth evidence, can only be known in terms relative to the isostatic uplift. The picture can be gained from a study of the highest marine limit for each shoreline (see Fig. 73). This indicates that during the construction of the East Fife shorelines, relative sea level was falling; but an important relative rise of sea level took place at the time of the Perth Readvance. Thereafter a continuous relative fall is shown.

(vi) <u>The Pattern of Isokinetic Movement</u>

The general pattern of isokinetic movement, continuous though declining, and not given to many fluctuations, is strongly supported by the straightness and continuity of shorelines LG 1, 2, 7 and PG 1, 2, 3, 4. It is unlikely that there could have been several halts in the process of uplift. This throws doubt upon the stable land-stable sea condition. In addition, since the principal tendency of both land and sea during the late and post-glacial periods was to rise, it is unlikely that conditions involving subsidence of land or sea would obtain, except in the case of LG 7. Instead it is much more likely that during the formation of most shorelines the land at least was being uplifted.

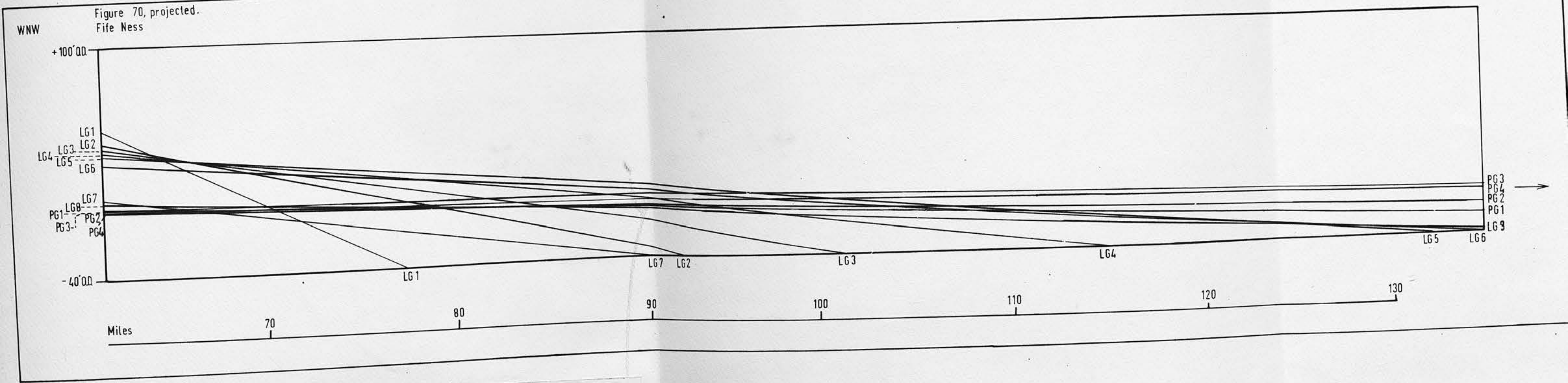


FIGURE 72 All shoreline regression lines, projected to common base level.

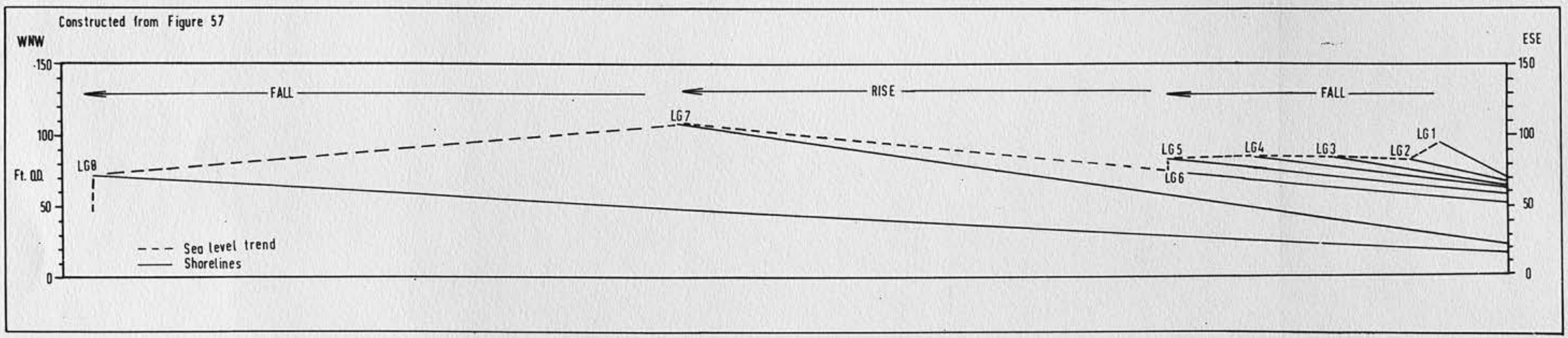


FIGURE 73 Relative sea level change during the late-glacial period on the northern side of the Forth valley and estuary.

A study of the Forth shorelines indicates that during this condition shorelines could have been formed during any of the following conditions:

1. Steady rise of the land, decelerating rise of the sea.
2. Accelerating rise of the land, accelerating rise of the sea.
3. Decelerating rise of the land, decelerating rise of the sea.
4. Steady rise of the land and steady rise of the sea.

But in practice it is not possible to distinguish between the various types of movement, and the conditions involving equal land and sea uplift (2, 3, 4), seem as favourable as the other. This can be shown in the following way. The area under study embraces only a small portion of the isostatically affected area. This is indicated by the fact that if the two lowest post glacial shorelines are projected eastwards, the upper line does not cross the lower until a point 183 miles east of Stirling (Fig. 74). Actually, since the surface is domed, the crossing point would probably lie somewhat nearer Stirling, but still a considerable distance to the east. For, since the shorelines are so straight on the graphs, the radius of curvature of the uplifted dome is probably very great. In consequence the difference in rate of uplift between two places 60 miles apart is probably quite small. Hence conditions involving a similar rise of both sea and land at one point could well produce a shoreline at least 60 miles long.

(vii) Other Forms of Land Movement

The evidence does not suggest any other forms of land movement,

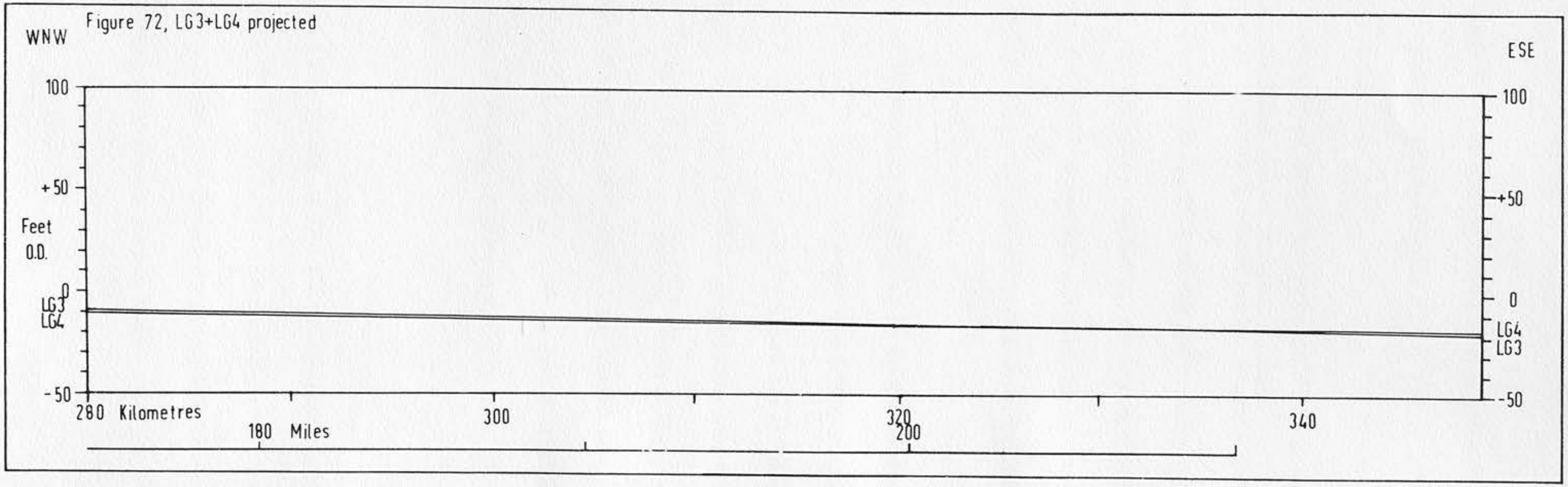


FIGURE 74 Eastward projection of the regression lines for PG3 and PG4.

though such forms as suggested by Barrel (1915) and Hallam (1963) (see Chapter X), cannot be ruled out.

(viii) Uncorrelated Terraces

Several isolated terraces have not been accounted for, and yet would appear to be marine. They are marked on Figure 57. Those at Stirling (a), Alloa (b and c), Kirkcaldy (d and e) and Kincardine (g) may possibly be explained as terraces formed because large amounts of detrital material were distributed in sheltered places during a falling sea level. It is noticeable that except for one Kirkcaldy feature (d, near Aberdour), which is the smallest, all these are located near former ice fronts or near the ends of proglacial meltwater channels. The terraces h - l have already been discussed. They are in subsidence areas and their heights may be somewhat distorted. Probably they represent one or more post-glacial sea levels. Terraces (m) and (n), near Elie, are both somewhat doubtful features; n is affected by blown sand and m, near Newark Castle, may be artificial. O is the doubtful feature at Leven, where the forming of playing fields has probably altered the ground surface.

(ix) Conclusions

The shorelines in this area north of the Forth do not represent all the shore features formed during late- and post-glacial time in the area. Many were undoubtedly formed during the low sea levels associated with late-glacial readvances and if these remain they are now covered by more recent deposits of the present sea level. Some ephemeral features have undoubtedly suffered elimination by subaerial erosion. On the evidence of the shorelines above sea level that have been preserved, the following main conclusions have been reached:

(a) Isostatic uplift took place during late- and post-glacial times in the area north of the Forth.

(b) This uplift took the form of an expanding dome.

(c) Shorelines were formed at the margin of the retreating ice sheet and after the final retreat, and were formed because land and sea movements were occasionally in a state of near equilibrium - the isokinetic theory.

(d) The Perth Readvance was a sufficiently major event to have caused a temporary depression of the land.

3. THE SEQUENCE OF FORMATION OF DISPLACED SHORELINES ON THE NORTHERN SIDE OF THE FORTH VALLEY AND ESTUARY

The retreat of the last ice sheet to cover the Forth area imposed a heavy burden on the earth's crust there, and it reacted by subsiding. During the retreat of the ice sheet extensive down-wasting took place, so that the ice sheet became very much thinner. The result was that isostatic recovery of the crust probably began before the land had been fully relieved of its ice cover. When the land was uncovered the sea level stood relatively higher than today, and under the conditions then prevailing, was very variable. The land was rising at a steady rate, however, and occasionally the movements of land and sea were in equilibrium. Since at that time there was a considerable amount of glacial detrital material available, shoreline terraces were probably formed in a shorter period of time than would take now. In this way two (LG 1, 2) and possibly six (LG 1 - 6) shorelines were formed outside the margin of the retreating ice sheet.

After a considerable retreat there occurred a major readvance. This interrupted the isostatic recovery by causing temporary subsidence. During the ensuing retreat, one major shoreline (LG 7) and possibly another (LG 8) were formed.

Since there is no clear record of shorelines contemporaneous with the second late-glacial readvance in the area (the Loch Lomond Re-advance) it is not known whether this had a similar effect on the area to its predecessor. There is no evidence of such an effect in the post-glacial shorelines (PG 1 - 4), which indicate continuous uplift. Below the lowest post-glacial shoreline, PG 4, there is some evidence for a shoreline at 13 - 20 feet O.D., but it is very fragmentary and most of the areas are badly affected by coal mining subsidence.

CHAPTER XII

CONCLUSION

The generally accepted patterns of raised shorelines on the northern side of the Forth valley and estuary are substantially in error. This investigation has shown that a radically different pattern of raised shorelines exists in the area, and that from this pattern and the associated glacial features there may be interpreted the following general sequence of events:

1. During the Würm period, the Forth area was covered by a great ice sheet which depressed the crust of the earth beneath it. As the ice sheet began to retreat, and as the load decreased, the crust reacted by trying to maintain isostatic equilibrium, thus rising. During the retreat large quantities of water, which had been abstracted from the oceans during the build-up of this and other contemporary ice sheets, were returned to the oceans and world sea level rose. Thus by the time the Forth area began to be released from the ice and the sea was able to gain access, both isostatic and eustatic rise were in progress. This resulted in the formation of several displaced shorelines, which mark periods when isostatic and eustatic movement were in equilibrium.

2. Two (LG1-2) and probably four other (LG3-6) displaced shorelines were formed during this early period while the ice probably retreated without major interruption from Fife Ness to Leven. Each shoreline slopes down towards the east, demonstrating that maximum isostatic uplift lay in the west, and each shoreline is less steeply sloping than the one above it, suggesting regular uplift.

3. The six displaced shorelines are as follows:

LG1 is the best developed. It slopes eastwards from a height of 90-92 feet O. D. at Anstruther to 75-78 feet O. D. at Fife Ness. It is associated with a prolonged halt of the retreating ice near the site of Anstruther.

LG2 is also well formed. It achieves 81-83 feet O. D. near Pittenweem, and slopes down to 68-69 feet O. D. at Fife Ness. It displays no definite association with a former ice front, but there are instances of parts having been formed in association with dead ice.

LG3 is less clear, but has been defined as sloping eastwards from a maximum of 81-84 feet O. D. near Elie to a low of 64-65 feet O. D. near Fife Ness. There is evidence that certain fragments were formed alongside masses of dead ice.

LG4 is better defined, sloping eastward from 82-84 feet O. D. near Lower Largo down to 72-73 feet O. D. near Pittenweem. It appears to have been formed while the ice front lay in the vicinity of the site of Lower Largo. The highest Kincraig rock bench (80 feet O. D.) was probably formed by the sea of this level.

LG5 is better developed than either of its two predecessors, and slopes from 77-81 feet O. D. near Leven down to 60-61 feet O. D. at Fife Ness. The second Kincraig rock bench (70 feet O. D.) appears to be a part of this level. The ice front associated with this shoreline lay near the site of Leven.

LG6 is least well developed, since its fragments are well scattered. It appears to slope from 72-73 feet O. D. at Leven, where it is associated with a large dead-ice hollow, to 53-56 feet O. D. at Fife Ness.

The pattern of the above shorelines suggests that during this stage isostatic movement was in the form of an expanding dome.

5. The subsequent retreat of the ice is less well documented by the field evidence, and likewise there is little record of local sea level movement. After a retreat of an unknown, but probably not inconsiderable, distance, a major readvance occurred, correlated with the Perth Readvance. A well marked shoreline, LG7, was formed while the ice lay very near the maximum of the readvance, and it would appear that this shoreline represents a transgression. It runs from 106-108 feet O.D. at Kincardine to 66-68 feet O.D. at Burntisland, and a projection of the line of slope eastwards suggests that the 37-38 feet O.D. Kincraig rock bench is a part of this feature. Apart from the carse, this shoreline is the best marked shoreline in the area investigated. Its inclination is steeper than that of LG 4-6 when these are plotted on a line through the most probable direction of maximum displacement, WNW-ESE. This interruption in the shoreline pattern suggests that the weight of the ice of the Perth Readvance caused a temporary renewed depression of the crust.

6. During further retreat of the Perth Readvance ice, a shoreline seems to have been formed at least west of Stirling, sloping eastwards from 68-69 feet O.D. at Wester Borland, near Thornhill, to 64-65 feet O.D. at Burnbank. This has been called LG8.

7. Some time afterwards, during Zone III of the pollen sequence, or 10,800-10,300 B.P., another major readvance occurred, the Loch Lomond Readvance. In the area investigated it was associated with a low sea level, but subsequently, a transgression laid down a deposit of fine grey sand

over the outwash gravels. The surface of this deposit slopes down towards the east. Sea level fell, and peat grew on the surface of this marine deposit. Peat in a similar situation in the Forth valley has been Carbon 14 dated at 8421±157 B.P.

8. Sea level rose, and submerged the peat, excepting a small island of peat on the site of Flanders Moss. The carse clays were deposited during this transgression, their altitude reflecting at least four sea levels, and showing that isostatic rise was still in progress.

   PG1 slopes from 47-48 feet O.D. at Tarr down to 40-41 feet O.D. near Tullibody.

   PG2 slopes from 42-43 feet O.D. near Ballinton down to 38-39 feet O.D. by Menstrie.

   PG3 slopes from 31-32 feet O.D. near Bridge of Allan down to 29-30 feet O.D. at Cambus.

   PG4 slopes from 23-24 feet O.D. at Alloa down to 22-23 feet O.D. at Kincardine.

   Each slopes less steeply than the one above it, suggesting no interruption in the rate of isostatic recovery. Remnants of these shorelines occur eastwards in the estuary, but it has not been possible to make definite correlations. A Carbon 14 date of 5492±130 B.P. from the base of a peat moss lying on the carse of PG1 shows that this shoreline at least was formed by that date.

9. The shorelines defined after LG7 suggest that the movement of an expanding isostatic dome was renewed after the Perth Readvance.

APPENDIX I

A NOTE ON CARBON 14 DATINGS

In order to compare accurately the Carbon 14 dates quoted in this work, the following points should be noted:

1. All Carbon 14 dates published prior to 1962 are based on a half-life of Carbon 14 of 5568±30 B. P. All B. P. dates quoted may have either 1960 or the year of publication as present.
2. All Carbon 14 dates published since 1962 are based on a half-life of Carbon 14 of 5570±30 B. P. All B. P. dates quoted are pre-1950.

(Radiocarbon, 1962)

APPENDIX II.

BOREHOLES.

Note: Figures given opposite the description of the deposit indicate the depth below which that deposit occurs. 0 = levelled height.

BH.1. NS.5686.9791.
Not levelled.

	cm.
2. Peat.	0.
1. Gravel.	100.

BH.2. NN.6038.0013.
48.2. ft. O.D. 14.69. M.O.D.

	cm.
2. Carse.	0.
1. Medium Grey sand, and fine gravel.	140.
Max.	150.

BH.3. NN.6041.0010.
47.7. ft. O.D. 14.54. M.O.D.

	cm.
3. Carse.	0.
2. Fine grey sand	142.
1. Reddish gravel.	155.
max.	165.

BH.4. NN.6050.0018.
47.5. ft. O.D. 14.48. M.O.D.

	cm.
4. Carse.	0.
3. Peat.	221.
2. Fine grey sand	239.
1. Gravel and sand.	257.
max.	261.

BH.5. NN.6059.0021.
48.6. ft. O.D. 14.81. M.O.D.

	cm.
3. Peat.	0.
2. Carse.	50.
1. Gravel.	360.
max.	371.

BH.6. NN.6071.0026.
48.1. ft. O.D. 14.66. M.O.D.

	cm.
7. Peat.	0.
6. Carse.	30.
5. Transition.	288.
4. Peat.	291.
3. Transition.	296.
2. Fine grey sand.	301.
1. Gravel.	332.
max.	334.

BH.7. NN.6123.0045.
47.8. ft. O.D. 14.57. M.O.D.

	cm.
4. Peat.	0.
3. Carse.	23.
2. Peat.	300.
1. Fine grey sand.	326.
max.	420.

BH.8. NN.6169.0043.
47.8. ft. O.D. 14.57. M.O.D.

	cm.
3. Carse.	0.
2. Peat.	330.
1. Fine grey sand.	355.
max.	366.

BH.9. NN.6239.0022.
46.3. ft. O.D. 14.11. M.O.D.

	cm.
4. Carse.	0.
3. Sleech.	116.
2. Peat.	337.
1. Fine grey sand.	355.
max.	400.

BH.10. NS.6061.9867.
Not levelled.

	cm.
10. Sphagnum peat.	0.
9. Marshy peat-more compressed.	166.
8. Soft pinkish clay. No. veg.	202.
7. Greyish clay with plant, remains.	213.
6. Marshy peat.	221.
5. Transition.	343.
4. Soft grey clay.	349.
3. Grey-pink clay.	378.
2. Pink clay.	388.
1. Pink silt with stones.	400.
Max.	418.

BH.11. NS.6526.0007.
48.9. ft. O.D. 14.90. M.O.D.

	cm.
2. Peat.	0.
1. Grey gravel.	120.
Max.	130.

BH.12. NS.6524.0004.
47.9. ft. O.D. 14.60. M.O.D.

	cm.
2. Peat.	0.
1. Tough reddish clay.	160.
Max.	200.

BH.13. NS.6523.0000.
45.2. ft. O.D. 13.78. M.O.D.

	cm.
2. Peat.	0.
1. Gravel.	130.
Max.	166.

BH.14. NS.6518.9997.
46.7. ft. O.D. 14.23. M.O.D.

	cm.
4. Carse.	0.
3. Peat.	85.
2. Fine grey sand.	112.
1. Pinkish silt.	157.
Max.	184.

BH.15. NS.6512.9949.
45.1. ft. O.D. 13.75. M.O.D.

	cm.
4. Grey-brown carse.	0.
3. Sleech, laminations.	133.
2. Coarse sand.	572.
1. Gravel.	587.
Max.	604.

BH.16. NS.6512.9910.
44.3. ft. O.D. 13.50. M.O.D.

	cm.
5. Grey-brown carse.	0.
4. Sleech, some veg.	150.
3. Peat.	289.
2. Transition.	402.
1. Fine grey sand.	421.
Max.	489.

BH.17. NS.6514.9855.
58.8. ft. O.D. 17.92. M.O.D.

	cm.
5. Peat.	0.
4. Grey clay silt.	411.
3. Transition.	709.
2. Peat.	728.
1. Fine grey sand.	809.
Max.	833.

BH.18. NS.6512.9761.
44.8. ft. O.D. 13.66. M.O.D.

	cm.
6. Grey-brown carse.	0.
5. Sleech, laminations,	133
4. shell fragments.	433.
3. Peat.	538.
2. Transition.	551.
1. Fine grey sand.	566.
Max.	600

BH.19. NS.6514.9698.
43.3. ft. O.D. 12.20. M.O.D.

	cm.
2. Carse.	0.
1. Sleech, shell, fragments.	133.
Max.	766.

BH.20. NS.6488.9904.
43.0. ft. O.D. 13.11. M.O.D.

	cm.
3. Carse. and sleech.	0.
2. Transition.	235.
1. Peat.	246.
Max.	300.

BH.21. NS.6480.9903.
42.3. ft. O.D. 12.89. M.O.D.

	cm.
3. Carse and sleech.	0.
2. Transition.	186.
1. Peat.	197.
Max.	233.

BH.22. NS.6478.9903.
42.0. ft. O.D. 12.80. M.O.D.

	cm.
3. Carse and sleech.	0.
2. Transition.	174.
1. Peat.	190.

BH.23. NS.6473.9903.
41.9. ft. O.D. 12.77. M.O.D.

	cm.
3. Carse and sleech.	0.
2. Transition.	138.
1. Peat.	158.
Max.	200.

BH.24. NS.6472.9903.
42.1. ft. O.D. 12.83 M.O.D.

	cm.
5. Peat.	0.
4. Transition.	73.
3. Carse and sleech.	76.
2. Transition.	147.
1. Peat.	156.
Max.	200.

BH.25. NS.6471.9903.
42.6. ft. O.D. 12.98. O.D.

	cm.
4. Peat.	0.
3. Sleech.	138.
2. Transition.	193.
1. Peat.	211.
Max.	233.

BH.26. NS.6470.9903.
42.6. ft. O.D. 12.98. M.O.D.

	cm.
3. Peat.	0.
2. Sleech.	153.
1. Peat.	189.
Max.	233.

BH.27. NS.6468. 9904.
43.7. ft. O.D. 13.32 M.O.D.

	CM.
4. Peat.	0.
3. Peat and carse.	133.
2. Peat.	179.
1. Fine blue grey sand.	341.
Max.	366.

BH.28. NS.6456.9903.
52.7. ft. O.D. 16.06. M.O.D.

	cm.
2. Peat.	0.
1. Fine blue-grey sand.	618.
Max.	806.

BH.29. NS.6440.9904.
54.6. ft. O.D. 16.64. M.O.D.

	cm.
2. Peat.	0.
1. Fine blue-grey sand.	711.
Max.	733.

BH.30. NS.6588.98D4.
Not levelled.

	Cm.
2 Peat.	0.
1. Carse.	73.
Max.	200.

BH.31. NS.7188.9841.
42.2. ft. O.D. 12.86. M.O.D.

	cm.
6. Grey-brown carse.	0.
5. Sleech.	105.
4. Transition.	222.
3. Peat.	235.
2. Transition.	273.
1. Fine grey sand.	277.
Max.	360.

BH.32. NS.7188.9783.
40.8. ft. O.D. 12.44. M.O.D.

	cm.
3. Grey-brown carse.	0.
2. Sleech, pieces of veg.	166.
1. Fine grey sand	379.
Max.	382.

BH.33. NS.7180.9716.
39.1. ft. O.D. 11.92. M.O.D.

	cm.
3. Grey-brown carse	0.
2. Sleech, laminations.	166.
1. Gravel.	630.
Max.	633.

BH.34. NS.7174.9651.
38.6. ft. O.D. 11.77. M.O.D.

	cm.
3. Grey-brown carse.	
2. Sleech.	133-166.
1. Coarse sand.	561.
Max.	566.

BH.35. NS.7164.9590.
34.5. ft. O.D. 10.52. M.O.D.

	cm.
2. Grey-brown carse.	0.
1. Sleech, laminations, coarser with depth.	174
Max.	700.

BH.36. NS.7154.9530.
34.5. ft. O.D. 10.52. M.O.D.

	cm.
2. Grey-brown carse.	0.
1. Sleech.	200.
Max.	533.

BH.37. NS.7284.9843.
Not levelled.

	cm.
2. Carse.	0.
1. Gravel.	155.
Max.	

BH.38. NS.7318.9822.
Not levelled.

	cm.
2. Carse, some stones.	0.
1. Gravel.	90.

BH.39. NS.7327.9821.
40.7. ft. O.D. 12.41. M.O.D.

	cm.
2. Carse.	0.
1. Gravel.	110.

BH.40. NS.7337.9816.
40.4 ft. O.D. 12.31. M.O.D.

	cm.
2. Carse.	0.
1. Gravel.	110.

BH.41. NS.7386.9691.
Not levelled.

	cm.
3. Peat.	0.
2. Transition.	166.
1. Carse.	174.
Max.	600.

BH.42. NS.7770.9803.
35.1. ft. O.D. 10.70. M.O.D.

	cm.
5. Carse.	0.
4. Sleech, shells.	145.
3. Peat and sleech.	336.
2. Fine grey sand	493.
1. Red clay, stones.	500.
Max.	502.

BH.43. NS.7770.9740.
32.4 ft. O.D. 988. M.O.D.

	cm.
2. Carse.	0.
1. Sleech.	200.
Max.	500.

BH.44. NS.7767.9684.
32.2 ft. O.D. 9.81 M.O.D.

	cm.
2. Carse.	0.
1. Sleech, becoming coarser with depth.	98.
Max.	533.

BH.45. NS.7768.9640.
32.0. ft. O.D. 9.75 M.O.D.

	cm.
2. Carse.	0.
1. Sleech, lenses of sand.	168.
max.	533.

BH.46. NS.7762.9584.
28.4. ft. O.D. 8.65 M.O.D.

	cm.
3. Grey-brown carse.	0.
2. Light grey sleech.	100.
1. Gravel.	402.
Max.	417.

BH.47. NS.8033.9600.
31.0. ft. O.D. 9.45. M.O.D.

	cm.
3. Grey-brown carse.	0.
2. Sleech, shells.	140.
1. Gravel.	232.
Max.	235.

BH.48. NS.8032.9594.
32.5 ft. O.D. 9.91. M.O.D.

	cm.
2. Brown carse.	0.
1. Gravel.	221.
Max.	221.

BH.49. NS.8151.9581.
41.5. ft. O.D. 12.65. M.O.D.

	cm.
3. Carse.	0.
2. Peat.	192.
1. Red clay and stones.	252.
Max.	290.

BH.50. NS.8153.9590.
41.0. ft. O.D. 12.50. M.O.D.

	cm.
3. Carse.	0.
2. Peat.	228.
1. Gravel.	247.
Max.	270

BH.51. NS.8382.9679.
36.4. ft. O.D. 11.09. M.O.D.

	cm.
4. Brown carse.	0.
3. Sleech.	191.
2. Peat.	228.
1. Pink clay-silt.	238.
Max.	266.

BH.52. NS.8380.9630.
37.9. ft. O.D. 11.55. M.O.D.

	cm.
5. Brown carse.	0.
4. Sleech.	187.
3. Peat.	416.
2. Fine blue-grey sand.	435.
1. Pink clay-silt.	455.
Max.	455.

BH.53. NS.8384.9584.
31.0. ft. O.D. 9.45. M.O.D.

	cm.
2. Carse.	0.
1. Sleech. some vegetation	190.
Max.	208.

BH.54. NS.8390.9534.
24.8. ft. O.D. 7.56. M.O.D.

	cm.
3. Brown carse.	0.
2. Sleech, some shells	175.
1. Gravel.	430.
Max.	445.

BH.55. NS.8394.9469.
21.9. ft. O.D. 6.68. M.O.D.

	cm.
2. Carse. Brown-grey.	0.
1. Sleech, coarser with depth.	200.
Max.	450.

BH.56. NS.8390.9424.
22.2. ft. O.D. 6.77. M.O.D.

	cm.
2. Grey-brown carse.	0.
1. Sleech, with shells, coarser with depth.	197.

Max. 580.

BH.57. NS.8394.9370.
19.2. ft. O.D. 5.85. M.O.D.

	cm.
2. Grey-brown carse.	0.
1. Sleech, coarser with depth.	194.
Max.	666.

BH.58. NS.9053.9135.
17.0. ft. O.D. 5.18. M.O.D.

	cm.
5. Brown-grey carse.	0.
4. Bed of shells.	180.
3. Sleech.	215.
2. Fine grey sand.	261.
1. Bedrock?	300.

BH.59. NS.9049.9100.
11.3. ft. O.D. 3.44. M.O.D.

	cm.
2. Brown-grey carse.	0.
1. Sleech, silty.	177.
Max.	274.

BH.60. NS.9040.9031.
7.3. ft. O.D. 2.23. M.O.D.

	cm.
2. Brown-grey carse.	0.
1. Sleech, laminations.	169.
Max.	500.

BH.61. NS.9045.8986.
3.5. ft. O.D. 1.07. M.O.D.

	cm.
2. Grey carse.	0.
1. Sleech, shell fragments.	100.
Max.	421.

Note: Sampling not continuous in BH 2-9, 27-29, and 30.

APPENDIX III.

LEVELLED HEIGHTS.

Reference No:	Height O.D. Feet.	Height O.D. Metres.	Closing Error. Ft.	Grid. Reference.
S.1.	72.0.	21.96.	-0.67 Corrected	NN.7258.0034.
S.2.	70.9.	21.62.	"	NN.7269.0022.
S.3.	67.8.	20.66.	"	NN.7276.0012.
S.4.	70.5.	21.47.	"	NN.7283.0006.
S.5.	66.1.	20.14.	"	NN.7290.0003.
S.6.	64.7.	19.72.	"	NS.7300.9998.
S.7.	63.8.	19.44.	"	NS.7305.9994.
S.8.	61.6.	18.78.	"	NS.7310.9989.
S.9.	61.3.	18.67.	"	NS.7313.9982.
S.10.	31.5.	9.59.	0.00.	NS.8376.9589.
S.11.	31.6.	9.62.	"	NS.8368.9589.
S.12.	30.2.	9.20.	"	NS.8391.9589.
S.13.	30.5.	9.28.	"	NS.8404.9589.
S.14.	31.0.	9.45.	"	NS.8383.9587.
S.15.	86.5.	26.36.	+1.14 Corr.	NN.6247.0076.
S.16.	86.7.	26.44.	"	NN.6246.0073.
S.17.	86.8.	26.47.	"	NN.6244.0072.
S.18.	86.3.	26.31.	"	NN.6242.0071.
S.19.	87.1.	26.55.	"	NN.6241.0068.
S.20.	48.0.	14.65.	"	NN.6277.0063.
S.21.	47.7.	14.52.	"	NN.6283.0066.
S.22.	47.8.	14.56.	"	NN.6287.0066.
S.23.	47.7.	14.54.	"	NN.6292.0063.
S.24.	47.5.	14.47.	"	NN.6300.0062.
S.25.	67.7.	20.63.	-0.38 Corr.	NN.6506.0038.
S.26.	67.4.	20.55.	"	NN.6510.0035.
S.27.	65.8.	20.06.	"	NN.6516.0032.
S.28.	67.9.	20.69.	"	NN.6521.0029.
S.29.	67.7.	20.63.	"	NN.6530.0023.
S.30.	47.3.	14.42.	"	NN.6537.0004.
S.31.	48.2.	14.69.	"	NN.6532.0007.
S.32.	47.1.	14.34.	"	NN.6549.0001.
S.33.	46.0.	14.02.	"	NS.6556.9994.
S.34.	46.0.	14.03.	"	NS.6561.9986.
S.35.	45.4.	13.84.	"	NS.6576.9973.
S.36.	45.9.	14.00.	"	NS.6606.9960.
S.37.	45.8.	13.97.	"	NS.6613.9957.
S.38.	45.7.	13.94.	"	NS.6640.9950.
S.39.	45.8.	13.96.	"	NS.6648.9948.
S.40.	45.8.	13.95.	"	NS.6653.9945.
S.41.	45.6.	13.90.	"	NS.6658.9940.
S.42.	45.7.	13.92.	"	NS.6630.9953.
S.43.	41.5.	12.65.	0.00	NS.6863.9797.
S.44.	41.4.	12.61.	"	NS.6858.9796.
S.45.	41.4.	12.63.	"	NS.68469793.
S.46.	40.3.	12.29.	"	NS.6878.9797.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
S.47.	41.9.	12.77.	"	NS.6881.9796.
S.48.	41.9.	12.77.	"	NS.6885.9796.
S.49.	40.8.	12.44.	"	NS.6890.9795,
S.50.	41.7.	12.70.	"	NS.6893.9795.
S.51.	41.8.	12.73.	"	NS.6901.9798.
S.52.	42.0.	12.79.	"	NS.6909.9802.
S.53.	42.6.	12.97.	"	NS.6913.9803.
S.54.	42.8.	13.03.	"	NS.6925.9802.
S.55.	42.5.	12.94.	"	NS.6933.9800.
S.56.	41.0.	12.48.	"	NS.6855.9795.
S.57.	41.3.	12.59.	"	NS.6837.9796.
S.58.	41.3.	12.59.	"	NS.6833.9802.
S.59.	42.4.	12.91.	"	NS.6830.9809.
S.60.	74.4.	22.69.	+ 0.07	NS.7084.9898.
S.61.	73.3.	22.34.	"	NS.7090.9898.
S.62.	80.1.	24.41.	"	NS.7070.9885.
S.63.	79.8.	24.33.	"	NS.7068.9878.
S.64.	80.0.	24.38.	"	NS.7066.9874.
S.65.	80.2.	24.46.	"	NS.7066.9870.
S.66.	60.6.	18.48.	"	NS.7085.9877.
S.67.	60.6.	18.48.	"	NS.7080.9872.
S.68.	60.6.	18.47.	"	NS.7076.9868.
S.69.	60.3.	18.39.	"	NS.7072.9867.
S.70.	59.0.	17.98.	"	NS.7066.9860.
S.71.	46.0.	14.03.	+ 0.01	NS.7197.9854.
S.72.	44.8.	13.65.	"	NS.7189.9853.
S.73.	44.0.	13.41.	"	NS.7183.9850.
S.74.	43.6.	13.29.	"	NS.7180.9852.
S.75.	43.3.	13.19.	"	NS.7176.9850.
S.76.	43.0.	13.09.	"	NS.7178.9842.
S.77.	42.2.	12.87.	"	NS.7182.9839.
S.78.	42.5.	12.96.	"	NS.7188.9840.
S.79.	43.5.	13.25.	"	NS.7192.9842.
S.80.	43.1.	13.13.	"	NS.7196.9843.
S.81.	67.0.	20.42.	- 0.02	NS.7190.9874.
S.82.	67.3.	20.50.	"	NS.7188.9873.
S.83.	66.3.	20.20.	"	NS.7184.9875.
S.84.	65.5.	19.95.	"	NS.71829875.
S.85.	65.3.	19.90.	"	NS.7180.9875.
S.86.	45.2.	13.78.	0.00	NS.7156.9846.
S.87.	45.5.	13.87.	"	NS.7142.9849.
S.88.	45.0.	13.72.	"	NS.7140.9851.
S.89.	45.3.	13.81.	"	NS.7137.9853.
S.90.	45.4.	13.84.	"	NS.7134.9856.
S.91.	45.7.	13.93.	"	NS.7132.9854.
S.92.	45.1.	13.75.	"	NS.7135.9850.
S.93.	45.2.	13.78.	"	NS.7137.9846.
S.94.	45.2.	13.78.	"	NS.7140.9844.
S.95.	45.6.	13.90.	"	NS.7143.9842.
S.96.	36.3.	11.07.	0.00	NS.7700.9820.
S.97.	36.0.	10.97.	"	NS.7710.9826.

Reference No.	Height O.D. Feet.	Height O.D. Metrés.	Closing Error.	Grid Reference.
S.98.	37.8.	11.52.	"	NS.7719.9825.
S.99.	36.8.	11.23.	"	NS.7724.9826.
S.100.	37.9.	11.56.	"	NS.7731.9826.
S.101.	35.7.	10.88.	"	NS.7741.9818.
S.102.	15.6.	4.75.	+0.11 Corr.	NS.8196.9500.
S.103.	15.5.	4.73.	"	NS.8187.9506.
S.104.	16.7.	5.08.	"	NS.8180.9506.
S.105.	15.9.	4.84.	"	NS.8170.9506.
S.106.	15.2.	4.63.	"	NS.8161.9506.
S.107.	30.4.	9.25.	+0.27 Corr.	NS.8499.9520.
S.108.	31.3.	9.54.	"	NS.8499.8526.
S.109.	30.3.	9.23.	"	NS.8499.8532.
S.110.	31.3.	9.53.	"	NS.8500.9510.
S.111.	30.6.	9.32.	"	NS.8503.9503.
S.112.	46.2.	14.08.	"	NS.8518.9508.
S.113.	44.4.	13.53.	"	NS.8523.9500.
S.114.	43.7.	13.31.	"	NS.8528.9489.
S.115.	42.3.	12.88.	"	NS.8532.9478.
S.116.	42.7.	13.02.	"	NS.8533.9473.
S.117.	10.8.	3.29.	-0.03	NS.9416.8660.
S.118.	10.5.	3.20.	"	NS.9420.8654.
S.119.	10.0.	3.06.	"	NS.9420.8649.
S.120.	10.0.	3.05.	"	NS.9418.8642.
S.121.	17.6.	5.36.	"	NS.9442.8660.
S.122.	17.3.	5.26.	"	NS.9438.8665.
S.123.	23.2.	7.06.	"	NS.9424.8683.
S.124.	16.1.	4.90.	"	NS.9428.8680.
S.125.	15.8.	4.82.	"	NS.9434.8671.
S.126.	14.0.	4.26.	"	NS.9417.8694.
S.127.	26.0.	7.93.	+0.01	NS.8712.9357.
S.128.	26.2.	7.99.	"	NS.8708.9348.
S.129.	25.5.	7.78.	"	NS.8717.9346.
S.130.	25.2.	7.70.	"	NS.8704.9350.
S.131.	25.4.	7.74.	"	NS.8700.9350.
S.132.	39.3.	11.96.	0.00	NS.8418.9688.
S.133.	38.3.	11.66.	"	NS.8409.9683.
S.134.	37.7.	11.48.	"	NS.8400.9680.
S.135.	39.3.	11.96.	"	NS.8385.9680.
S.136.	39.3.	12.04.	"	NS.8423.9686.
S.137.	39.1.	11.92.	0.00	NS.8220.9687.
S.138.	39.6.	12.09.	"	NS.8227.9683.
S.139.	40.2.	12.24.	"	NS.8206.9684.
S.140.	39.9.	12.17.	"	NS.8203.9677.
S.141.	38.8.	11.81.	"	NS.8242.9682.
S.142.	23.1.	7.03.	0.18	NS.8983.9228.
S.143.	22.5.	6.87.	"	NS.8990.9228.
S.144.	23.1.	7.05.	"	NS.8978.9229.
S.145.	24.2.	7.37.	"	NS.8968.9232.
S.146.	23.6.	7.18.	"	NS.8972.9230.
S.147.	38.7.	10.28.	"	NS.8976.9254.
S.148.	33.0.	10.06.	"	NS.8968.9255.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
S.149.	34.7.	10.57.	"	NS.8982.9255.
S.150.	31.5.	9.60.	"	NS.8990.9250.
S.151.	32.3.	9.85.	"	NS.8986.9253.
S.152.	38.9.	11.87.	0.90 Corr.	NS.8160.9607.
S.153.	39.3.	11.98.	"	NS.8160.9616.
S.154.	41.1.	12.63.	"	NS.8152.9585.
S.155.	39.6.	12.08.	"	NS.8150.9577.
S.156.	37.2.	11.33.	"	NS.8156.9597.
S.157.	32.8.	9.99.	"	NS.8032.9596.
S.158.	31.1.	9.48.	"	NS.8033.9600.
S.159.	30.3.	9.24.	"	NS.8032.9588.
S.160.	31.5.	9.59.	"	NS.8038.9583.
S.161.	32.4.	9.89.	"	NS.8030.9610.
S.162.	32.9.	10.03.	0.11	NS.9055.9169.
S.163.	34.7.	10.58.	"	NS.9059.9168.
S.164.	36.3.	11.07.	"	NS.9062.9166.
S.165.	35.6.	10.85.	"	NS.9066.9165.
S.166.	30.5.	9.30.	"	NS.9048.9170.
S.167.	18.2.	5.56.	"	NS.9048.9151.
S.168.	17.4.	5.31.	"	NS.9052.9152.
S.169.	21.0.	6.39.	"	NS.9057.9152.
S.170.	22.5.	6.86.	"	NS.9061.9153.
S.171.	22.0.	6.70.	"	NS.9067.9156.
S.172.	21.2.	6.45.	"	NS.9072.9157.
S.173.	21.8.	6.63.	"	NS.9076.9157.
S.174.	23.9.	7.27.	"	NS.9080.9157.
S.175.	22.0.	6.70.	"	NS.9084.9154.
S.176.	20.2.	6.16.	"	NS.9071.9146.
S.177.	138.0.	42.07.	-0.09.	NN.7158.0283.
S.178.	136.9.	41.72.	"	NN.7164.0282.
S.179.	135.1.	41.19.	"	NN.7168.0277.
S.180.	132.6.	40.43.	"	NN.7173.0272.
S.181.	132.1.	40.27.	"	NN.7182.0270.
S.182.	132.1.	40.27.	"	NN.7188.0267.
S.183.	132.5.	40.38.	"	NN.7194.0264.
S.184.	132.8.	40.49.	"	NN.7200.0259.
S.185.	132.5.	40.40.	"	NN.7196.0255.
S.186.	129.8.	39.57.	"	NN.7193.0252.
S.187.	130.1.	39.66.	"	NN.7192.0246.
S.188.	130.1.	39.65.	"	NN.7190.0233.
S.189.	128.7.	39.24.	"	NN.7187.0240.
S.190.	128.4.	39.13.	"	NN.7184.0235.
S.191.	131.8.	40.18.	"	NN.7182.0230.
S.192.	131.2.	40.00.	"	NN.7180.0228.
S.193.	126.3.	38.51.	"	NN.7210.0249.
S.194.	138.6.	42.26.	-0.08.	NN.7152.0288.
S.195.	141.2.	43.03.	"	NN.7148.0295.
S.196.	143.5.	43.73.	"	NN.7145.0305.
S.197.	146.9.	44.76.	"	NN.7142.0312.
S.198.	149.7.	45.63.	"	NN.7138.0318.
S.199.	152.6.	46.51.	"	NN.7137.0325.
S.200.	158.3.	48.25.	"	NN.7132.0332.
S.201.	144.1.	43.93.	"	NN.7136.0302.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
S.202.	142.4.	43.41.	"	NN.7134.0297.
S.203.	141.4.	43.09.	"	NN.7133.0291.
S.204.	139.6.	42.54.	"	NN.7132.0286.
S.205.	139.7.	42.57.	"	NN.7131.0280.
S.206.	138.9.	42.33.	"	NN.7142.0274.
S.207.	72.2.	21.99.	+0.12	NS.8580.9472.
S.208.	74.1.	22.58.	"	NS.8591.9458.
S.209.	69.5.	21.17.	"	NS.8567.9485.
S.210.	69.5.	21.19.	"	NS.8564.9492.
S.211.	70.6.	21.52.	"	NS.8566.9498.
S.212.	74.0.	22.57.	0.00	NS.8049.9595.
S.213.	74.8.	22.81.	"	NS.8049.9598.
S.214.	74.8.	22.80.	"	NS.8048.9505.
S.215.	73.0.	22.25.	"	NS.8046.9612.
S.216.	73.9.	22.52.	"	NS.8046.9623.
S.217.	73.4.	22.37.	"	NS.8048.9628.
S.218.	75.2.	22.91.	"	NS.8049.9638.
S.219.	75.5.	23.01.	"	NS.8049.9643.
S.220.	75.9.	23.14.	"	NS.8050.9650.
S.221.	81.7.	24.91.	+0.10.	NS.8153.9635.
S.222.	83.2.	25.34.	"	NS.8147.9628.
S.223.	83.4.	25.41.	"	NS.8143.9620.
S.224.	85.2.	25.96.	"	NS.8140.9622.
S.225.	84.9.	25.87.	"	NS.8137.9618.
S.226.	84.6.	25.78.	"	NS.8138.9612.
S.227.	83.4.	25.42.	"	NS.8140.9604.
S.228.	89.8.	27.36.	"	NS.8131.9633.
S.229.	90.2.	27.49.	"	NS.8131.9637.
S.230.	114.8.	34.99.	"	NS.8138.9641.
S.231.	117.4.	35.77.	"	NS.8133.9646.
S.232.	115.1.	35.08.	"	NS.8148.9640.
S.233.	114.1.	34.78.	"	NS.8154.9652.
S.234.	115.2.	35.11.	"	NS.8154.9650.
S.235.	117.2.	35.73.	"	NS.8145.9658.
S.236.	117.3.	35.75.	"	NS.8143.9650.
S.237.	39.1.	11.93.	0.00	NS.8160.9621.
S.238.	39.8.	12.13.	"	NS.8162.9630.
S.239.	40.3.	12.27.	"	NS.8164.9638.
S.240.	40.4.	12.32.	"	NS.8170.9647.
S.241.	40.2.	12.25.	"	NS.8175.9653.
S.242.	42.9.	13.08.	"	NS.8184.9668.
S.243.	126.9.	38.69.	+0.29 corr.	NS.9498.8695.
S.244.	127.6.	38.88.	"	NS.9503.8690.
S.245.	127.9.	38.98.	"	NS.9513.8680.
S.246.	128.9.	39.30.	"	NS.9518.8673.
S.247.	130.5.	39.77.	"	NS.9525.8668.
S.248.	129.7.	39.55.	"	NS.9530.8662.
S.249.	128.4.	39.15.	"	NS.9536.8659.
S.250.	127.3.	38.81.	"	NS.9543.8653.
S.251.	126.3.	38.56.	"	NS.9550.8650.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid. Reference.
S.252.	125.4.	38.23.	"	NS.9558.8648.
S.253.	124.0.	37.80.	"	NS.9563.8647.
S.254.	122.6.	37.38.	"	NS.9562.8642.
S.255.	125.3.	38.19.	"	NS.9574.8648.
S.256.	124.7.	38.00.	"	NS.9580.8645.
S.257.	123.2.	37.55.	"	NS.9589.8645.
S.258.	121.8.	37.14.	"	NS.9595.8646.
S.259.	113.0.	34.44.	"	NS.9590.8634.
S.260.	106.7.	32.53.	"	NS.9583.8635.
S.261.	104.9.	31.97.	"	NS.9578.8632.
S.262.	101.9.	31.07.	"	NS.9569.8632.
S.263.	101.4.	30.91.	"	NS.9560.8635.
S.264.	101.1.	30.82.	"	NS.9552.8636.
S.265.	100.8.	30.71.	"	NS.9544.8638.
S.266.	101.5.	30.95.	"	NS.9538.8640.
S.267.	103.5.	31.55.	"	NS.9528.8644.
S.268.	100.9.	30.76.	"	NS.9520.8648.
S.269.	99.8.	30.43.	"	NS.9518.8653.
S.270.	99.3.	30.27.	"	NS.9510.8657.
S.271.	99.6.	30.37.	"	NS.9503.8662.
S.272.	98.5.	30.01.	"	NS.9496.8668.
S.273.	100.7.	30.69.	"	NS.9491.8675.
S.274.	102.0.	31.10.	"	NS.9486.8679.
S.275.	100.4.	30.61.	"	NS.9473.8690.
S.276.	130.7.	39.82.	+ 0.08.	NS.9653.8646.
S.277.	131.6.	40.11.	"	NS.9646.8647.
S.278.	131.9.	40.20.	"	NS.9640.8649.
S.279.	119.2.	36.32.	"	NS.9619.8638.
S.280.	120.7.	36.78.	"	NS.9612.8639.
S.281.	119.7.	36.47.	"	NS.9604.8641.
S.282.	120.0.	36.59.	"	NS.9640.8638.
S.283.	116.9.	35.64.	"	NS.9657.8630.
S.284.	113.0.	34.46.	"	NS.9663.8629.
S.285.	111.3.	33.87.	"	NS.9669.8623.
S.286.	108.8.	33.17.	"	NS.9670.8618.
S.287.	110.2.	33.59.	"	NS.9665.8619.
S.288.	111.0.	33.82.	"	NS.9661.8622.
S.289.	110.4.	33.66.	"	NS.9658.8625.
S.290.	112.8.	34.37.	"	NS.9663.8622.
S.291.	102.9.	31.37.	"	NS.9680.8609.
S.292.	101.7.	30.98.	"	NS.9689.8607.
S.293.	99.8.	30.43.	"	NS.9696.8606.
S.294.	98.6.	30.04.	"	NS.9704.8606.
S.295.	98.0.	29.86.	"	NS.9708.8606.
S.296.	97.8.	29.75.	"	NS.9719.8605.
S.297.	97.7.	29.78.	"	NS.9727.8599.
S.298.	77.0.	23.47.	+ 0.10	NN.5927.0002.
S.299.	76.0.	24.38.	"	NS.5934.9997.
S.300.	72.4.	22.05.	"	NS.5937.9990.
S.301.	69.5.	21.16.	"	NS.5940.9984.
S.302.	68.1.	20.75.	"	NS.5944.9978.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
S.303.	65.9.	20.08.	"	NS.5951.9975.
S.304.	63.0.	19.20.	"	NS.5958.9973.
S.305.	61.2.	18.65.	"	NS.5963.9977.
S.306.	59.7.	18.18.	"	NS.5968.9982.
S.307.	57.0.	17.39.	"	NS.5972.9988.
S.308.	56.1.	17.09.	"	NS.5975.9995.
S.309.	53.7.	16.36.	"	NN.5976.0002.
S.310.	50.7.	15.46.	"	NN.5980.0014.
S.311.	51.1.	15.58.	"	NN.5973.0018.
S.312.	52.8.	16.08.	"	NN.5968.0022.
S.313.	53.3.	16.23.	"	NN.5965.0025.
S.314.	52.9.	16.12.	"	NN.5967.0030.
S.315.	52.3.	15.94.	"	NN.5964.0036.
S.316.	53.7.	16.38.	"	NN.5962.0044.
S.317.	48.5.	14.77.	"	NN.5977.0031.
S.318.	46.5.	14.18.	"	NN.5984.0021.
S.319.	46.4.	14.63.	"	NN.5990.0015.
S.320.	46.5.	14.16.	"	NN.6006.0000.
S.321.	46.5.	14.16.	"	NS.6012.9996.
S.322.	50.5.	15.39.	"	NS.6010.9992.
S.323.	49.9.	15.20.	"	NS.6003.9990.
S.324.	49.5.	15.08.	"	NS.5999.9987.
S.325.	50.2.	15.31.	"	NS.5992.9984.
S.326.	50.3.	15.33.	"	NS.5992.9991.
S.327.	50.3.	15.31.	"	NS.5992.9997.
S.328.	50.7.	15.46.	"	NN.5989.0004.
S.329.	52.3.	15.93.	"	NS.4987.9985.
S.330.	55.2.	16.81.	"	NS.5983.9985.
S.331.	56.8.	17.31.	"	NS.5980.9985.
S.332.	53.3.	16.25.	"	NS.5998.9976.
S.333.	57.6.	17.54.	"	NS.5982.9953.
S.334.	57.2.	17.42.	"	NS.5985.9950.
S.335.	55.3.	16.86.	"	NS.5993.9949.
S.336.	56.4.	17.18.	"	NS.5977.9956.
S.337.	50.6.	15.41.	"	NS.5991.9968.
S.338.	66.4.	20.24.	0.00.	NS.5659.9990.
S.339.	66.7.	20.33.	"	NS.5654.9987.
S.340.	67.6.	20.60.	"	NS.5650.9982.
S.341.	68.0.	20.71.	"	NS.5643.9978.
S.342.	66.2.	20.17.	"	NS.5654.9976.
S.343.	66.0.	20.11.	"	NS.5662.9977.
S.344.	64.7.	19.72.	"	NS.5673.9979.
S.345.	63.9.	19.47.	"	NS.5681.9980.
S.346.	64.0.	19.53.	"	NS.5688.9975.
S.347.	63.2.	19.26.	"	NS.5696.9975.
S.348.	62.3.	18.99.	"	NS.5704.9975.
S.349.	62.0.	18.89.	"	NS.5713.9975.
S.350.	67.5.	20.57.	"	NS.5640.9972.
S.351.	67.3.	20.53.	"	NS.5635.9965.
S.352.	67.8.	20.66.	"	NS.5629.9959.
S.353.	63.4.	19.32.	"	NS.5628.9951.
S.354.	61.8.	18.83.	"	NS.5618.9945.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid. Reference.
S.355.	60.3.	18.38.	"	NS.5610.9920.
S.356.	62.3.	18.97.	"	NS.5602.9914.
S.357.	72.5.	22.10.	"	NS.5578.9955.
S.358.	72.3.	22.06.	"	NS.5583.9960.
S.359.	74.9.	22.84.	"	NS.55869968.
S.360.	74.3.	22.64.	"	NS.5614.9983.
S.361.	72.7.	22.17.	"	NS.5623.9987.
S.362.	714.	21.76.	"	NS.5631.9991.
S.363.	71.6.	21.84.	"	NS.5635.9996.
S.364.	71.1.	21.67.	"	NN.5639.0000.
S.365.	70.3.	21.42.	"	NN.5644.0004.
S.366.	68.8.	20.97.	"	NN.5640.0015.
S.367.	72.6.	22.13.	"	NN.5631.0010.
S.368.	73.3.	22.34.	"	NN.5626.0005.
S.369.	71.9.	21.92.	"	NN.5624.0030.
S.370.	72.8.	22.18.	"	NN.5620.0028.
S.371.	74.6.	22.73.	"	NN.5617.0025.
S.372.	75.4.	22.99.	"	NN.5612.0026.
S.373.	77.5.	23.63.	"	NN.5602.0021.
S.374.	79.0.	24.11.	"	NN.5593.0017.
S.375.	81.6.	24.87.	"	NN.5588.0009.
S.376.	85.6.	26.08.	"	NN.5579.0000.
S.377.	82.8.	25.22.	"	NS.5570.9994.
S.378.	27.6.	8.42.	+ 0.01.	NS.8587.9410.
S.379.	28.0.	8.53.	"	NS.8596.9407.
S.380.	28.0.	8.52.	"	NS.8603.9406.
S.381.	27.5.	8,39.	"	NS.8610.9403.
S.382.	27.0.	8.24.	"	NS.8617.9399.
S.383.	27.0.	8.22.	"	NS.8626.9394.
S.384.	27.0.	8.21.	"	NS.8633.9389.
S.385.	27.1.	8.26.	"	NS.8641.9383.
S.386.	27.4.	8.35.	"	NS.8574.9415.
S.387.	27.6.	8.42.	"	NS.8575.9416.
S.388.	35.5.	10.81.	+ 0.01.	NS.8528.9463.
S.389.	28.3.	8.64.	"	NS.8525.9450.
S.390.	28.4.	8.65.	"	NS.8520.9452.
S.391.	31.9.	9.72.	"	NS.8517.9469.
S.392.	32.4.	9.86.	"	NS.8514.9480.
S.393.	31.4.	9.58.	"	NS.8509.9494.
S.394.	30.6.	9.34.	"	NS.8504.9500.
S.395.	41.0.	12.51.	+ 0.07.	NS.8513.9526.
S.396.	42.0.	12.81.	"	NS.8523.9533.
S.397.	41.6.	12.67.	"	NS.8543.9531.
S.398.	41.2.	12.55.	"	NS.8540.9549.
S.399.	40.8.	40.77.	"	NS.8546.9556.
S.400.	41.0.	40.95.	"	NS.8551.9562.
S.401.	40.4.	40.40.	"	NS.8554.9568.
S.402.	41.5.	41.50.	"	NS.8561.9571.
S.403.	40.8.	40.75.	"	NS.8563.9576.
S.404.	30.1.	30.10.	"	NS.8500.9536.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
S.405.	30.4.	9.28.	"	NS.8500.9550.
S.406.	30.2.	9.21.	"	NS.8501.9558.
S.407.	30.1.	9.17.	"	NS.8505.9564.
S.408.	32.1.	9.77.	"	NS.85069555.
S.409.	30.4.	9.26.	"	NS.8510.9570.
S.410.	30.8.	9.39.	"	NS.8518.9574.
S.411.	30.9.	9.42.	"	NS.8527.9569.
S.412.	31.5.	9.61.	"	NS.8534.9580.
S.413.	31.6.	9.62.	"	NS.8540.9580.
S.414.	31.2.	9.49.	"	NS.8560.9586.
S.415.	32.2.	9.80.	"	NS.8567.9590.
S.416.	31.8.	9.70.	"	NS.8573.9592.
S.417.	30.3.	9.23.	"	NS.8587.9598.
S.418.	30.2.	9.21.	"	NS.8599.9604.
S.419.	30.0.	9.15.	"	NS.8608.9603.
S.420.	29.9.	9.11.	"	NS.8617.9603.
S.421.	30.1.	9.18.	"	NS.8592.9620.
S.422.	35.2.	10.71.	"	NS.8593.9637.
S.423.	34.6.	10.53.	"	NS.8600.9637.
S.424.	36.0.	10.96.	"	NS.8603.9638.
S.425.	36.4.	11.10.	"	NS.8610.9639.
S.426.	36.2.	11.02.	"	NS.8615.9640.
S.427.	30.7.	9.36.	- 0.02	NS.8570.9639.
S.428.	30.8.	9.39.	"	NS.8562.9637.
S.429.	33.0.	10.06.	"	NS.8554.9636.
S.430.	31.3.	9.53.	"	NS.8545.9636.
S.431.	33.5.	10.20.	"	NS.8508.9624.
S.432.	30.8.	9.39.	"	NS.8502.9618.
S.433.	29.9.	9.10.	"	NS.8471.9620.
S.434.	29.8.	9.08.	"	NS.8462.9618.
S.435.	31.9.	9.72.	"	NS.8453.9637.
S.436.	32.6.	9.92.	"	NS.8460.9640.
S.437.	30.0.	9.15.	"	NS.8456.9615.
S.438.	30.8.	9.39.	"	NS.8443.9632.
S.439.	24.8.	7.55.	0.00	NS.8391.9536.
S.440.	7.4.	2.25.	- 0.02	NS.8493.9380.
S.441.	7.3.	2.22.	"	NS.8488.9380.
s.442.	7.7.	2.33.	"	NS.8478.9381.
S.443.	7.5.	2.30.	"	NS.8469.9379.
S.444.	9.8.	2.97.	"	NS.8460.9373.
S.445.	5.5.	1.68.	"	NS.8455.9368.
S.446.	6.3.	1.93.	"	NS.8450.9361.
S.447.	6.8.	2.06.	"	NS.8446.9357.
S.448.	21.8.	6.65.	"	NS.8437.9389.
S.449.	22.5.	6.85.	"	NS.8413.9394.
S.450.	19.2.	5.84.	"	NS.8396.9372.
S.451.	20.7.	6.30.	"	NS.8397.9379.
S.452.	21.4.	6.52.	"	NS.8398.9387.
S.453.	23.1.	7.03.	"	NS.8398.9412.
S.454.	24.4.	7.43.	"	NS.8398.9420.
S.455.	22.2.	6.76.	"	NS.8389.9426.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
S.456.	23.7.	7.22.	"	NS.8398.9437.
S.457.	26.5.	8.07.	"	NS.8398.9445.
S.458.	26.1.	7.95.	"	NS.8398.9455.
S.459.	24.4.	7.43.	"	NS.8399.9459.
S.460.	23.0.	7.02.	"	NS.8398.9463.
S.461.	21.9.	6.68.	"	NS.8398.9470.
S.462.	21.9.	6.66.	"	NS.8403.9468.
S.463.	22.9.	6.98.	"	NS.8403.9474.
S.464.	22.8.	6.94.	"	NS.8403.9481.
S.465.	22.7.	6.91.	"	NS.8403.9490.
S.466.	22.3.	6.79.	"	NS.8403.9498.
S.467.	22.6.	6.89.	"	NS.8394.9507.
S.468.	24.3.	7.41.	"	NS.8394.9518.
S.469.	25.3.	7.70.	"	NS.8394.9527.
S.470.	27.3.	8.33.	"	NS.8394.9544.
S.471.	27.2.	8.28.	"	NS.8394.9551.
S.472.	28.2.	8.60.	"	NS.8394.9559.
S.473.	29.6.	9.03.	"	NS.8394.9567.
S.474.	29.9.	9.11.	"	NS.8394.9573.
S.475.	30.1.	9.19.	"	NS.8394.9581.
S.476.	28.5.	8.67.	"	NS.8394.9589.
S.477.	38.3.	11.66.	"	NS.8380.9598.
S.478.	38.3.	11.66.	"	NS.8379.9606.
S.479.	37.3.	11.37.	"	NS.8378.9614.
S.480.	36.5.	11.12.	"	NS.8378.9623.
S.481.	37.9.	11.55.	"	NS.8378.9630.
S.482.	38.4.	11.71.	"	NS.8379.9643.
S.483.	37.7.	11.50.	"	NS.8378.9651.
S.484.	38.9.	11.85.	"	NS.8378.9658.
S.485.	38.1.	11.62.	"	NS.8378.9670.
S.486.	36.4.	11.11.	"	NS.8383.9680.
S.487.	38.4.	11.69.	0.00.	NS.8377.9681.
S.488.	38.4.	11.72.	"	NS.8381.9683.
S.489.	37.9.	11.55.	"	NS.8387.9683.
S.490.	37.6.	11.45.	"	NS.8393.9684.
S.491.	38.1.	11.60.	"	NS.8398.9684.
S.492.	114.5.	34.91.	+0.02.	NS.9722.8613.
S.493.	111.7.	34.05.	"	NS.9728.8613.
S.494.	108.1.	32.96.	"	NS.9736.8614.
S.495.	100.1.	30.51.	"	NS.9743.8604.
S.496.	100.9.	30.75.	"	NS.9749.8604.
S.497.	97.5.	29.73.	"	NS.9739.8597.
S.498.	96.9.	29.52.	"	NS.9747.8598.
S.499.	96.8.	29.50.	"	NS.9753.8601.
S.500.	98.6.	30.04.	"	NS.9760.8602.
S.501.	98.5.	30.03.	"	NS.9767.8603.
S.502.	100.5.	30.64.	"	NS.9779.8599.
S.503.	100.7.	30.69.	"	NS.9788.8599.
S.504.	99.4.	30.28.	"	NS.9794.8600.
S.505.	115.4.	35.16.	"	NS.9791.8609.
S.506.	116.6.	35.55.	"	NS.9789.8610.
S.507.	117.7.	35.87.	"	NS.9786.8612.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
S.508.	118.5.	36.13.	"	NS.9782.8613.
S.509.	120.4.	36.70.	"	NS.9784.8618.
S.510.	55.1.	16.80.	+ 0.01.	NS.9588.8622.
S.511.	56.1.	17.08.	"	NS.9583.8622.
S.512.	56.7.	17.29.	"	NS.9581.8623.
S.513.	55.3.	16.85.	"	NS.9579.8621.
S.514.	36.2.	11.05.	- 0.01.	NS.9597.8604.
S.515.	36.1.	10.99.	"	NS.9593.8605.
S.516.	28.9.	8.81.	"	NS.9593.8599.
S.517.	28.4.	8.64.	"	NS.9596.8598.
S.518.	10.3.	3.13.	"	NS.9603.8587.
S.519.	10.6.	3.24.	"	NS.9607.8591.
S.520.	13.3.	4.06.	"	NS.9605.8595.
S.521.	15.5.	4.72.	"	NS.9603.8599.
S.522.	18.7.	5.71.	"	NS.9603.8602.
S.523.	20.0.	6.09.	"	NS.9604.8605.
S.524.	42.1.	12.82.	- 0.02.	NS.9547.8618.
S.525.	42.5.	12.95.	"	NS.9552.8617.
S.526.	43.0.	13.12.	"	NS.9557.8617.
S.527.	43.3.	13.20.	"	NS.9560.8617.
S.528.	13.9.	4.24.	"	NS.9570.8604.
S.529.	14.8.	4.35.	"	NS.9564.8605.
S.530.	14.5.	4.43.	"	NS.9559.8606.
S.531.	13.6.	4.15.	"	NS.9551.8605.
S.532.	13.3.	4.06.	"	NS.9543.8604.
S.533.	13.7.	4.18.	"	NS.9540.8599.
S.534.	14.7.	4.49.	"	NS.9538.8596.
S.535.	15.3.	4.67.	"	NS.9540.8592.
S.536.	17.7.	5.40.	"	NS.9535.8600.
S.537.	41.1.	12.54.	- 0.03.	NS.9520.8577.
S.538.	41.5.	12.64.	"	NS.9515.8579.
S.539.	40.6.	12.37.	"	NS.9512.8582.
S.540.	34.7.	10.57.	"	NS.9498.8586.
S.541.	34.4.	10.48.	"	NS.9495.8585.
S.542.	32.4.	9.89.	"	NS.9493.8586.
S.543.	33.6.	10.24.	"	NS.9500.8592.
S.544.	40.4.	12.33.	"	NS.9514.8595.
S.545.	41.0.	12.49.	"	NS.9519.8598.
S.546.	40.4.	12.31.	"	NS.9523.8603.
S.547.	40.8.	12.44.	"	NS.9527.8605.
S.548.	30.2.	9.20.	+ 0.01.	NS.8426.9590.
S.549.	29.3.	8.94.	"	NS.8416.9587.
S.550.	28.3.	8.61.	"	NS.8408.9586.
S.551.	30.1.	9.16.	"	NS.8390.9582.
S.552.	30.0.	9.15.	"	NS.8383.9585.
S.553.	31.4.	9.56.	"	NS.8375.9585.
S.554.	31.3.	9.53.	"	NS.8367.9586.
S.555.	31.3.	9.54.	"	NS.8360.9586.
S.556.	30.9.	9.43.	"	NS.8351.9585.
S.557.	30.9.	9.40.	"	NS.8346.9586.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
S.558.	31.1.	9.44.	"	NS.8341.9587.
S.559.	30.8.	9.38.	"	NS.8332.9588.
S.560.	30.1.	9.16.	"	NS.8322.9588.
S.561.	29.7.	9.04.	"	NS.8316.9588.
S.562.	30.2.	9.21.	"	NS.8310.9588.
S.563.	30.7.	9.36.	"	NS.8304.9591.
S.564.	30.9.	9.42.	"	NS.8300.9595.
S.565.	31.3.	9.55.	"	NS.8293.9594.
S.566.	31.3.	9.53.	"	NS.8287.9593.
S.567.	31.6.	9.64.	"	NS.8280.9594.
S.568.	32.1.	9.77.	"	NS.8271.9595.
S.569.	32.8.	10.00.	"	NS.8262.9595.
S.570.	37.1.	11.31.	"	NS.8192.9580.
S.571.	35.3.	10.76.	"	NS.8192.9573.
S.572.	34.6.	10.54.	"	NS.8192.9564.
S.573.	34.3.	10.46.	"	NS.8192.9555.
S.574.	33.6.	10.23.	"	NS.8193.9546.
S.575.	31.4.	9.57.	"	NS.8198.9540.
S.576.	30.9.	9.41.	"	NS.8200.9534.
S.577.	31.9.	9.73.	"	NS.8190.9541.
S.578.	33.1.	10.10.	"	NS.8183.9541.
S.579.	33.9.	10.33.	"	NS.8177.9542.
S.580.	33.7.	10.26.	"	NS.8170.9541.
S.581.	31.3.	9.53.	"	NS.8193.9533.
S.582.	31.5.	9.59.	"	NS.8186.9530.
S.583.	30.2.	9.21.	"	NS.8181.9528.
S.584.	30.0.	9.15.	"	NS.8176.9526.
S.585.	30.7.	9.36.	"	NS.8210.9548.
S.586.	30.6.	9.31.	"	NS.8216.9550.
S.587.	31.7.	9.65.	"	NS.8223.9552.
S.588.	32.0.	9.76.	"	NS.8228.9555.
S.589.	31.1.	9.46.	"	NS.8203.9527.
S.590.	30.0.	9.16.	"	NS.8207.9520.
S.591.	28.5.	8.67.	"	NS.8201.9513.
S.592.	21.9.	6.66.	"	NS.8202.9508.
S.593.	15.5.	4.74.	"	NS.8158.9505.
S.594.	15.3.	4.66.	"	NS.8156.9498.
S.595.	18.1.	5.51.	"	NS.8158.9491.
S.596.	20.2.	6.14.	"	NS.8158.9483.
S.597.	20.5.	6.26.	"	NS.8158.9477.
S.598.	20.9.	6.38.	"	NS.8158.9469.
S.599.	20.5.	6.25.	"	NS.8165.9470.
S.600.	19.7.	6.00.	"	NS.8172.9471.
S.601.	20.1.	6.12.	"	NS.8179.9472.
S.602.	19.4.	5.90.	"	NS.8190.9474.
S.603.	19.5.	5.94.	"	NS.8196.9472.
S.604.	19.8.	6.03.	"	NS.8203.9472.
S.605.	19.1.	5.82.	"	NS.8211.9471.
S.606.	25.8.	7.85.	"	NS.8112.9511.
S.607.	27.3.	8.33.	"	NS.8107.9516.
S.608.	27.5.	8.39.	"	NS.8099.9522.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
S.609.	28.1.	8.56.		NS.8092.9527.
S.610.	31.3.	9.53.	"	NS.8037.9583.
S.611.	31.8.	9.70.	"	NS.8032.9591.
S.612.	32.6.	9.92.	"	NS.8031.9601.
S.613.	31.8.	9.68.	"	NS.8031.9612.
S.614.	30.3.	9.24.	"	NS.8030.9620.
S.615.	31.0.	9.46.	"	NS.8028.9630.
S.616.	31.7.	9.65.	"	NS.8023.9635.
S.617.	31.9.	9.71.	"	NS.8017.9640.
S.618.	32.7.	9.96.	"	NS.8018.9648.
S.619.	31.8.	9.68.	"	NS.8021.9653.
S.620.	33.7.	10.27.	"	NS.8020.9657.
S.621.	34.7.	10.58.	"	NS.8017.9657.
S.622.	34.2.	10.43.	"	NS.8012.9652.
S.623.	32.7.	9.97.	"	NS.8006.9653.
S.624.	33.2.	10.13.	"	NS.8005.9660.
S.625.	33.5.	10.22.	"	NS.8006.9667.
S.626.	33.2.	10.12.	"	NS.8002.9675.
S.627.	33.1.	10.08.	"	NS.7995.9683.
S.628.	36.8.	11.21.	"	NS.8012.9668.
S.629.	37.2.	11.34.	"	NS.8018.9665.
S.630.	20.4.	6.21.	0.00.	NS.9425.8688.
S.631.	19.6.	5.97.	"	NS.9429.8683.
S.632.	21.6.	6.60.	"	NS.9436.8678.
S.633.	18.2.	5.56.	"	NS.9400.8671.
S.634.	17.5.	5.35.	"	NS.9442.8664.
S.635.	18.3.	5.57.	"	NS.9447.8655.
S.636.	18.4.	5.62.	"	NS.9442.8647.
S.637.	16.7.	5.09.	"	NS.9435.8645.
S.638.	12.6.	3.84.	"	NS.9430.8651.
S.639.	13.7.	4.19.	"	NS.9433.8658.
S.640.	14.5.	4.43.	"	NS.9431.8662.
S.641.	15.1.	4.61.	"	NS.9428.8669.
S.642.	14.8.	4.52.	"	NS.9423.8673.
S.643.	16.1.	4.87.	"	NS.9417.8680.
S.644.	14.5.	4.43.	"	NS.9410.8686.
S.645.	14.8.	4.52.	"	NS.9404.8691.
S.646.	14.3.	4.36.	"	NS.9397.8695.
S.647.	13.9.	4.25.	"	NS.9390.8698.
S.648.	13.0.	3.97.	"	NS.9383.8700.
S.649.	12.0.	3.67.	"	NS.9374.8700.
S.650.	13.4.	4.08.	"	NS.9368.8699.
S.651.	13.1.	3.96.	"	NS.9361.8703.
S.652.	19.1.	5.83.	"	NS.9363.8714.
S.653.	18.2.	5.54.	"	NS.9370.8709.
S.654.	17.8.	5.44.	"	NS.9380.8710.
S.655.	19.1.	5.83.	"	NS.9388.8712.
S.656.	37.3.	11.37.	"	NS.9425.8703.
S.657.	38.2.	11.64.	"	NS.9421.8706.
S.658.	38.5.	11.74.	"	NS.9418,8709.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
S.659.	39.5.	12.03.	"	NS.9414.8712.
S.660.	7.2.	2.19.	0.00	NS.9398.8666.
S.661.	6.6.	2.02.	"	NS.9392.8670.
S.662.	6.2.	1.88.	"	NS.9384.8672.
S.663.	5.7.	1.74.	"	NS.9378.8673.
S.664.	5.3.	1.62.	"	NS.9370.8672.
S.665.	4.9.	1.50.	"	NS.9362.8674.
S.666.	4.6.	1.41.	"	NS.9356.8678.
S.667.	4.3.	1.32.	"	NS.9350.8681.
S.668.	3.8.	1.15.	"	NS.9345.8686.
S.669.	4.2.	1.28.	"	NS.9340.8691.
S.670.	4.4.	1.34.	"	NS.9338.8695.
S.671.	4.2.	1.28.	"	NS.9332.8699.
S.672.	4.5.	1.37.	"	NS.9327.8705.
S.673.	4.6.	1.41.	"	NS.9322.8709.
S.674.	5.0.	1.53.	"	NS.9318.8713.
S.675.	5.4.	1.63.	"	NS.9312.8716.
S.676.	5.2.	1.57.	"	NS.9306.8719.
S.677.	5.2.	1.57.	"	NS.9299.8721.
S.678.	10.8.	3.29.	0.00.	NS.9742.8574.
S.679.	10.7.	3.27.	"	NS.9738.9576.
S.680.	15.5.	4.74.	"	NS.9731.8573.
S.681.	16.2.	4.95.	"	NS.9728.8569.
S.682.	17.8.	5.44.	"	NS.9729.8574.
S.683.	19.8.	6.05.	"	NS.9736.8578.
S.684.	106.1.	32.34.	-0.01.	NS.9339.9042.
S.685.	108.0.	32.92.	"	NS.9342.9037.
S.686.	107.3.	32.71.	"	NS.9342.9032.
S.687.	108.5.	33.06.	"	NS.9339.9021.
S.688.	105.9.	32.28.	"	NS.9340.9012.
S.689.	106.3.	32.40.	"	NS.9348.9005.
S.690.	111.4.	33.96.	"	NS.9355.9000.
S.691.	134.3.	40.92.	"	NS.9359.9009.
S.692.	136.9.	41.72.	"	NS.9358.9012.
S.693.	138.8.	42.31.	"	NS.9356.9016.
S.694.	144.0.	43.89.	"	NS.9355.9023.
S.695.	147.3.	44.90.	"	NS.9355.9028.
S.696.	149.4.	45.54.	"	NS.9354.9032.
S.697.	150.2.	45.79.	"	NS.9353.9035.
S.698.	110.7.	33.74.	"	NS.9339.9052.
S.699.	115.6.	35.24.	"	NS.9339.9060.
S.700.	122.5-123.0.	37.34-37.49.	"	NS.9337.9071.
S.701.	123.0.	37.49.	"	NS.9333.9081.
S.702.	114.1.	34.77.	"	NS.9341.9048.
S.703.	127.1.	38.75.	0.00.	NS.9380.8932.
S.704.	124.4.	37.91.	"	NS.9375.8928.
S.705.	123.2.	37.55.	"	NS.9371.8922.
S.706.	121.2.	36.95.	"	NS.9369.8919.
S.707.	122.8.	37.43.	"	NS.9371.8930.
S.708.	34.5.	10.51.	+0.02.	NS.7154.9530.
S.709.	35.4.	10.79.	"	NS.7156.9537.
S.710.	35.1.	10.70.	"	NS.7156.9548.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
S.711.	34.2.	10.43.	"	NS.7157.9554.
S.712.	33.3.	10.16.	"	NS.7155.9562.
S.713.	34.2.	10.43.	"	NS.7155.9570.
S.714.	36.0.	10.96.	"	NS.7157.9576.
S.715.	35.8.	10.92.	"	NS.7157.9583.
S.716.	35.6.	10.86.	"	NS.7158.9588.
S.717.	34.9.	10.63.	"	NS.7156.9595.
S.718.	34.5.	10.52.	"	NS.7163.9592.
S.719.	35.8.	10.90.	"	NS.7156.9601.
S.720.	36.8.	11.23.	"	NS.7156.9607.
S.721.	37.2.	11.34.	"	NS.7156.9614.
S.722.	37.2.	11.33.	"	NS.7156.9620.
S.723.	37.6.	11.47.	"	NS.7156.9628.
S.724.	37.6.	11.45.	"	NS.7156.9637.
S.725.	37.1.	11.30.	"	NS.7162.9645.
S.726.	35.6.	10.86.	"	NS.7167.9654.
S.727.	37.9.	11.54.	"	NS.7169.9660.
S.728.	39.4.	12.00.	"	NS.7170.9666.
S.729.	38.6.	11.76.	- 0.05	NS.7174.9672.
S.730.	39.4.	12.00.	"	NS.7171.9681.
S.731.	39.7.	12.11.	"	NS.7172.9683.
S.732.	39.3.	11.98.	"	NS.7172.9690.
S.733.	38.9.	11.84.	"	NS.7175.9695.
S.734.	38.8.	11.84.	"	NS.7177.9703.
S.735.	39.0.	11.90.	"	NS.7178.9709.
S.736.	39.1.	11.91.	"	NS.7180.9718.
S.737.	39.2.	11.96.	"	NS.7185.9719.
S.738.	39.6.	12.06.	"	NS.7188.9729.
S.739.	40.3.	12.30.	"	NS.7191.9735.
S.740.	39.6.	12.07.	"	NS.7192.9746.
S.741.	39.7.	12.11.	"	NS.7193.9752.
S.742.	39.4.	12.00.	"	NS.7197.9759.
S.743.	39.8.	12.13.	"	NS.7202.9766.
S.744.	40.3.	12.27.	"	NS.7206.9773.
S.745.	40.3.	12.29.	"	NS.7207.9781.
S.746.	40.8.	12.43.	"	NS.7188.9783.
S.747.	40.3.	12.27.	"	NS.7205.9788.
S.748.	40.8.	12.45.	"	NS.7204.9796.
S.749.	40.5.	12.36.	"	NS.7203.9805.
S.750.	40.6.	12.39.	"	NS.7200.9813.
S.751.	41.1.	12.48.	"	NS.7198.9820.
S.752.	41.1.	12.49.	"	NS.7192.9826.
S.753.	41.3.	12.59.	"	NS.7190.9833.
S.754.	41.1.	12.55.	"	NS.7190.9838.
S.755.	42.2.	12.87.	"	NS.7188.9842.
S.756.	44.3.	13.50.	"	NS.7237.9853.
S.757.	43.1.	13.10.	"	NS.7243.9856.
S.758.	43.4.	13.23.	"	NS.7251.9855.
S.759.	43.0.	13.11.	"	NS.7260.9854.
S.760.	40.7.	12.39.	- 0.02.	NS.7326.9821.
S.761.	40.4.	12.31.	"	NS.7337.9817.
S.762.	41.1.	12.48.	"	NS.7331.9825.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
S.763.	42.7.	13.02.	"	NS.7342.9832.
S.764.	42.6.	13.00.	"	NS.7347.9837.
S.765.	45.1.	13.70.	"	NS.7353.9839.
S.766.	45.2.	13.79.	"	NS.7360.9843.
S.767.	45.5.	13.88.	"	NS.7368.9848.
S.768.	45.7.	13.92.	"	NS.7371.9858.
S.769.	45.6.	13.89.	"	NS.7379.9855.
S.770.	46.1.	14.04.	"	NS.7382.9859.
S.771.	44.2.	13.48.	+ 0.03.	NS.7393.9863.
S.772.	43.6.	13.30.	"	NS.7383.9868.
S.773.	45.5.	14.17.	+ 0.04.	NS.7375.9868.
S.774.	46.5.	14.19.	"	NS.7370.9872.
S.775.	45.5.	13.87.	"	NS.7363.9877.
S.776.	47.1.	14.31.	"	NS.7360.9881.
S.777.	14.7.	14.69.	"	NS.7352.9888.
S.778.	14.7.	14.69.	"	NS.7350.9894.
S.779.	14.8.	14.75.	"	NS.7350.9900.
S.780.	15.7.	14.73.	"	NS.7346.9906.
S.781.	16.9.	16.86.	"	NS.7343.9921.
S.782.	17.5.	17.50.	"	NS.7340.9926.
S.783.	16.8.	16.78.	"	NS.7335.9920.
S.784.	16.5.	16.55.	"	NS.7330.9925.
S.785.	17.0.	16.91.	"	NS.7323.9933.
S.786.	17.6.	17.55.	"	NS.7320.9941.
S.787.	18.1.	17.95.	"	NS.7317.9949.
S.788.	18.7.	18.67.	"	NS.7315.9956.
S.789.	18.7.	18.70.	"	NS.7315.9962.
S.790.	18.9.	18.86.	"	NS.7316.9971.
S.791.	18.7.	18.66.	"	NS.7315.9976.
S.792.	28.2.	28.23.	+ 0.01.	NT.0274.8586.
S.793.	28.3.	28.27.	"	NT.0279.8582.
S.794.	28.1.	28.11.	"	NT.0284.8578.
S.795.	28.0.	28.01.	"	NT.0289.8570.
S.796.	28.1.	28.10.	"	NT.0291.8561.
S.797.	28.0.	27.93.	"	NT.0296.8553.
S.798.	90.5.	27.57.	"	NT.0303.8549.
S.799.	87.1.	26.50.	"	NT.0307.8544.
S.800.	88.6.	27.00.	"	NT.0315.8538.
S.801.	89.6.	27.32.	"	NT.0320.8532.
S.802.	90.0.	27.44.	"	NT.0324.8527.
S.803.	89.2.	27.19.	"	NT.0330.8521.
S.804.	89.1.	27.11.	"	NT.0345.8501.
S.805.	88.9.	27.09.	"	NT.0348.8496.
S.806.	88.6.	27.00.	"	NT.0352.8488.
S.807.	90.4.	27.56.	"	NT.0353.8482.
S.808.	15.7.	4.79.	0.00.	NT.0291.8530.
S.809.	15.3.	4.67.	"	NT.0285.8535.
S.810.	14.3.	4.35.	"	NT.0281.8539.
S.811.	6.2.	1.88.	"	NT.0260.8563.
S.812.	6.6.	2.00.	"	NT.0263.8560.
S.813.	6.4.	1.94.	"	NT.0267.8557.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
S.814.	6.6.	2.00.	"	NT.0270.8553.
S.815.	6.8.	2.08.	"	NT.0272.8548.
S.816.	6.8.	2.06.	"	NT.0276.8543.
S.817.	6.6.	2.00.	"	NT.0280.8539.
S.818.	6.3.	1.91.	"	NT.0281.8534.
S.819.	5.7.	1.73.	"	NT.0284.8529.
S.820.	6.1.	1.85.	"	NT.0303.8508.
S.821.	6.0.	1.83.	"	NT.0307.8499.
S.822.	5.7.	1.73.	"	NT.0310.8492.
S.823.	5.8.	1.76.	"	NT.0314.8481.
S.824.	22.0.	6.72.	- 0.01.	NT.0291.8534.
S.825.	24.7.	7.54.	"	NT.0295.8531.
S.826.	15.1.	4.60.	+ 0.02.	NT.0318.8481.
S.827.	15.0.	4.58.	"	NT.0322.8470.
S.828.	33.4.	10.19.	"	NT.0322.8484.
S.829.	37.3.	11.35.	"	NT.0321.8488.
S.830.	35.4.	10.77.	"	NT.0318.8491.
S.831.	33.6.	10.24.	"	NT.0316.8497.
S.832.	33.9.	10.32.	"	NT.0315.8503.
S.833.	37.5.	11.41.	"	NT.0316.8499.
S.834.	40.7.	12.41.	"	NT.0317.8501.
S.835.	42.9.	13.06.	"	NT.0314.8505.
S.836.	35.9.	10.93.	"	NT.0312.8509.
S.837.	39.2.	11.95.	"	NT.0311.8512.
S.838.	40.5.	12.36.	"	NT.0310.8516.
S.839.	42.1.	12.82.	"	NT.0308.8519.
S.840.	103.5.	31.53.	- 0.04.	NT.0311.8631.
S.841.	102.8.	31.32.	"	NT.0308.8638.
S.842.	103.8.	31.64.	"	NT.0303.8642.
S.843.	103.8.	31.64.	"	NT.0281.8642.
S.844.	104.5.	31.84.	"	NT.0275.8643.
S.845.	102.1.	31.11.	"	NT.0270.8644.
S.846.	90.7.	27.64.	"	NT.0252.8640.
S.847.	93.6.	28.53.	"	NT.0243.8641.
S.848.	94.6.	28.83.	"	NT.0234.8642.
S.849.	94.6.	28.83.	"	NT.0215.8646.
S.850.	94.6.	28.83.	"	NT.0191.8648.
S.851.	94.0.	28.65.	"	NT.0183.8644.
S.852.	95.8.	29.19.	"	NT.0174.8644.
S.853.	96.1.	29.30.	"	NT.0167.8642.
S.854.	97.9.	29.85.	"	NT.0160.8643.
S.855.	94.3.	29.75.	0.00	NT.0093.8712.
S.856.	98.9.	30.15.	"	NT.0093.8716.
S.857.	97.9.	29.84.	"	NT.0088.8720.
S.858.	93.5.	28.51.	"	NT.0086.8716.
S.859.	98.0.	29.88.	"	NT.0102.8710.
S.860.	100.5.	30.62.	"	NT.0109.8706.
S.861.	6.6.	2.01.	0.00.	NT.0251.8567.
S.862.	7.1.	2.13.	"	NT.0246.8573.
S.863.	5.9.	1.80.	"	NT.0240.8580.
S.864.	5.2.	1.60.	"	NT.0236.8588.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
S.865.	5.3.	1.61.	"	NT.0231.8593.
S.866.	5.4.	1.66.	"	NT.0225.8599.
S.867.	5.2.	1.60.	"	NT.0220.8604.
S.868.	5.5.	1.70.	"	NT.0214.8609.
S.869.	5.4.	1.66.	"	NT.0210.8613.
S.870.	5.7.	1.75.	"	NT.0204.8617.
S.871.	5.3.	1.63.	"	NT.0198.8619.
S.872.	5.0.	1.54.	"	NT.0189.8620.
S.873.	5.3.	1.61.	"	NT.0180.8620.
S.874.	5.5.	1.67.	"	NT.0173.8619.
S.875.	5.4.	1.64.	"	NT.0165.8619.
S.876.	5.3.	1.61.	"	NT.0159.8619.
S.877.	5.1.	1.55.	"	NT.0151.8618.
S.878.	5.4.	1.64.	"	NT.0144.8617.
S.879.	31.1.	9.47.	- 0.05.	NT.0257.8588.
S.880.	31.5.	9.59.	"	NT.0256.8593.
S.881.	33.1.	10.05.	"	NT. 0256.8598.
S.882.	32.1.	9.74.	"	NT.0259.8583.
S.883.	13.6.	4.13.	"	NT.0249.8584.
S.884.	13.2.	4.01.	"	NT.0253.8582.
S.885.	13.1.	3.99.	"	NT.0253.8577.
S.886.	16.5.	5.04.	"	NT.0262.8571.
S.887.	21.5.	6.54.	"	NT.0265.8568.
S.888.	19.2.	5.84.	"	NT.0268.8564.
S.889.	12.8.	3.91.	"	NT.0271.8559.
S.890.	100.0.	30.48.	- 0.01.	NT.0651.8480.
S.891.	100.3.	30.56.	"	NT.0655.8480.
S.892.	101.1.	30.78.	"	NT.0662.8481.
S.893.	98.4.	30.00.	"	NT.0657.8477.
S.894.	100.8.	30.72.	"	NT.0668.8473.
S.895.	100.1.	30.50.	"	NT.0655.8472.
S.896.	89.1.	27.17.	- 0.01.	NT.0638.8400.
S.897.	89.9.	27.39.	"	NT.0632.8408.
S.898.	87.2.	26.58.	"	NT.0629.8412.
S.899.	86.2.	26.29.	"	NT.0629.8400.
S.900.	85.6.	26.09.	"	NT.0610.8391.
S.901.	85.9.	26.18.	"	NT.0621.8422.
S.902.	87.6.	26.69.	"	NT.0613.8430.
S.903.	90.7.	27.64.	"	NT.0607.8431.
S.904.	97.1.	29.60.	- 0.02.	NT.0495.8463.
S.905.	100.5.	30.63.	"	NT.0489.8464.
S.906.	100.4.	30.61.	"	NT.0490.8460.
S.907.	99.3.	30.27.	"	NT.0501.8460.
S.908.	96.1.	29.29.	"	NT.0510.8460.
S.909.	94.5.	28.79.	"	NT.0520.8460.
S.910.	93.1.	28.34.	"	NT.0512.8453.
S.911.	94.4.	28.76.	"	NT.0520.8451.
S.912.	93.6.	28.54.	"	NT.0530.8451.
S.913.	92.7.	28.27.	"	NT.0528.8460.
S.914.	92.5.	28.21.	"	NT.0536.8460.
S.915.	92.4.	28.15.	"	NT.0545.8462.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
S.916.	92.6.	28.22.	"	NT.0545.8462.
S.917.	91.8.	27.99.	"	NT.0536.8451.
S.918.	91.8.	27.97.	"	NT.0542.8452.
S.919.	91.6.	27.91.	"	NT.0550.8454.
S.920.	93.8.	28.60.	"	NT.0555.8460.
S.921.	97.7.	29.76.	"	NT.0565.8448.
S.922.	94.9.	28.93.	"	NT.0574.8440.
S.923.	94.9.	28.92.	"	NT.0584.8447.
S.924.	95.1.	28.98.	"	NT.0591.8449.
S.925.	94.7.	28.85.	"	NT.0572.8465.
S.926.	99.1.	30.22.	"	NT.0584.8468.
S.927.	94.6.	28.83.	"	NT.0681.0463.
S.928.	131.4.	40.04.	- 0.02.	NN.7204.0252.
S.929.	125.9.	38.36.	"	NN.7217.0246.
S.930.	125.4.	38.21.	"	NN.7221.0242.
S.931.	125.7.	38.30.	"	NN.7228.0238.
S.932.	124.8.	38.05.	0.00.	NN.7173.0075.
S.933.	125.5.	38.27.	"	NN.7168.0079.
S.934.	126.5.	38.57.	"	NN.7164.0085.
S.935.	128.2.	39.09.	"	NN.7160.0090.
S.936.	125.4.	38.23.	"	NN.7143.0107.
S.937.	127.5.	38.87.	"	NN.7141.0113.
S.938.	122.0.	37.20.	- 0.02.	NN.7203.0048.
S.939.	121.1.	36.91.	"	NN.7203.0042.
S.940.	119.4.	36.39.	"	NN.7203.0036.
S.941.	118.9.	36.24.	"	NN.7207.0029.
S.942.	119.8.	36.53.	"	NN.7209.0022.
S.943.	119.4.	36.41.	"	NN.7209.0016.
S.944.	119.1.	36.31.	"	NN.7208.0007.
S.945.	115.0.	35.07.	"	NN.7220.0014.
S.946.	113.9.	34.73.	"	NN.7221.0007.
S.947.	116.7.	35.58.	"	NN.7223.0001.
S.948.	111.8.	34.09.	"	NS.7233.9993.
S.949.	124.3.	37.90.	"	NS.7231.9982.
S.950.	116.1.	35.40.	"	NN.7220.0022.
S.951.	117.0.	35.67.	"	NN.7215.0033.
S.952.	133.9.	40.82.	+ 0.07.	NS.7464.9962.
S.953.	133.4.	40.65.	"	NS.7470.9954.
S.954.	132.9.	40.51.	"	NS.7473.9943.
S.955.	133.6.	40.72.	"	NS.7478.9928.
S.956.	129.1.	39.31.	"	NS.7479.9921.
S.957.	127.1.	38.70.	"	NS.7478.9915.
S.958.	121.6.	37.05.	"	NS.7478.9906.
S.959.	121.5.	37.02.	"	NS.7479.9898.
S.960.	119.1.	36.26.	"	NS.7481.9892.
S.961.	116.4.	35.47.	"	NS.7484.9887.
S.962.	119.1.	36.26.	"	NS.7486.9883.
S.963.	114.3.	34.83.	"	NS.7483.9882.
S.964.	115.0.	35.06.	"	NS.7489.9878.
S.965.	116.9.	35.62.	"	NS.7493.9873.
S.966.	114.3.	34.84	"	NS.7498.9868.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
S.967.	112.1.	34.17.	"	NS.7500.9859.
S.968.	110.7.	33.74.	"	NS.7503.9852.
S.969.	131.7.	40.15.	- 0.05.	NN.7290.0195.
S.970.	131.8.	40.17.	"	NN.7293.0192.
S.971.	130.6.	39.82.	"	NN.7286.0189.
S.972.	130.7.	39.82.	"	NN.7302.0188.
S.973.	129.7.	39.53.	"	NN.7305.0184.
S.974.	126.9.	39.30.	"	NN.7310.0182.
S.975.	126.1.	38.43.	"	NN.7312.0181.
S.976.	112.6.	34.32.	+ 0.06.	NS.7298.9932.
S.977.	113.0.	34.45.	"	NS.7290.9935.
S.978.	113.5.	34.60.	"	NS.7283.9937.
S.979.	113.5.	34.60.	"	NS.7278.9940.
S.980.	114.1.	34.78.	"	NS.7252.9950.
S.981.	115.1.	35.04.	"	NS.7248.9957.
S.982.	115.5.	35.20.	"	NS.7244.9964.
S.983.	114.3.	34.83.	"	NS.7241.9971.
S.984.	115.0.	35.06.	"	NS.7239.9982.
S.985.	113.8.	34.68.	"	NS.7258.9842.
S.986.	76.3.	23.25.	"	NN.7228.0062.
S.987.	77.8.	23.70.	"	NN.7223.0067.
S.988.	79.3.	24.18.	"	NN.7218.0070.
S.989.	81.2.	24.76.	"	NN.7211.0073.
S.990.	61.0.	18.57.	"	NN.7247.0056.
S.991.	60.1.	18.31.	"	NN.7253.0055.
S.992.	68.1.	20.72.	- 0.01.	NN.7310.0034.
S.993.	68.4.	20.85.	"	NN.7312.0043.
S.994.	69.4.	21.15.	"	NN.7326.0025.
S.995.	67.0.	20.43.	"	NN.7335.0017.
S.996.	57.0.	17.37.	+ 0.04.	NS.7330.9986.
S.997.	54.5.	16.57.	"	NS.7331.9978.
S.998.	55.5.	16.93.	"	NS.7330.9972.
S.999.	53.7.	16.37.	"	NS.7334.9972.
S.1000.	52.1.	15.88.	"	NS.7335.9968.
S.1001.	51.0.	15.62.	"	NS.7335.9966.
S.1002.	59.6.	15.11.	"	NS.7337.9960.
S.1003.	47.3.	14.43.	"	NS.7361.9912.
S.1004.	47.1.	14.35.	"	NS.7368.9906.
S.1005.	42.6.	12.98.	"	NS.7375.9900.
S.1006.	42.3.	12.90.	"	NS.7379.9895.
S.1007.	42.4.	12.93.	"	NS.7383.9889.
S.1008.	42.6.	12.97.	"	NS.7388.9884.
S.1009.	43.1.	13.13.	"	NS.7392.9880.
S.1010.	43.2.	13.16.	"	NS.7398.9876.
S.1011.	42.7.	13.01.	"	NS.7403.9875.
S.1012.	41.6.	12.67.	"	NS.7408.9874.
S.1013.	45.1.	13.74.	"	NS.7371.9892.
S.1014.	45.4.	13.84.	"	NS.7368.9896.
S.1015.	46.8.	14.27.	+ 0.08.	NS.9334.8788.
S.1016.	48.4.	14.74.	"	NS.9336.8783.
S.1017.	48.3.	14.73.	"	NS.9336.8780.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
S.1018.	48.2.	14.68.	"	NS.9337.8775.
S.1019.	45.1.	13.75.	"	NS.9337.8771.
S.1020.	106.2.	32.36.	+ 0.05.	NS.9363.8771.
S.1021.	105.7.	32.21.	"	NS.9368.8766.
S.1022.	103.7.	31.60.	"	NS.9372.8758.
S.1023.	104.9.	31.96.	"	NS.9378.8752.
S.1024.	106.1.	32.33.	"	NS.9387.8747.
S.1025.	163.3.	49.78.	+ 0.07.	NS.9403.8758.
S.1026.	161.1.	49.11.	"	NS.9407.8756.
S.1027.	161.4.	49.20.	"	NS.9411.8753.
S.1028.	161.4.	49.20.	"	NS.9413.8751.
S.1029.	160.2.	48.83.	"	NS.9419.8749.
S.1030.	97.1.	29.56.	+ 0.03.	NS.9554.9792.
S.1031.	104.4.	31.82.	"	NS.9554.9792.
S.1032.	103.2.	31.45.	"	NS.9538.9791.
S.1033.	110.4.	33.64.	"	NS.9528.9795.
S.1034.	108.7.	33.12.	"	NS.9543.9799.
S.1035.	112.2.	34.21.	"	NS.9560.9792.
S.1036.	91.1.	27.72.	+ 0.14 corr	NS.9383.9741.
S.1037.	90.4.	27.54.	"	NS.9376.9741.
S.1038.	95.2.	29.02.	"	NS.9380.9747.
S.1039.	95.5.	29.11.	"	NS.9374.9747.
S.1040.	131.6.	40.11.	+ 0.03.	NS.9249.9736.
S.1041.	130.5.	39.78.	"	NS.9248.9736.
S.1042.	130.5.	39.78.	"	NS.9246.9736.
S.1043.	118.4.	36.09.	+ 0.10.	NN.7173.0201.
S.1044.	114.1.	34.74.	"	NN.7165.0211.
S.1045.	110.7.	33.74.	"	NN.7147.0213.
S.1046.	-	-	-	-
S.1047.	108.8.	3317.	+ 0.05.	NN.7203.0105.
S.1048.	109.2.	33.29.	"	NN.7198.0107.
S.1049.	110.1.	33.57.	"	NN.7191.0111.
S.1050.	104.1.	31.69.	"	NN.7200.0116.
S.1051.	26.1.	7.95.	+ 0.02.	NS.6473.9707.
S.1052.	25.5.	7.76.	"	NS.6473.9707.
S.1053.	20.5.	6.25.	"	NS.6473.9707.
S.1054.	44.8.	13.66.	+ 0.08.	NS.6021.9997.
S.1055.	43.6.	13.30.	"	NN.6028.0000.
S.1056.	42.8.	13.04.	"	NN.6040.0007.
S.1057.	47.7.	14.54.	"	NN.6042.0011.
S.1058.	48.2.	14.70.	"	NN.6038.0013.
S.1059.	47.5.	14.48.	"	NN.6049.0017.
S.1060.	48.6.	14.81.	"	NN.6058.0021.
S.1061.	48.1.	14.67.	"	NN.6070.0036.
S.1062.	47.8.	14.56.	"	NN.6121.0046.
S.1063.	47.8.	14.56.	"	NN.6168.0043.
S.1064.	46.3.	14.10.	"	NN.6239.0022.
S.1065.	69.6.	21.21.	0.00.	NS.6782.9866.
S.1066.	68.4.	20.84.	"	NS.6788.9862.
S.1067.	67.2.	20.48.	"	NS.6793.9858.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
S.1068.	63.9.	19.46.	"	NS.6801.9849.
S.1069.	61.2.	18.67.	0.00.	NS.6843.9824.
S.1070.	65.7.	20.09.	"	NS.6850.9827.
S.1071.	69.3.	21.11.	"	NS.6857.9828.
S.1072.	89.6.	27.30.	0.00.	NS.6654.9966.
S.1073.	88.5.	26.98.	"	NS.6661.9963.
S.1074.	88.8.	27.06.	"	NS.6669.9961.
S.1075.	108.2.	32.97.	0.00.	NS.8839.9527.
S.1076.	110.2.	33.58.	"	NS.8830.9516.
S.1077.	111.8.	34.06.	"	NS.8825.9517.
S.1078.	114.7.	34.95.	"	NS.8820.9522.
S.1079.	107.4.	32.72.	"	NS.8857.9513.
S.1080.	41.1.	12.52.	0.00.	NS.8990.9710.
S.1081.	42.7.	13.01.	"	NS.8998.9712.
S.1082.	42.6.	12.98.	"	NS.9004.9716.
S.1083.	40.9.	12.46.	"	NS.9013.9716.
S.1084.	43.6.	13.29.	"	NS.9022.9716.
S.1085.	42.2.	12.86.	"	NS.9033.9713.
S.1086.	41.3.	12.59.	"	NS.9042.9710.
S.1087.	64.5.	19.66.	+ 0.01.	NS.9246.9660.
S.1088.	65.1.	19.84.	"	NS.9241.9661.
S.1089.	65.2.	19.26.	"	NS.9240.9658.
S.1090.	64.5.	19.66.	"	NS.9243.9657.
S.1091.	43.2.	13.16.	0.00.	NS.8599.9714.
S.1092.	42.6.	12.97.	"	NS.8606.9715.
S.1093.	43.3.	13.19.	"	NS.8617.9716.
S.1094.	42.7.	12.94.	"	NS.8625.9719.
S.1095.	43.8.	13.34.	"	NS.8634.9733.
S.1096.	62.1.	18.89.	0.00.	NS.8539.9709.
S.1097.	63.6.	19.38.	"	NS.8534.9708.
S.1098.	65.7.	20.03.	"	NS.8528.9706.
S.1099.	39.2.	11.95.	0.00.	NS.8342.9681.
S.1100.	39.2.	11.95.	"	NS.8335.9681.
S.1101.	39.3.	11.97.	"	NS.8326.9681.
S.1102.	40.1.	12.21.	"	NS.8316.9682.
S.1103.	41.1.	12.52.	"	NS.8308.9683.
S.1104.	27.2.	8.30.	0.00.	NS.8643.9376.
S.1105.	28.7.	8.76.	"	NS.8651.9370.
S.1106.	27.5.	8.39.	"	NS.8669.9382.
S.1107.	26.8.	8.18.	"	NS.8677.9378.
S.1108.	27.1.	8.27.	"	NS.8684.9372.
S.1109.	26.3.	8.03.	"	NS.8690.9367.
S.1110.	26.2.	8.00.	"	NS.8694.9359.
S.1111.	131.9.	40.20.	+ 0.04.	NS.8062.9690.
S.1112.	129.1.	39.35.	"	NS.8071.9688.
S.1113.	128.7.	39.22.	"	NS.8080.9683.
S.1114.	127.7.	38.92.	"	NS.8089.9685.
S.1115.	127.1.	38.70.	"	NS.8093.9689.
S.1116.	133.0.	40.55.	"	NS.8056.9593.
S.1117.	133.8.	40.79.	"	NS.8051.9695.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
S.1118.	134.3.	40.93.	"	NS.8045.9699.
S.1119.	99.6.	30.35.	"	NN.6395.0074.
S.1120.	97.6.	29.75.	+ 0.09.	NN.6401.0074.
S.1121.	95.4.	29.07.	"	NN.6406.0072.
S.1122.	92.0.	28.02.	"	NN.6412.0069.
S.1123.	89.5.	27.29.	"	NN.6417.0066.
S.1124.	87.4.	26.64.	"	NN.6423.0062.
S.1125.	87.1.	26.56.	"	NN.6430.0060.
S.1126.	86.4.	26.35.	"	NN.6438.0060.
S.1127.	68.4.	20.86.	"	NN.6383.0047.
S.1128.	68.5.	20.87.	"	NN.6387.0043.
S.1129.	68.7.	20.95.	"	NN.6390.0040.
S.1130.	65.9.	20.09.	"	NN.6410.0025.
S.1131.	66.5.	20.25.	"	NN.6416.0024.
S.1132.	46.4.	14.16.	"	NN.6408.0017.
S.1133.	46.8.	14.27.	"	NN.6401.0020.
S.1134.	46.6.	14.19.	"	NN.6396.0024.
S.1135.	46.7.	14.22.	"	NN.6388.0029.
S.1136.	46.8.	14.29.	"	NN.6379.0032.
S.1137.	46.6.	14.20.	"	NN.6415.0013.
S.1138.	46.3.	14.10.	"	NN.6422.0011.
S.1139.	45.7.	13.94.	"	NN.6428.0011.
S.1140.	46.1.	14.01.	"	NN.6432.0012.
S.1141.	45.7.	13.94.	"	NN.6438.0012.
S.1142.	46.1.	14.01.	"	NN.6445.0016.
S.1143.	48.8.	14.88.	"	NN.6458.0018.
S.1144.	58.2.	17.73.	"	NN.6443.0026.
S.1145.	61.1.	18.61.	"	NN.6454.0030.
S.1146.	67.0.	20.39.	"	NN.6470.0038.
S.1147.	68.3.	20.82.	"	NN.6476.0041.
S.1148.	72.7.	22.17.	"	NN.6480.0045.
S.1149.	76.0.	23.17.	"	NN.6445.0062.
S.1150.	87.3.	26.61.	"	NN.6458.0060.
S.1151.	86.0.	26.19.	"	NN.6463.0062.
S.1152.	92.0.	28.02.	"	NN.6468.0063.
S.1153.	90.4.	27.57.	"	NN.6471.0059.
S.1154.	91.2.	27.80.	"	NN.6478.0060.
S.1155.	93.2.	28.40.	"	NN.6480.0061.
S.1156.	48.5.	14.77.	"	NN.6524.0007.
S.1157.	47.9.	14.59.	"	NN.6523.0003.
S.1158.	45.2.	13.79.	"	NN.6521.0001.
S.1159.	46.7.	14.22.	"	NS.6517.9998.
S.1160.	45.7.	13.94.	"	NS.6518.9992.
S.1161.	45.6.	13.91.	"	NS.6518.9984.
S.1162.	45.5.	13.87.	"	NS.6518.9977.
S.1163.	45.2.	13.78.	"	NS.6518.9970.
S.1164.	44.8.	13.66.	"	NS.6520.9963.
S.1165.	45.1.	13.74.	"	NS.6513.9950.
S.1166.	44.5.	13.55.	"	NS.6512.9944.
S.1167.	43.8.	13.34.	"	NS.6512.9938.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
S.1168.	45.0.	13.69.	"	NS.6513.9932.
S.1169.	45.3.	13.79.	"	NS.6514.9925.
S.1170.	44.0.	13.42.	"	NS.6515.9916.
S.1171.	44.3.	13.51.	"	NS.6511.9911.
S.1172.	43.8.	13.35.	"	NS.6511.9904.
S.1173.	43.4.	13.23.	"	NS.6511.9898.
S.1174.	43.9.	13.37.	"	NS.6512.9889.
S.1175.	44.1.	13.40.	"	NS.6512.9883.
S.1176.	44.4.	13.52.	"	NS.6512.9973.
S.1177.	44.4.	13.55.	"	NS.6513.9968.
S.1178.	46.3.	14.10.	"	NS.6513.9864.
S.1179.	54.9.	16.73.	"	NS.6513.9862.
S.1180.	58.8.	17.92.	"	NS.6514.9856.
S.1181.	58.5.	17.82.	"	NS.6514.9849.
S.1182.	58.8.	17.93.	"	NS.6514.9842.
S.1183.	59.2.	18.03.	"	NS.6515.9835.
S.1184.	59.2.	18.06.	"	NS.6515.9827.
S.1185.	59.3.	18.07.	"	NS.6516.9820.
S.1186.	57.6.	17.56.	"	NS.6515.9812.
S.1187.	57.8.	17.62.	"	NS.6515.9804.
S.1188.	55.9.	17.03.	"	NS.6515.9797.
S.1189.	46.8.	14.28.	"	NS.6516.9793.
S.1190.	45.6.	13.89.	"	NS.6516.9788.
S.1191.	45.3.	13.80.	"	NS.6516.9780.
S.1192.	45.3.	13.79.	"	NS.6516.9772.
S.1193.	44.8.	13.65.	"	NS.6511.9762.
S.1194.	44.5.	13.55.	"	NS.6510.9756.
S.1195.	45.1.	13.70.	"	NS.6511.9748.
S.1196.	44.3.	13.51.	"	NS.6511.9740.
S.1197.	43.8.	13.34.	"	NS.6511.9732.
S.1198.	43.3.	13.21.	"	NS.6511.9726.
S.1199.	43.1.	13.13.	"	NS.6511.9728.
S.1200.	42.3.	12.91.	"	NS.6511.9712.
S.1201.	42.4.	12.94.	"	NS.6512.9706.
S.1202.	41.7.	12.71.	- 0.02.	NS.6514.9698.
S.1203.	113.7.	34.66.	+ 0"05.	NT.0038.8770.
S.1204.	100.1.	30.51.	"	NT.0020.8760.
S.1205.	99.2.	30.24.	"	NT.0018.8766.
S.1206.	116.7.	35.57.	"	NT.0041.8775.
S.1207.	118.0.	35.97.	"	NT.0049.8780.
S.1208.	121.4.	37.00.	"	NT.0060.8782.
S.1209.	132.1.	40.26.	+ 0.05.	NS.9951.8763.
S.1210.	132.5.	40.39.	"	NS.9955.8760.
S.1211.	131.8.	40.17.	"	NS.9960.8757.
S.1212.	104.0.	31.70.	0.00.	NS.9979.8756.
S.1213.	103.9.	31.67.	"	NS.9982.8750.
S.1214.	103.5.	31.55.	"	NS.9983.8742.
S.1215.	101.9.	31.06.	"	NT.0002.8729.
S.1216.	100.1.	30.51.	"	NT.0004.8721.
S.1217.	99.6.	30.36.	"	NT.0008.8715.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
S.1218.	99.2.	30.24.	"	NT.0013.8709.
S.1219.	99.0.	30.18.	"	NT.0019.8703.
S.1220.	95.6.	29.14.	+ 0.02.	NT.0007.8828.
S.1221.	96.4.	29.38.	"	NT.0010.8820.
S.1222.	98.5.	30.02.	"	NT.0014.8813.
S.1223.	98.1.	29.87.	"	NT.0019.8809.
S.1224.	99.3.	30.27.	"	NT.0023.8804.
S.1225.	42.7.	13.02.	0.00.	NS.6776.9835.
S.1226.	43.3.	13.20.	"	NS.6783.9836.
S.1227.	42.8.	13.05.	"	NS.6790.9833.
S.1228.	42.7.	13.02.	"	NS.6793.9828.
S.1229.	42.3.	12.89.	"	NS.6804.9826.
S.1230.	42.4.	12.92.	"	NS.6812.9826.
S.1231.	42.5.	12.94.	"	NS.6819.9823.
S.1232.	42.4.	12.92.	"	NS.6826.9818.
S.1233.	42.3.	12.89.	"	NS.6831.9812.
S.1234.	43.7.	13.32.	"	NS.6772.9844.
S.1235.	43.5.	13.26.	"	NS.6773.9856.
S.1236.	43.7.	13.32.	"	NS.6767.9862.
S.1237.	43.9.	13.38.	"	NS.6760.9868.
S.1238.	43.8.	13.35.	"	NS.6750.9872.
S.1239.	43.5.	13.26.	"	NS6739.9872.
S.1240.	73.8.	22.49.	- 0.01.	NS.7040.9849.
S.1241.	69.7.	21.24.	"	NS.7049.9852.
S.1242.	70.5.	21.48.	"	NS.7056.9857.
S.1243.	64.6.	19.68.	"	NS.7061.9858.
S.1244.	62.1.	18.93.	"	NS.7059.9854.
S.1245.	62.9.	19.18.	"	NS.7053.9850.
S.1246.	64.3.	19.60.	"	NS.7048.9848.
S.1247.	80.0.	24.39.	"	NS.7032.9846.
S.1248.	83.1.	25.29.	"	NS.7028.9845.
S.1249.	86.0.	26.22.	"	NS.7022.9843.
S.1250.	41.1.	12.50.	0.00.	NS.7024.9810.
S.1251.	41.0.	12.50.	"	NS.7028.9818.
S.1252.	40.4.	12.30.	"	NS.7034.9819.
S.1253.	41.1.	12.51.	"	NS.7045.9822.
S.1254.	41.4.	12.60.	"	NS.7052.9827.
S.1255.	40.7.	12.39.	"	NS.7060.9829.
S.1256.	40.8.	12.44.	"	NS.7069.9832.
S.1257.	41.3.	12.57.	"	NS.7016.9807.
S.1258.	41.1.	12.53.	"	NS.7008.9804.
S.1259.	41.4.	12.60.	"	NS.7000.9804.
S.1260.	41.4.	12.62.	"	NS.6991.9805.
S.1261.	42.9.	13.06.	"	NS.6980.9806.
S.1262.	42.3.	12.88.	"	NS.6971.9808.
S.1263.	42.2.	12.85.	"	NS.6965.9806.
S.1264.	41.9.	12.76.	"	NS.6959.9803.
S.1265.	41.5.	12.63.	"	NS.6951.9802.
S.1266.	41.4.	12.60.	"	NS.6942.9801.
S.1267.	45.2.	13.77.	0.00.	NS.7141.9846.
S.1268.	44.6.	13.59.	"	NS.7135.9851.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
S.1269.	44.7.	13.63.	"	NS.7129.9859.
S.1270.	46.1.	14.01.	"	NS.7122.9862.
S.1271.	47.3.	14.42.	"	NS.7113.9865.
S.1272.	43.5.	13.25.	"	NS.7088.9865.
S.1273.	44.1.	13.40.	"	NS.7081.9861.
S.1274.	44.4.	13.52.	"	NS.7077.9858.
S.1275.	42.7.	13.01.	"	NS.7093.9853.
S.1276.	44.5.	13.57.	"	NS.7105.9849.
S.1277.	40.0.	12.16.	0.00.	NS.7342.9818.
S.1278.	40.2.	12.25.	"	NS.7349.9818.
S.1279.	40.0.	12.16.	"	NS.7354.9810.
S1280.	39.7.	12.09.	"	NS.7361.9807.
S.1281.	39.3.	11.96.	"	NS.7367.9803.
S.1282.	39.1.	11.90.	"	NS.7372.9800.
S.1283.	38.9.	11.86.	"	NS.7378.9795.
S.1284.	39.1.	11.87.	"	NS.7383.9790.
S1285.	39.2.	11.95.	"	NS.7378.9783.
S.1286.	38.4.	11.70.	"	NS.7372.9776.
S.1287.	38.7.	11.80.	"	NS.7386.9798.
S.1288.	40.3.	12.27.	"	NS.7390.9805.
S.1289.	39.0.	11.89.	"	NS.7390.9785.
S.1290.	37.8.	11.51.	"	NS.7397.9782.
S.1291.	38.2.	11.63.	"	NS.7407.9780.
S.1292.	37.9.	11.54.	"	NS.7412.9780.
S.1293.	37.9.	11.54.	"	NS.7418.9781.
S.1294.	36.6.	11.14.	"	NS.7424.9783.
S.1295.	37.4.	11.35.	"	NS.7437.9791.
S.1296.	38.3.	11.66.	"	NS.7442.9805.
S.1297.	39.5.	12.04.	"	NS.7413.9813.
S.1298.	41.8.	12.73.	"	NS.7394.9815.
S.1299.	22.1.	6.70.	+ 0.02.	NS.7509.9714.
S.1300.	22.1.	6.73.	"	NS.7498.9712.
S.1301.	22.1.	6.73.	"	NS.7497.9718.
S.1302.	22.6.	6.89.	"	NS.7499.9725.
S.1303.	23.1.	7.00.	"	NS.7495.9743.
S.1304.	23.3.	7.11.	"	NS.7492.9748.
S.1305.	24.3.	7.41.	"	NS.7495.9753.
S.1306.	24.1.	7.34.	"	NS.7500.9758.
S.1307.	23.7.	7.24.	+ 0.05.	NS.9293.8916.
S.1308.	23.5.	7.16.	"	NS.9269.9004.
S.1309.	23.3.	7.09.	"	NS.9262.9007.
S.1310.	22.4.	6.84.	"	NS.9255.9010.
S.1311.	22.4.	6.82.	"	NS.9246.9016.
S.1312.	22.1.	6.75.	"	NS.9238.9018.
S.1313.	22.6.	6.89.	"	NS.9232.9023.
S.1314.	22.4.	6.83.	"	NS.9225.9029.
S.1315.	22.2.	6.78.	"	NS.9217.9032.
S.1316.	21.9.	6.68.	"	NS.9208.9035.
S.1317.	22.3.	6.78.	"	NS.9203.9040.
S.1318.	22.1.	6.73.	"	NS.9194.9044.
S.1319.	23.4.	7.13.	"	NS.9163.9069.
S.1320.	22.9.	6.99.	"	NS.9149.9081.
S.1321.	24.2.	7.37.	"	NS.9148.9092.
S.1322.	24.9.	7.57.	"	NS.9142.9097.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
S.1323.	25.3.	7.72.	"	NS.9138.9099.
S.1324.	22.9.	6.97.	"	NS.9131.9097.
S.1325.	22.6.	6.89.	"	NS.9120.9106.
S.1326.	22.8.	6.94.	"	NS.9117.9110.
S.1327.	22.4.	6.83.	"	NS.9114.9116.
S.1328.	21.4.	6.51.	"	NS.9111.9123.
S.1329.	21.0.	6.39.	"	NS.9107.9130.
S.1330.	20.8.	6.35.	"	NS.9103.9137.
S.1331.	25.5.	7.78.	"	NS.9099.9142.
S.1332.	21.2.	6.45.	"	NS.9093.9139.
S.1333.	21.9.	6.67.	"	NS.9093.9145.
S.1334.	22.7.	6.91.	"	NS.9088.9150.
S.1334.	25.8.	7.87.	"	NS.9082.9158.
S.1336.	26.8.	8.18.	"	NS.9087.9156.
S.1337.	17.0.	5.17.	- 0.10.	NS.9052.9137.
S.1338.	14.7.	4.49.	"	NS.9052.9129.
S.1339.	14.0.	4.27.	"	NS.9050.9120.
S.1340.	13.5.	4.12.	"	NS.9047.9111.
S.1341.	11.3.	3.45.	"	NS.9047.9099.
S.1342.	8.6.	2.63.	"	NS.9049.9091.
S.1343.	11.5.	3.51.	"	NS.9049.9081.
S.1344.	8.4.	2.55.	"	NS.9048.9073.
S.1345.	8.3.	2.53.	"	NS.9048.9063.
S.1346.	8.0.	2.43.	"	NS.9048.9054.
S.1347.	8.0.	2.42.	"	NS.9048.9047.
S.1348.	7.5.	2.28.	"	NS.9047.9041.
S.1349.	7.3.	2.23.	"	NS.9040.9033.
S.1350.	8.0.	2.45.	"	NS.9031.9026.
S.1351.	7.4.	2.26.	"	NS.9030.9017.
S.1352.	7.9.	2.40.	"	NS.9033.9007.
S.1353.	5.3.	1.61.	"	NS.9036.9001.
S.1354.	3.5.	1.05.	"	NS.9046.8987.
S.1355.	7.0.	2.13.	"	NS.9082.8953.
S.1356.	70.7.	21.53.	+ 0.02.	NS.9078.9278.
S.1357.	71.4.	21.78.	"	NS.9086.9278.
S.1358.	72.4.	22.07.	"	NS.9093.9278.
S.1359.	72.6.	22.11.	"	NS.9106.9276.
S.1360.	72.9.	22.23.	"	NS.9112.9274.
S.1361.	71.4.	21.75.	"	NS.9070.9279.
S.1362.	73.6.	22.43.	"	NS.9002.9280.
S.1363.	73.3.	22.33.	"	NS.9054.9280.
S.1364.	72.0.	21.93.	"	NS.9047.9281.
S.1365.	73.6.	22.42.	"	NS.9042.9282.
S.1366.	107.7.	32.82.	0.00.	NS.9836.8893.
S.1367.	108.4.	33.03.	"	NS.9833.8897.
S.1368.	108.7.	33.14.	"	NS.9830.8901.
S.1369.	120.2.	36.63.	0.00.	NS.9845.8950.
S.1370.	119.2.	36.33.	"	NS.9848.8951.
S.1371.	118.7.	36.19.	"	NS.9852.8951.
S.1372.	117.9.	35.93.	"	NS.9854.8951.
S.1373.	35.1.	10.69.	+ 0.03.	NS.7769.9804.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
S.1374.	34.7.	10.56.	"	NS.7767.9797.
S.1375.	34.5.	10.51.	"	NS.7767.9791.
S.1376.	34.1.	10.38.	"	NS.7767.9785.
S.1377.	33.3.	10.16.	"	NS.7766.9772.
S.1378.	33.9.	10.32.	"	NS.7767.9765.
S.1379.	33.9.	10.33.	"	NS.7768.9760.
S.1380.	33.6.	10.23.	"	NS.7768.9753.
S.1381.	33.2.	10.12.	"	NS.7768.9474.
S.1382.	32.4.	9.88.	"	NS.7769.9741.
S.1383.	33.2.	10.13.	"	NS.7749.9733.
S.1384.	32.7.	9.97.	"	NS.7749.9726.
S.1385.	32.8.	10.01.	"	NS.7749.9718.
S.1386.	32.9.	10.04.	"	NS.7750.9710.
S.1387.	32.2.	9.81.	"	NS.7764.9694.
S.1388.	32.3.	9.84.	"	NS.7763.9685.
S.1389.	32.5.	9.90.	"	NS.7761.9680.
S.1390.	32.2.	9.82.	"	NS.7760.9672.
S.1391.	31.9.	9.72.	"	NS.7758.9664.
S.1392.	32.5.	9.92.	"	NS.7759.9658.
S.1393.	32.0.	9.76.	"	NS.7761.9651.
S.1394.	32.1.	9.78.	"	NS.7763.9643.
S.1395.	32.0.	9.76.	"	NS.7767.9640.
S.1396.	31.1.	9.49.	0.00.	NS.7770.9630.
S.1397.	29.8.	9.08.	"	NS.7770.9622.
S.1398.	29.5.	8.99.	"	NS.7769.9614.
S.1399.	29.3.	8.93.	"	NS.7770.9605.
S.1400.	30.2.	9.22.	"	NS.7770.9596.
S.1401.	28.4.	8.65.	"	NS.7762.9588.
S.1402.	28.2.	8.59.	"	NS.7761.9581.
S.1403.	26.5.	8.08.	"	NS.7762.9575.
S.1404.	24.4.	7.44.	"	NS.7764.9569.
S.1405.	22.3.	6.79.	"	NS.7765.9562.
S.1406.	16.9.	5.14.	"	NS.7756.9554.
S.1407.	16.8.	5.12.	"	NS.7763.9555.
S.1408.	16.4.	5.00.	"	NS.7770.9557.
S.1409.	13.7.	4.18.	"	NS.7773.9560.
S.1410.	23.4.	7.14.	0.00.	NS.7620.9710.
S.1411.	22.9.	6.97.	"	NS.7621.9706.
S.1412.	22.6.	6.88.	"	NS.7620.9701.
S.1413.	22.5.	6.85.	"	NS.7619.9696.
S.1414.	22.6.	6.90.	"	NS.7617.9699.
S.1415.	23.4.	7.13.	"	NS.7620.9704.
S.1416.	20.2.	6.17.	"	NS.7606.9699.
S.1417.	21.0.	6.39.	"	NS.7609.9704.
S.1418.	34.2.	10.43.	+ 0.01.	NS.7612.9794.
S.1419.	35.4.	10.78.	"	NS.7608.9795.
S.1420.	36.7.	11.18.	"	NS.7610.9806.
S.1421.	35.6.	10.84.	"	NS.7614.9811.
S.1422.	38.1.	11.60.	"	NS.7613.9817.
S.1423.	38.1.	11.61.	"	NS.7620.9823.
S.1424.	37.7.	11.49.	"	NS.7628.9828.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
S.1425.	36.4.	11.09.	"	NS.7649.9823.
S.1426.	37.0.	11.29.	"	NS.7654.9822.
S.1427.	36.3.	11.05.	"	NS.7663.9822.
S.1428.	36.5.	11.13.	"	NS.7671.9820.
S.1429.	36.0.	10.97.	"	NS.7678.9819.
S.1430.	35.7.	10.88.	"	NS.7683.9818.
S.1431.	35.3.	10.76.	"	NS.7690.9817.
S.1432.	35.1.	10.70.	"	NS.7697.9817.
S.1433.	35.1.	10.70.	"	NS.7703.9820.
S.1434.	35.0.	10.65.	- 0.06.	NS.7717.9814.
S.1435.	36.1.	10.99.	"	NS.7716.9827.
S.1436.	37.2.	11.32.	"	NS.7723.9826.
S.1437.	35.6.	10.86.	"	NS.7753.9810.
S.1438.	35.0.	10.66.	"	NS.7761.9807.
S.1439.	151.9.	46.28.	0.00.	NS.7890.9800.
S.1440.	150.6.	45.89.	"	NS.7894.9799.
S.1441.	149.8.	45.66.	"	NS.7898.9796.
S.1442.	149.1.	45.45.	"	NS.7902.9795.
S.1443.	148.1.	45.14.	"	NS.7905.9794.
S.1444.	146.3.	44.60.	"	NS.7908.9793.
S.1445.	145.7.	44.41.	"	NS.7911.9791.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
F.1.	111.8.	34.07.	+ 0.06.	NO.6178.0886.
F.2.	113.4.	34.56.	"	NO.6173.0881.
F.3.	113.3.	34.53.	"	NO.6171.0876.
F.4.	113.6.	34.63.	"	NO.6168.0871.
F.5.	113.1.	34.47.	"	NO.6163.0864.
F.6.	21.9.	6.69.	+ 0.19 corr.	NO.5801.0437.
F.7.	23.6.	7.19.	"	NO.5808.0456.
F.8.	22.7.	6.90.	"	NO.5810.0460.
F.9.	21.1.	6.43.	"	NO.5812.0466.
F.10.	16.3.	4.98.	"	NO.5813.0452.
F.11.	15.2.	4.64.	"	NO.5818.0456.
F.12.	16.3.	4.98.	"	NO.5821.0476.
F.13.	16.9.	5.16.	"	NO.5828.0481.
F.14.	16.3.	4.98.	"	NO.5832.0484.
F.15.	15.0.	4.57.	"	NO.5837.0486.
F.16.	15.0.	4.58.	"	NO.5831.0482.
F.17.	99.2.	30.24.	- 0.02.	NO.5714.0515.
F.18.	98.9.	30.15.	"	NO.5705.0520.
F.19.	100.2.	30.53.	"	NO.5699.0523.
F.20.	99.3.	30.27.	"	NO.5710.0537.
F.21.	100.1.	30.50.	"	NO.5721.0534.
F.22.	120.7.	36.78.	- 0.02.	NO.5569.0550.
F.23.	121.4.	37.01.	"	NO.5573.0556.
F.24.	120.7.	36.78.	"	NO.5579.0561.
F.25.	121.9.	37.16.	"	NO.5584.0563.
F.26.	121.4.	37.02.	"	NO.5590.0567.
F.27.	108.7.	33.13.	+ 0.05.	NO.5377.0458.
F.28.	110.0.	33.52.	"	NO.5368.0457.
F.29.	110.2.	33.59.	"	NO.5358.0454.
F.30.	117.3.	35.74.	"	NO.5383.0479.
F.31.	114.6.	34.92.	"	NO.5393.0480.
F.32.	113.8.	34.69.	"	NO.5404.0479.
F.33.	113.3.	34.52.	"	NO.5418.0480.
F.34.	68.8.	20.98.	+ 0.10 corr.	NT.2942.9254.
F.35.	68.5.	20.89.	"	NT.2949.9256.
F.36.	64.0.	19.49.	"	NT.2956.9257.
F.37.	61.8.	18.84.	"	NT.2961.9257.
F.38.	60.2.	18.36.	"	NT.2967.9257.
F.39.	64.0.	19.49.	"	NT.2972.9255.
F.40.	94.1.	28.68.	+ 0.03.	NT.2708.9050.
F.41.	95.9.	29.23.	"	NT.2706.9065.
F.42.	94.4.	28.78.	"	NT.2709.9073.
F.43.	94.2.	28.72.	"	NT.2710.9079.
F.44.	103.7.	31.60.	"	NT.2678.9088.
F.45.	102.6.	31.27.	"	NT.2681.9090.
F.46.	105.7.	32.21.	"	NT.2675.9092.
F.47.	112.8.	34.38.	"	NT.2672.9099.
F.48.	113.6.	34.64.	"	NT.2670.9103.
F.49.	62.8.	19.14.	- 0.02.	NT.2329.8659.
F.50.	61.0.	18.58.	"	NT.2338.8659.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
F.51.	59.9.	18.24.	"	NT.2350.8655.
F.52.	67.1.	20.45.	+ 0.73 corr	NT.2213.8616.
F.53.	67.2.	20.47.	"	NT.2210.8614.
F.54.	68.1.	20.76.	"	NT.2206.8612.
F.55.	66.2.	20.18.	"	NT.2203.8611.
F.56.	79.6.	24.26.	+ 0.03.	NT.3252.9481.
F.57.	80,6.	24.58.	"	NT.3257.9487.
F.58.	82.1.	25.02.	"	NT.3260.9492.
F.59.	82.9.	25.26.	"	NT.3266.9497.
F.60.	82.6.	25.18.	"	NT.3271.9503.
F.61.	119.3.	36.37.	"	NT.2680.9163.
F.62.	121.2.	36.94.	"	NT.2673.9160.
F.63.	118.7.	36.19.	"	NT.2677.9156.
F.64.	117.8.	35.91.	"	NT.2682.9159.
F.65.	81.5.	24.84.	0.00.	NO.4760.0021.
F.66.	83.4.	25.42.	"	NO.4753.0020.
F.67.	84.3.	25.71.	"	NO.4748.0019.
F.68.	71.9.	21.92	+0.01/+0.32.	NT.4632.9979.
F.69.	71.9.	21.91	"	NT.4633.9981.
F.70.	80.5.	24/54	"	NT.4637.9981.
F.71.	80.2.	24.45	"	NT.4638.9979.
F.72.	36.9.	11.26	"	NT.4628.9980.
F.73.	37.7.	11.50	"	NT.4630.9983.
F.74.	38.1.	11.61	"	NT.4633.9988.
F.75.	37.4.	11.41	"	NT.4638.9990.
F.76.	13.2.	4.02	"	NT.4620.9982.
F.77.	12.8.	3.91	"	NT.4623.9985.
F.78.	12.3.	3.75	"	NT.4628.9988.
F.79.	12.2.	3.71	"	NT.4631.9993.
F.80.	12.0.	3.67	"	NT.4633.9996.
F.81.	44.3.	13.51	"	NO.4642.0011.
F.82.	34.6.	10.53	"	NO.4640.0019.
F.83.	34.9.	10.63	"	NO.4642.0023.
F.84.	34.9.	10.62	"	NO.4645.0028.
F.85.	34.9.	10.63	"	NO.4650.0032.
F.86.	34.9.	10.63	"	NO.4653.0034.
F.87.	38.9.	11.85.	"	NO.4691.0040.
F.88.	37.4.	11.39.	"	NO.4697.0041.
F.89.	36.5.	11.13.	"	NO.4703.0041.
F.90.	34.4.	10.48.	"	NO.4707.0041.
F.91.	163.0.	49.67.	+0.02.	NO.4303.0363.
F.92.	163.4.	49.81.	"	NO.4309.0363.
F.93.	163.4.	49.82.	"	NO.4297.0360.
F.94.	77.6.	23.66.	+0.03.	NO.4135.0324.
F.95.	77.4.	23.59.	"	NO.4135.0324.
F.96.	76.4.	23.28.	0.00.	NO.4096.0327.
F.97.	77.7.	23.68.	"	NO.4100.0331.
F.98.	79.3.	24.17.	"	NO.4103.0332.
F.99.	77.7.	24.31.	"	NO.4108.0330.
F.100.	77.9.	23.73.	"	NO.4109.0327.
F.101.	144.3.	43.97.	+0.02.	NO.4087.0392.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
F.102.	142.5.	43.43.	"	NO.4088.0390.
F.103.	141.1.	43.02.	"	NO.4089.0387.
F.104.	141.0.	42.97.	"	NO.4087.0383.
F.105.	142.1.	43.30.	"	NO.4085.0388.
F.106.	118.2.	36.03.	- 0.01.	NO.4073.0391.
F.107.	133.0.	40.53.	"	NO.4028.0357.
F.108.	133.2.	40.59.	"	NO.4032.0360.
F.109.	133.9.	40.83.	"	NO.4037.0364.
F.110.	136.6.	41.64.	"	NO.4041.0377.
F.111.	136.5.	41.60.	"	NO.4044.0380.
F.112.	81.0.	24.69.	+ 0.07.	NO.3989.0247.
F.113.	79.3.	24.16.	"	NO.3985.0247.
F.114.	79.1.	24.10.	"	NO.3980.0247.
F.115.	67.9.	20.71.	0.00.	NO.3738.0140.
F.116.	65.1.	19.84.	"	NO.3743.0142.
F.117.	64.1.	19.54.	"	NO.3740.0150.
F.118.	63.5.	19.34.	"	NO.3750.0152.
F.119.	119.3.	36.35.	+ 0.03.	NO.3530.0095.
F.120.	118.5.	36.12.	"	NO.3519.0088.
F.121.	91.7.	27.94.	"	NO.3513.0081.
F.122.	89.8.	27.36.	"	NO.3514.0077.
F.123.	113.7.	34.65.	"	NO.3536.0092.
F.124.	123.3.	37.59.	+ 0.04.	NO.3681.0178.
F.125.	123.2.	37.54.	"	NO.3679.0181.
F.126.	123.7.	37.69.	"	NO.3674.0184.
F.127.	124.4.	37.93.	"	No.3668.0187.
F.128.	126.3.	38.51.	"	NO.3664.0181.
F.129.	123.8.	37.74.	"	NO.3682.0192.
F.130.	128.8.	39.24.	+ 0.06.	NO.3507.0094.
F.131.	76.1.	23.20.	- 0.05.	NT.0943.8298.
F.132.	77.3.	23.56.	"	NT.0937.8298.
F.133.	79.0.	24.10.	"	NT.0930.8297.
F.134.	28.1.	8.56.	+ 0.28 corr.	NO.6003.0586.
F.135.	21.3.	6.50.	"	NO.6002.0584.
F.136.	20.4.	6.23.	"	NO.6001.0583.
F.137.	21.4.	6.51.	"	NO.5996.0581.
F.138.	20.9.	6.37.	"	NO.5996.0581.
F.139.	24.9.	7.58.	"	NO.5995.0583.
F.140.	25.4.	7.74.	"	NO.5992.0582.
F.141.	20.4.	6.23.	"	NO.5991.0580.
F.142.	21.2.	6.45.	"	NO.5979.0568.
F.143.	28.2.	8.58.	"	NO.5983.0572.
F.144.	19.2.	5.84.	"	NO.5985.0571.
F.145.	17.4.	5.29.	"	NO.5992.0578.
F.146.	19.6.	5.97.	"	NO.5993.0580.
F.147.	20.0.	6.08.	"	NO.5996.0581.
F.148.	60.7.	18.51.	"	NO.5998.0587.
F.149.	60.7.	18.49.	"	NO.6000.0588.
F.150.	58.6.	17.85.	"	NO.6008.0604.
F.151.	37.4.	11.38.	0.00.	NT.4989.9951.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
F.152.	37.8.	11.52.	"	NT.4982.0051.
F.153.	36.1.	10.99.	"	NT.4978.9948.
F.154.	36.8.	11.22.	"	NT.4974.9943.
F.155.	38.6.	11.76.	"	NT.4970.9942.
F.156.	33.8.	10.31.	"	NT.4995.9947.
F.157.	160.5.	48.93.	+ 0.03.	NO.4410.0327.
F.158.	162.5.	49.54.	"	NO.4417.0326.
F.159.	165.3.	50.37.	"	NO.4421.0323.
F.160.	20.6.	6.29.	+ 0.05.	NO.4750.0043.
F.161.	20.4.	6.20.	"	NO.4743.0042.
F.162.	20.7.	6.32.	"	NO.4737.0041.
F.163.	20.6.	6.28.	"	NO.4730.0042.
F.164.	20.9.	6.36.	"	NO.4723.0042.
F.165.	21.4.	6.52.	"	NO.4758.0045.
F.166.	22.3.	6.78.	"	NO.4768.0049.
F.167.	43.6.	13.29.	+ 0.02.	NO.5062.0063.
F.168.	44.1.	13.45.	"	NO.5068.0068.
F.169.	45.3.	13.80.	"	NO.5072.0070.
F.170.	45.7.	13.91.	"	NO.5079.0072.
F.171.	17.9.	5.46.	"	NO.5075.0062.
F.172.	16.4.	5.00.	"	NO.5075.0062.
F.173.	21.0.	6.40.	"	NO.5075.0062.
F.174.	24.7.	7.54.	"	NO.5075.0062.
F.175.	26.4.	8.03.	"	NO.5075.0062.
F.176.	27.5.	8.37.	"	NO.5075.0062.
F.177.	69.0.	21.03.	+0.02.	NO.5054.0082.
F.178.	69.1.	21.07.	"	NO.5052.0086.
F.179.	69.0.	21.04.	"	NO.5058.0088.
F.180.	69.2.	21.10.	"	NO.5062.0090.
F.181.	66.8.	20.37.	"	NO.5070.0091.
F.182.	64.4.	19.64.	"	NO.5078.0092.
F.183.	69.8.	21.28.	"	NO.5039.0076.
F.184.	78.5.	23.94.	"	NO.5028.0076.
F.185.	75.9.	23.14.	"	NO.5019.0074.
F.186.	115.9.	35.34.	+ 0.02.	NO.4411.0295.
F.187.	116.8.	35.61.	"	NO.4406.0302.
F.188.	117.7.	35.89.	"	NO.4399.0305.
F.189.	114.9.	35.03.	"	NO.4391.0306.
F.190.	114.3.	34.85.	"	NO.4416.0289.
F.191.	112.8.	34.39.	"	NO.4419.0285.
F.192.	111.1.	33.88.	"	NO.4427.0283.
F.193.	81.2.	24.76.	+ 0.07.	NO.6164.0810.
F.194.	81.7.	24.89.	"	NO.6171.0820.
F.195.	81.7.	24.91.	"	NO.6176.0828.
F.196.	81.6.	24.88.	"	NO.6180.0835.
F.197.	72.8.	22.19.	"	NO.6176.0805.
F.198.	73.2.	22.30.	"	NO.6184.0813.
F.199.	73.4.	22.38.	"	NO.6199.0833.
F.200.	102.9.	31.36.	- 0.05.	NO.5777.0490.
F.201.	95.2.	29.01.	"	NO.5788.0489.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
F.202.	92.2.	28.10.	"	NO.5795.0488.
F.203.	92.1.	28.10.	"	NO.5794.0492.
F.204.	90.4.	27.56.	"	NO.5795.0498.
F.205.	91.5.	27.88.	"	NO.5799.0503.
F.206.	91.5.	27.88.	"	NO.5805.0509.
F.207.	91.7.	27.96.	"	NO.5811.0514.
F.208.	90.8.	27.68.	- 0.19 corr.	NO.4417.0272.
F.209.	91.5.	27.90.	"	NO.4408.0272.
F.210.	92.5.	28.20.	"	NO.4399.0273.
F.211.	93.1.	28.37.	"	NO.4389.0274.
F.212.	88.0.	26.81.	"	NO.4424.0269.
F.213.	89.1.	27.15.	"	NO.4432.0270.
F.214.	88.3.	26.91.	"	NO.4442.0272.
F.215.	77.8.	23.72.	"	NO.4527.0262.
F.216.	78.8.	24.02.	"	NO.4530.0269.
F.217.	75.8.	23.09.	"	NO.4537.0270.
F.218.	75.3.	22.96.	"	NO.4546.0270.
F.219.	74.0.	22.56.	"	NO.4554.0270.
F.220.	74.2.	22.62.	"	NO.4562.0270.
F.221.	75.5.	23.02.	"	NO.4570.0269.
F.222.	70.5.	21.48.	"	NO.4551.0255.
F.223.	69.9.	21.31.	"	NO.4541.0259.
F.224.	74.1.	22.58.	"	NO.4529.0241.
F.225.	74.7.	22.78.	"	NO.4535.0234.
F.226.	73.8.	22.49.	"	NO.4542.0229.
F.227.	72.5.	22.10.	"	NO.4477.0253.
F.228.	75.5.	23.00.	"	NO.4468.0252.
F.229.	88.1.	26.83.	+ 0.11 corr.	NO.3442.0053.
F.230.	89.4.	27.25.	"	NO.3436.0053.
F.231.	88.7.	27.03.	"	NO.3428.0053.
F.232.	90.2.	27.49.	"	NO.3418.0052.
F.233.	92.0.	28.04.	"	NO.3408.0051.
F.234.	93.0.	28.33.	"	NO.3396.0048.
F.235.	71.0.	21.63.	+ 0.01.	NO.3425.0032.
F.236.	70.0.	21.33.	"	NO.3428.0038.
F.237.	69.2.	21.08.	"	NO.3433.0039.
F.238.	68.4.	20.85.	"	NO.3440.0038.
F.239.	68.1.	20.75.	"	NO.3442.0035.
F.240.	59.9.	18.25.	"	NO.3438.0029.
F.241.	57.8.	17.61.	"	NO.3445.0029.
F.242.	54.6.	16.63.	"	NO.3452.0030.
F.243.	80.5.	24.55.	"	NO.3413.0030.
F.244.	82.4.	25.12.	"	NO.3407.0032.
F.245.	84.1.	25.62.	"	NO.3397.0039.
F.246.	85.7.	26.11.	"	NO.3390.0038.
F.247.	88.2.	26.88.	"	NO.3406.0041.
F.248.	87.4.	26.63.	"	NO.3410.0042.
F.249.	116.4.	35.48.	0.00.	NO.3421.0074.
F.250.	116.3.	35.43.	"	NO.3417.0073.
F.251.	115.0.	35.05.	+ 0.10.	NO.3410.0072.
			"	

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
F.252.	113.5.	34.59.	"	NO.3403.0072.
F.253.	116.0.	35.37.	"	NO.3387.0070.
F.254.	115.2.	35.12.	"	NO.3374.0073.
F.255.	116.7.	35.56.	"	NO.3362.0073.
F.256.	116.8.	35.59.	"	NO.3355.0074.
F.257.	124.2.	37.86.	"	NO.3347.0070.
F.258.	124.4.	37.91.	"	NO.3338.0070.
F.259.	117.2.	35.72.	"	NO.3338.0074.
F.260.	119.0.	36.26.	"	NO.3330.0075.
F.261.	120.7.	36.79.	"	NO.3313.0076.
F.262.	121.9.	37.15.	"	NO.3305.0076.
F.263.	144.9.	44.17.	- 0.01.	NO.3296.0081.
F.264.	147.4.	44.91.	"	NO.3288.0084.
F.265.	106.9.	32.57.	+ 0.03.	NO.3373.0060.
F.266.	107.7.	32.81.	"	NO.3365.0062.
F.267.	109.9.	33.50.	"	NO.3357.0062.
F.268.	111.2.	33.89.	"	NO.3348.0061.
F.269.	111.8.	34.08.	"	NO.3339.0061.
F.270.	90.8.	27.69.	+ 0.01.	NT.1504.8457.
F.271.	90.6.	27.62.	"	NT.1512.8456.
F.272.	93.2.	28.40.	"	NT.1512.8463.
F.273.	94.5.	28.81.	"	NT.1503.8466.
F.274.	95.9.	29.22.	+ 0.10.	NT.1433.8462.
F.275.	96.1.	29.29.	"	NT.1436.8462.
F.276.	109.1.	33.24.	"	NT.1451.8458.
F.277.	62.3.	18.95.	"	NT.1392.8422.
F.278.	60.7.	18.49.	"	NT.1385.8421.
F.279.	68.8.	20.96.	"	NT.1364.8441.
F.280.	74.9.	22.83.	"	NT.1378.8441.
F.281.	84.3.	25.69.	+ 0.02.	NT.0826.8344.
F.282.	83.0.	25.28.	"	NT.0832.8339.
F.283.	81.8.	24.92.	"	NT.0842.8332.
F.284.	98.4.	30.00.	"	NT.0848.8328.
F.285.	97.8.	29.81.	"	NT.0852.8322.
F.286.	82.5.	25.15.	"	NT.0870.8308.
F.287.	82.6.	25.17.	"	NT.0878.8307.
F.288.	82.3.	25.08.	"	NT.0886.8304.
F.289.	79.9.	24.34.	"	NT.0893.8302.
F.290.	80.2.	24.45.	"	NT.0898.8301.
F.291.	79.3.	24.18.	"	NT.0903.8300.
F.292.	78.5.	23.93.	"	NT.0908.8298.
F.293.	78.5.	23.93.	"	NT. 0912.8298.
F.294.	78.5.	23.94.	"	NT.0920.8297.
F.295.	79.9.	24.34.	"	NT.0928.8297.
F.296.	85.3.	25.99.	0.00.	NT.1135.8237.
F.297.	81.8.	24.93.	"	NT.1144.8232.
F.298.	80.3.	24.47.	"	NT.1156.8229.
F.299.	89.7.	27.34.	+ 0.05.	NT.1071.8430.
F.300.	88.1.	26.85.	"	NT.1074.8433.
F.301.	69.6.	21.20.	+ 0.02.	NT.1897.8506.
F.302.	69.7.	21.23.	"	NT.1894.8497.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
F.303.	72.0.	21.93.	"	NT.1892.8488.
F.304.	69.1.	21.18.	"	NT.1891.8480.
F.305.	69.9.	21.29.	"	NT.1889.8473.
F.306.	63.6.	19.40.	0.00.	NO.3754.0156.
F.307.	63.9.	19.47.	"	NO.3762.0160.
F.308.	64.2.	19.57.	"	NO.3769.0164.
F.309.	63.2.	19.28.	"	NO.3774.0165.
F.310.	61.1.	18.64.	"	NO.3785.0164.
F.311.	59.1.	18.03.	"	NO.3793.0162.
F.312.	73.0.	22.57.	0.00.	NO.3722.0149.
F.313.	73.6.	22.42.	"	NO.3715.0146.
F.314.	73.3.	22.33.	"	NO.3701.0140.
F.315.	72.8.	22.18.	"	NO.3694.0137.
F.316.	72.6.	22.12.	"	NO.3689.0139.
F.317.	124.8.	38.02.	+ 0.02.	NO.3682.0172.
F.318.	123.9.	37.75.	"	NO.3682.0168.
F.319.	116.2.	35.43.	"	NO.3673.0165.
F.320.	117.1.	35.70.	"	NO.3667.0164.
F.321.	124.8.	38.03.	"	NO.3662.0167.
F.322.	120.0.	36.57.	"	NO.3652.0062.
F.323.	114.2.	34.82.	"	NO.3653.0050.
F.324.	48.6.	14.83.	0.00.	NO.4396.0244.
F.325.	48.5.	14.78.	"	NO.4410.0243.
F.326.	49.4.	15.07.	"	NO.4418.0242.
F.327.	47.7.	15.16.	"	NO.4489.0235.
F.328.	51.9.	15.83.	"	NO.4495.0235.
F.329.	29.3.	8.93.	- 0.01.	NO.4439.0238.
F.330.	29.7.	9.05.	"	NO.4447.0237.
F.331.	29.7.	9.05.	"	NO.4453.0234.
F.332.	29.6.	9.01.	"	NO.4460.0232.
F.333.	28.8.	8.78.	"	NO.4469.0233.
F.334.	29.7.	9.04.	"	NO.4474.0230.
F.335.	30.3.	9.22.	"	NO.4482.0228.
F.336.	30.5.	9.28.	"	NO.4490.0228.
F.337.	108.9.	33.19.	+ 0.03.	NO.3289.0061.
F.338.	111.3.	33.92.	"	NO.3281.0066.
F.339.	112.3.	34.23.	"	NO.3274.0070.
F.340.	87.7.	26.74.	"	NO.3307.0045.
F.341.	89.7.	27.33.	"	NO.3301.0044.
F.342.	90.6.	27.62.	"	NO.3294.0044.
F.343.	91.2.	27.80.	"	NO.3289.0044.
F.344.	81.5.	24.84.	"	NO.3286.0039.
F.345.	80.2.	24.45.	"	NO.3294.0037.
F.346.	79.4.	24.19.	"	NO.3300.0035.
F.347.	105.9.	32.29.	"	NO.3313.0056.
F.348.	106.2.	32.37.	"	NO.3308.0057.
F.349.	107.6.	32.81.	"	NO.3300.0059.
F.350.	112.5.	34.28.	+ 0.10.	NO.3270.0073.
F.351.	113.2.	34.52.	"	NO.3253.0076.
F.352.	114.0.	34.76.	"	NO.3257.0078.
F.353.	115.6.	35.23.	"	NO.3251.0080.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
F.354.	117.2.	35.72.	"	NO.3247.0082.
F.355.	117.4.	35.78.	"	NO.3240.0084.
F.356.	117.2.	35.71.	"	NO.3233.0086.
F.357.	119.6.	36.44.	"	NO.3227.0086.
F1358.	122.6.	37.37.	"	NO.3220.0086.
F.359.	126.4.	38.54.	"	NO.3213.0085.
F.360.	129.2.	39.38.	"	NO.3206.0084.
F.361.	128.2.	39.08.	"	NO.3199.0084.
F.362.	129.9.	39.60.	"	NO.3192.0084.
F.363.	133.2.	40.60.	"	NO.3184.0083.
F.364.	136.0.	41.45.	"	NO.3180.0083.
F.365.	137.9.	42.04.	"	NO.3174.0082.
F.366.	139.3.	42.45.	"	NO.3170.0082.
F.367.	122.2.	37.24.	+ 0.10.	NO.3197.0056.
F.368.	121.9.	37.16.	"	NO.3201.0058.
F.369.	119.6.	36.45.	"	NO.3204.0059.
F.370.	119.7.	36.47.	"	NO.3207.0058.
F.371.	125.1.	38.12.	0.00.	NO.3560.0179.
F.372.	125.9.	38.37.	"	NO.3553.0181.
F.373.	126.6.	38.59.	"	NO.3547.0182.
F.374.	130.3.	39.71.	"	NO.3539.0182.
F.375.	130.0.	39.62.	"	NO.3530.0183.
F.376.	130.7.	39.83.	"	NO.3522.0183.
F.377.	133.0.	40.53.	"	NO.3515.0183.
F.378.	134.5.	40.99.	"	NO.3510.0183.
F.379.	135.8.	41.38.	"	NO.3502.0181.
F.380.	123.5.	37.63.	"	NO.3567.0177.
F.381.	129.0.	39.30.	"	NO.3566.0156.
F.382.	125.5.	38.24.	"	NO.3592.0163.
F.383.	110.1.	33.56.	"	NO.3588.0154.
F.384.	110.1.	33.56.	"	NO.3599.0151.
F.385.	110.9.	33.79.	"	NO.3592.0140.
F.386.	104.6.	31.87.	"	NO.3604.0139.
F.387.	112.4.	34.25.	"	NO.3564.0151.
F.388.	112.1.	34.18.	"	NO.3560.0151.
F.389.	153.3.	46.74.	"	NO.3569.0184.
F.390.	147.4.	44.94.	"	NO.3589.0184.
F.391.	144.7.	44.11.	"	NO.3603.0178.
F.392.	90.6.	27.62.	+ D,04.	NO.3519.0072.
F.393.	89.1.	27.17.	"	NO.3529.0072.
F.394.	115.6.	35.25.	"	NO.3544.0096.
F.395.	113.3.	34.53.	"	NO.3553.0098.
F.396.	105.8.	32.24.	"	NO.3560.0091.
F.397.	104.9.	31.96.	"	NO.3553.0088.
F.398.	109.3.	33.32.	"	NO.3566.0100.
F.399.	106.6.	32.50.	"	NO.3578.0100.
F.400.	103.3.	31.49.	"	NO.3588.0102.
F.401.	100.6.	30.65.	"	NO.3591.0101.
F.402.	96.6.	29.45.	"	NO.3590.0096.
F.403.	97.1.	29.58.	"	NO.3586.0093.
F.404.	96.6.	29.44.	"	NO.3581.0090.
F.405.	97.4.	29.67.	"	NO.3587.0088.

Reference. No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
F.406.	97.6.	29.74.	"	NO.3597.0101.
F.407.	98.2.	29.93.	"	NO.3606.0104.
F.408.	96.0.	29.26.	"	NO.3611.0105.
F.409.	93.9.	28.63.	"	NO.3619.0105.
F.410.	90.5.	27.57.	"	NO.3627.0107.
F.411.	88.2.	26.88.	"	NO.3634.0107.
F.412.	87.7.	26.73.	"	NO.3643.0107.
F.413.	85.7.	26.13.	"	NO.3651.0110.
F.414.	86.2.	26.26.	"	NO.3658.0104.
F.415.	74.6.	22.75.	"	NO.3653.0095.
F.416.	74.3.	22.65.	"	NO.3658.0095.
F.417.	73.8.	22.48.	"	NO.3661.0096.
F.418.	72.4.	22.07.	"	NO.3666.0098.
F.419.	72.0.	21.95.	"	NO.3670.0100.
F.420.	70.6.	21.52.	"	NO.3679.0108.
F.421.	65.4.	19.92.	"	NO.3660.0090.
F.422.	65.2.	19.86.	"	NO.3663.0091.
F.423.	65.4.	19.92.	"	NO.3666.0092.
F.424.	65.6.	20.00.	"	NO.3669.0094.
F.425.	61.1.	18.64.	"	NO.3670.0090.
F.426.	61.4.	18.71.	"	NO.3668.0089.
F.427.	61.6.	18.77.	"	NO.3665.0088.
F.428.	25.5.	7.76.	0.00.	NO.3660.0076.
F.429.	25.6.	7.79.	"	NO.3665.0077.
F.430.	24.9.	7.59.	"	NO.3671.0079.
F.431.	23.6.	7.18.	"	NO.3679.0080.
F.432.	21.8.	6.65.	"	NO.3685.0083.
F.433.	18.7.	5.69.	"	NO.3702.0083.
F.434.	66.3.	20.21.	+ 0.05.	NO.3866.0185.
F.435.	65.5.	19.95.	"	NO.3868.0194.
F.436.	73.7.	22.47.	"	NO.3870.0217.
F.437.	73.3.	22.35.	"	NO.3872.0222.
F.438.	67.0.	20.41.	"	NO.3877.0212.
F.439.	67.1.	20.45.	"	NO.3884.0219.
F.440.	66.3.	20.20.	"	NO.3891.0222.
F.441.	66.5.	20.28.	"	NO.3898.0226.
F.442.	71.4.	21.76.	"	NO.3890.0230.
F.443.	71.9.	21.92.	"	NO.3886.0228.
F.444.	72.6.	22.11.	"	NO.3904.0230.
F.445.	75.2.	22.91.	"	NO.3911.0232.
F.446.	70.0.	21.34.	"	NO.3921.0230.
F.447.	70.4.	21.46.	"	NO.3916.0226.
F.448.	69.8.	21.29.	"	NO.3910.0225.
F.449.	74.6.	22.72.	"	NO.3916.0234.
F.450.	76.5.	23.31.	"	NO.3921.0235.
F.451.	76.6.	23.34.	"	NO.3884.0230.
F.452.	69.7.	21.23.	"	NO.3941.0240.
F.453.	72.2.	21.99.	"	NO.3953.0236.
F.454.	71.8.	21.88.	"	NO.3961.0235.
F.455.	78.8.	24.02.	"	NO.3959.0248.
F.456.	78.5.	23.94.	"	NO.3963.0249.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
F.457.	78.0.	23.76.	"	NO.3969.0249.
F.458.	77.7.	23.69.	"	NO.3972.0249.
F.459.	77.4.	23.58.	"	NO.3974.0248.
F.460.	77.7.	23.69.	"	NO.3977.0248.
F.461.	81.8.	24.93.	"	NO.3999.0250.
F.462.	132.0.	40.23.	0.00.	NO.3832.0250.
F.463.	129.7.	39.54.	"	NO.3839.0251.
F.464.	130.0.	39.62.	"	NO.3845.0250.
F.465.	129.2.	39.39.	"	NO.3853.0249.
F.466.	128.7.	39.24.	"	NO.3859.0250.
F.467.	124.8.	38.04.	"	NO.3867.0250.
F.468.	121.8.	37.12.	"	NO.3872.0252.
F.469.	119.1.	36.30.	"	NO.3879.0254.
F.470.	121.6.	37.06.	"	NO.3885.0257.
F.471.	130.0.	39.62.	"	NO.3892.0260.
F.472.	124.5.	37.95.	"	NO.3856.0245.
F.473.	115.6.	35.23.	"	NO.3871.0230.
F.474.	123.1.	37.51.	"	NO.3884.0276.
F.475.	123.1.	37.51.	"	NO.3891.0290.
F.476.	123.0.	37.48.	"	NO.3896.0289.
F.477.	123.0.	37.48.	"	NO.3901.0289.
F.478.	122.1.	37.52.	"	NO.3906.0289.
F.479.	123.5.	37.63.	"	NO.3911.0287.
F.480.	123.3.	37.57.	"	NO.3917.0286.
F.481.	130.2.	39.67.	"	WO.3873.0299.
F.482.	129.8.	39.55.	"	NO.3866.0290.
F.483.	130.9.	39.90.	"	NO.3861.0288.
F.484.	129.8.	39.57.	"	NO.3850.0280.
F.485.	131.8.	40.18.	"	NO.3839.0278.
F.486.	71.8.	21.88.	- 0".04.	NT.1746.8381.
F.487.	73.1.	22.28.	"	NT.1724.8388.
F.488.	71.9.	21.91.	"	NT.1719.8391.
F.489.	70.5.	21.48.	"	NT.1713.8393.
F.490.	69.2.	21.09.	"	NT.1707.8395.
F.491.	71.9.	21.91.	"	NT.1699.8395.
F.492.	74.0.	22.55.	"	NT.1690.8394.
F.493.	73.4.	22.37.	"	NT.1683.8393.
F.494.	73.9.	22.52.	"	NT.1676.8391.
F.495.	73.8.	22.49.	"	NT.1669.8390.
F.496.	74.3.	22.64.	"	NT.1663.8388.
F.497.	75.1.	22.88.	"	NT.1655.8385.
F.498.	75.9.	23.13.	"	NT.1648.8383.
F.499.	3.4.	1.05	+ 0.03.	NT.1689.8373.
F.500.	6.4.	1.96.	"	NT.1679.8374.
F.501.	4.9.	1.50.	"	NT.1671.8372.
F.502.	4.4.	1.35.	"	NT.1662.8369.
F.503.	4.4.	1.35.	"	NT.1655.8367.
F.504.	4.0.	1.23.	"	NT.1650.8364.
F.505.	4.0.	1.23.	"	NT.1643.8366.
F.506.	4.4.	1.35.	"	NT.1634.8360.
F.507.	4.7.	1.44.	"	NT.1691.8371.
F.508.	4.8.	1.47.	"	NT.1697.8375.
F.509.	4.3.	1.32.	"	NT.1707.8375.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
F.510.	3.5.	1.08.	"	NT.1714.8373.
F.511.	3.9.	1.20.	"	NT.1722.8372.
F.512.	3.8.	1.17.	"	NT.1729.8372.
F.513.	21.4.	6.53.	"	NT.1712.8378.
F.514.	22.3.	6.79.	"	NT.1708.8380.
F.515.	20.9.	6.36.	"	NT.1703.8379.
F.516.	22.5.	6.86.	"	NT.1689.8379.
F.517.	111.8.	34.09.	0.00.	NT.1726.8407.
F.518.	112.2.	34.21.	"	NT.1730.8404.
F.519.	109.3.	33.33.	"	NT.1733.8403.
F.520.	107.4.	32.75.	"	NT.1739.8402.
F.521.	110.0.	33.54.	"	NT.1743.8402.
F.522.	112.0.	34.15.	"	NT.1748.8403.
F.523.	74.1.	22.60.	+ 0.08.	NT.1859.8452.
F.524.	70.6.	21.50.	"	NT.1862.8457.
F.525.	66.9.	20.38.	"	NT.1867.8456.
F.526.	71.6.	21.84.	"	NT.1855.8449.
F.527.	71.0.	21.63.	"	NT.1852.8445.
F.528.	73.0.	22.24.	"	NT.1851.8442.
F.529.	73.5.	22.39.	"	NT.1849.8440.
F.530.	76.4.	23.29.	0.00.	NT.1571.8281.
F.531.	77.6.	23.64.	"	NT.1567.8277.
F.532.	76.0.	23.17.	"	NT.1561.8270.
F.533.	74.8.	22.81.	"	NT.1557.8265.
F.534.	73.8.	22.50.	"	NT.1552.8259.
F.535.	82.8.	25.25.	- 0.02.	NT.1493.8331.
F.536.	78.5.	23.93.	"	NT.1484.8315.
F.537.	84.7.	25.81.	- 0.04.	NO.6298.0939.
F.538.	83.6.	25.47.	"	NO.6303.0940.
F.539.	82.6.	25.17.	"	NO.6308.0941.
F.540.	76.9.	23.45.	"	NO.6312.0940.
F.541.	75.7.	23.07.	"	NO.6318.0942.
F.542.	68.9.	20.99.	"	NO.6338.0948.
F.543.	69.2.	21.08.	"	NO.6331.0942.
F.544.	69.3.	21.13.	"	NO.6328.0938.
F.545.	64.8.	19.76.	"	NO.6323.0922.
F.546.	64.6.	19.68.	+ 0.02.	NO.6319.0917.
F.547.	77.8.	23.71.	"	NO.6302.0918.
F.548.	70.6.	21.51.	"	NO.6098.0722.
F.549.	72.4.	22.07.	"	NO.6093.0715.
F.550.	71.1.	21.66.	"	NO.6090.0707.
F.551.	70.0.	21.32.	"	NO.6087.0700.
F.552.	69.8.	21.28.	"	NO.6084.0691.
F.553.	77.8.	23.72.	"	NO.6074.0692.
F.554.	82.1.	25.03.	"	NO.6059.0697.
F.555.	82.8.	25.25.	"	NO.6054.0691.
F.556.	82.3.	25.08.	"	NO.6050.0683.
F.557.	81.3.	24.77.	"	NO.6047.0678.
F.558.	81.1.	24.73.	"	NO.6043.0671.
F.559.	81.7.	24.91.	"	NO.6041.0663.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
F.560.	85.4.	26.04.	"	NO.6041.0663.
F.561.	85.4.	26.04.	"	NO.6076.0711.
F.562.	84.6.	25.78.	+ 0.01.	NO.6000.0619.
F.563.	84.3.	25.69.	"	NO.5995.0613.
F.564.	84.2.	25.66.	"	NO.5990.0609.
F.565.	84.0.	25.59.	"	NO.5985.0604.
F.566.	83.3.	25.38.	"	NO.5978.0602.
F.567.	82.9.	25.26.	"	NO.5969.0597.
F.568.	82.6.	25.17.	"	NO.5960.0595.
F.569.	83.3.	25.38.	"	NO.5951.0593.
F.570.	83.5.	25.44.	"	NO.5945.0591.
F.571.	82.4.	25.11.	"	NO.5923.0584.
F.572.	74.7.	22.76.	"	NO.5937.0560.
F.573.	74.7.	22.76.	"	NO.5942.0562.
F.574.	75.3.	22.94.	"	NO.5945.0566.
F.575.	73.7.	22.45.	"	NO.5955.0568.
F.576.	72.8.	22.18.	"	NO.5961.0570.
F.577.	70.5.	21.48.	"	NO.5969.0586.
F.578.	97.0.	29.57.	"	NO.5925.0598.
F.579.	96.9.	29.54.	"	NO.5929.0601.
F.580.	96.7.	29.48.	"	NO.5932.0603.
F.581.	96.4.	29.37.	"	NO.5936.0604.
F.582.	95.9.	29.24.	"	NO.5940.0606.
F.583.	95.1.	28.99.	"	NO.5943.0608.
F.584.	94.7.	28.87.	"	NO.5948.0610.
F.585.	94.3.	28.75.	"	NO.5951.0611.
F.586.	94.2.	28.72.	"	NO.5953.0612.
F.587.	94.1.	28.69.	"	NO.5957.0614.
F.588.	94.3.	28.73.	- 0.01.	NO.5722.0462.
F.589.	91.7.	27.94.	"	NO.5720.0457.
F.590.	89.1.	27.15.	"	NO.5714.0451.
F.591.	89.1.	27.15.	"	NO.5710.0449.
F.592.	50.0.	15.24.	0.00.	NO.5572.0381.
F.593.	50.7.	15.45.	"	NO.5568.0381.
F.594.	51.7.	15.76.	"	NO.5563.0380.
F.595.	50.9.	15.51.	"	NO.5561.0380.
F.596.	51.4.	15.68.	"	NO.5558.0381.
F.597.	52.2.	15.92.	"	NO.5553.0383.
F.598.	53.5.	16.30.	"	NO.5550.0384.
F.599.	59.5.	18.13.	"	NO.5590.0389.
F.600.	66.3.	20.20.	0.00.	NO.5383.0239.
F.601.	67.5.	20.59.	"	NO.5390.0240.
F.602.	68.1.	20.74.	"	NO.5395.0240.
F.603.	68.2.	20.78.	"	NO.5400.0240.
F.604.	82.5.	25.14.	0.00.	NO.5441.0263.
F.605.	82.5.	25.15.	"	NO.5437.0260.
F.606.	82.0.	25.00.	"	NO.5432.0258.
F.607.	82.6.	25.17.	"	NO.5428.0255.
F.608.	81.8.	24.94.	"	NO.5423.0254.
F.609.	81.2.	24.76.	"	NO.5418.0252.
F.610.	79.2.	24.15.	"	NO.5413.0251.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
F.611.	71.3.	21.73.	+ 0.08.	NO.5558.0282.
F.612.	73.1.	22.28.	"	NO.5566.0285.
F.613.	74.3.	22.63.	"	NO.5572.0289.
F.614.	73.6.	22.43.	"	NO.5580.0294.
F.615.	72.8.	22.18.	"	NO.5582.0292.
F.616.	56.4.	17.19.	"	NO.5582.0282.
F.617.	56.1.	17.09.	"	NO.5587.0286.
F.618.	55.4.	16.89.	"	NO.5592.0290.
F.619.	55.9.	17.03.	"	NO.5598.0293.
F.620.	54.6.	16.65.	"	NO.5676.0382.
F.621.	57.1.	17.41.	"	NO.5682.0382.
F.622.	58.4.	17.80.	"	NO.5687.0381.
F.623.	74.0.	22.54.	+ 0.02.	NO.5233.0253.
F.624.	74.0.	22.54.	"	NO.5227.0251.
F.625.	72.8.	22.19.	"	NO.5218.0248.
F.626.	73.8.	22.48.	"	NO.5210.0248.
F.627.	78.9.	24.05.	"	NO.5222.0272.
F.628.	79.1.	24.11.	"	NO.5215.0267.
F.629.	79.8.	24.32.	"	NO.5208.0263.
F.630.	79.0.	24.08.	"	NO.5193.0260.
F.631.	77.8.	23.71.	"	NO.5189.0253.
F.632.	76.8.	23.41.	"	NO.5179.0252.
F.633.	75.1.	22.89.	"	NO.5170.0251.
F.634.	84.5.	25.75.	"	NO.5223.0276.
F.635.	82.8.	25.23.	"	NO.5228.0283.
F.636.	81.8.	24.93.	"	NO.5234.0288.
F.637.	62.6.	19.07.	0.00.	NO.5290.0297.
F.638.	65.1.	19.84.	"	NO.5287.0342.
F.639.	63.7.	19,41.	"	NO.5296.0348.
F.640.	62.3.	18.98.	"	NO.5305.0298.
F.641.	57.9.	17.64.	"	NO.5308.0356.
F.642.	57.1.	17.40.	"	NO.5336.0343.
F.643.	55.6.	16.94.	"	NO.5343.0341.
F.644.	55.4.	16.88.	"	NO.5355.0342.
F.645.	56.2.	17.12.	"	NO.5339.0303.
F.646.	56.6.	17.24.	"	NO.5328.0303.
F.647.	57.4.	17.49.	"	NO.5319.0303.
F.648.	59.7.	18.19.	"	NO.5139.0151.
F.649.	61.5.	18.76.	"	NO.5131.0146.
F.650.	60.8.	18.53.	"	NO.5122.0145.
F.651.	62.8.	19.14.	"	NO.5114.0145.
F.652.	37.8.	11.53.	0.00.	NO.5004.0027.
F.653.	36.3.	11.07.	"	NO.4999.0028.
F.564.	33.6.	10.25.	"	NO.4994.0026.
F.655.	30.3.	9.24.	"	NO.4988.0024.
F.656.	31.5.	9.61.	"	NO.4980.0023.
F.657.	32.4.	9.90.	"	NO.4972.0022.
F.658.	33.8.	10.31.	"	NO.4969.0022.
F.659.	33.5.	10.22.	"	NO.4964.0020.
F.660.	48.7.	14.85.	- 0.01.	NO.4810.0152.
F.661.	48.5.	14.80.	"	NO.4808.0147.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
F.662.	47.5.	14.47.	"	NO.4808.0143.
F.663.	47.4.	14.44.	"	NO.4807.0136.
F.664.	73.9.	22.53.	0.00.	NO.4240.0300.
F.665.	72.2.	22.01.	"	NO.4236.0295.
F.666.	70.1.	21.37.	"	NO.4222.0283.
F.667.	84.5.	25.76.	"	NO.4248.0304.
F.668.	84.6.	25.79.	"	NO.4255.0305.
F.669.	81.7.	24.91.	"	NO.4260.0306.
F.670.	84.7.	25.82.	"	NO.4263.0307.
F.671.	83.3.	25.39.	"	NO.4268.0308.
F.672.	83.7.	25.52.	"	NO.4274.0307.
F.673.	84.1.	25.64.	"	NO.4286.0307.
F.674.	105.2.	32.06.	- 0.01.	NO.4740.0328.
F.675.	105.0.	32.00.	"	NO.4736.0327.
F.676.	105.7.	32.21.	"	NO.4731.0327.
F.677.	86.5.	26.38.	"	NO.4769.0290.
F.678.	87.5.	26.68.	"	NO.4764.0286.
F.679.	96.8.	29.52.	"	NO.4762.0278.
F.680.	91.9.	28.02.	"	NO.4754.0274.
F.681.	78.2.	23.85.	"	NO.4720.0223.
F.682.	80.2.	24.46.	"	NO.4733.0213.
F.683.	83.2.	25.37.	"	NO.4728.0212.
F.684.	84.2.	25.68.	"	NO.4720.0212.
F.685.	85.5.	26.07.	"	NO.4716.0212.
F.686.	86.2.	26.29.	"	NO.4712.0212.
F.687.	78.2.	23.85.	"	NO.4735.0259.
F.688.	122.2.	37.26.	+ 0.01.	NO.4902.0378.
F.689.	124.6.	37.99.	"	NO.4894.0379.
F.690.	125.6.	38.30.	"	NO.4888.0380.
F.691.	125.8.	38.36.	"	NO.4881.0380.
F.692.	114.2.	34.82.	"	NO.4892.0368.
F.693.	113.5.	34.61.	"	NO.4899.0369.
F.694.	112.7.	34.36.	"	NO.4908.0372.
F.695.	112.2.	34.21.	"	NO.4913.0371.
F.696.	112.3.	34.24.	"	NO.4921.0375.
F.697.	112.5.	34.30.	"	NO.4931.0374.
F.698.	112.2.	34.21.	"	NO.4939.0373.
F.699.	102.2.	31.14.	+ 0.07.	NO.5053.0360.
F.700.	102.6.	31.27.	"	NO.5063.0358.
F.701.	103.4.	31.51.	"	NO.5073.0358.
F.702.	76.9.	23.43.	"	NO.5072.0337.
F.703.	76.9.	23.43.	"	NO.5065.0339.
F.704.	76.2.	23.22.	"	NO.5059.0342.
F.705.	75.7.	23.06.	"	NO.5051.0346.
F.706.	75.2.	22.91.	"	NO.5045.0348.
F.707.	76.2.	23.22.	"	NO.5039.0350.
F.708.	88.7.	27.03.	"	NO.5082.0342.
F.709.	60.0.	18.29.	+ 0.09.	NO.4804.0260.
F.710.	57.3.	17.47.	"	NO.4802.0256.
F.711.	56.6.	17.24.	"	NO.4797.0251.
F.712.	56.7.	17.28.	"	NO.4794.0247.

Reference No.	Height O.D. Feet.	Height O.D. Metres.	Closing Error.	Grid Reference.
F.713.	57.2.	17.42.	"	NO.4792.0243.
F.714.	55.8.	16.99.	"	NO.4791.0240.
F.715.	55.5.	16.91.	"	NO.4789.0236.
F.716.	55.7.	16.97.	"	NO.4784.0233.
F.717.	55.3.	16.86.	"	NO.4781.0230.
F.718.	47.2.	14.40.	"	NO.4775.0235.
F.719.	46.8.	14.28.	"	NO.4773.0238.
F.720.	75.3.	22.98.	+ 0.04.	NO.4831.0246.
F.721.	79.1.	24.12.	"	NO.4839.0250.
F.722.	79.6.	24.27.	"	NO.4842.0247.
F.723.	73.1.	22.29.	"	NO.4838.0240.
F.724.	30.5.	9.29.	"	NT.1337.8369.
F.725.	30.8.	9.39.	"	NT.1342.8373.
F.726.	31.0.	9.45.	"	NT.1346.8377.
F.727.	31.1.	9.49.	"	NT.1353.8381.
F.728.	31.8.	9.70.	"	NT.1361.8384.
F.729.	31.2.	9.50.	"	NT.1368.8389.
F.730.	33.2.	10.12.	"	NT.1370.8402.
F.731.	32.2.	9.81.	"	NT.1362.8391.
F.732.	108.0.	32.91.	+ 0.07.	NT.1103.8495.
F.733.	106.8.	32.55.	"	NT.1107.8494.
F.734.	108.0.	32.92.	"	NT.1112.8493.
F.735.	108.2.	32.97.	"	NT.1118.8494.
F.736.	109.5.	33.39.	"	NT.1127.8489.
F.737.	120.8.	36.82.	0.10.	NO.3323.0074.
F.738.	56.2.	17.13.	+ 0.02.	NO.6264.1000.
F.739.	55.1.	16.79.	+ 0.03.	NO.6273.0998.
F.740.	54.1.	16.49.	"	NO.6279.0995.
F.741.	53.5.	16.31.	"	NO.6284.0993.
F.742.	53.7.	16.37.	"	NO.6289.0992.
F.743.	61.9.	18.87.	"	NO.6292.0981.
F.744.	61.7.	18.81.	"	NO.6285.0982.
F.745.	60.7.	18.50.	"	NO.6277.0985.
F.746.	58.9.	17.95.	"	NO.6273.0990.
F.747.	60.1.	18.32.	"	NO.6265.0992.

APPENDIX IV.

A NOTE ON LINEAR REGRESSION ANALYSIS.

In this work, it was found that the technique of linear regression analysis as normally used could not be applied in cases with a very small range of heights over a short distance. To overcome this, each height was increased an amount proportionate to its distance along the graph so that a false slope was introduced into the pattern. Linear regression analysis was then applied, producing a satisfactory result in accordance with the new pattern of heights. Finally, the slope of the regression line was adjusted in accordance with the weighting given to the points, then the weighting was subtracted and the slope of the line reduced. The final result gave a satisfactory relationship with the original pattern of points on the graph. This procedure was used for the following shorelines:

PG.4.

PG.3.

LG.8.

and for the following sections of shorelines.

AX.

BY.

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