

M.F.C.P. 39. S.M. ROSSEROSION IN BURGHEAD BAY AND AT THE CULBIN SANDS IN 1980

The long sandy beaches of Burghead Bay and the Culbin Sands are classic examples of a coastline which is under attack from large waves coming in from the open sea - in this case from the exposed northeast quarter.

The erosion on this coast is at its worst when northeasterly gales coincide with tides which are higher than normal. Fortunately gales from this direction are not common in the inner Moray Firth, so several years may go past without noticeable loss of coastal material. When such a storm does occur, the waves batter the weak sand and shingle 'cliff'. Loosened shingle is moved westwards along the top of the beach as a 'storm beach shingle ridge' while the sand is removed by the undertow - a process which plays havoc with groynes and other forms of coastal defences.

The whole of this coastline is formed of old shingle ridges dating back to the time of the Post Glacial High Sea Level when the sea stood some 5 m higher than it does today. There is no solid rock to offer resistance to the waves or to act as a foundation for defences.

A quick examination of Burghead Bay shows that the eastern half gets some shelter from the rocky headland at Burghead, but westwards from the Millie Burn this shelter is progressively lost. It is not so obvious that the increase in erosion is not uniform and that it proceeds in a series of long scoops or curves some 500 to 1000 m (or more) in length in a manner which can be likened to the sweep of a carpenter's plane removing a shaving along the length of a plank. The overall effect at a given spot is for a section of more severe erosion to move along the coast followed by a lull until the next of the series reaches that point.

During 1980 there was little erosion in Burghead Bay due to wave action but on 24th October very high tides with fresh northeast winds effectively cleaned up the slumped material along the 'cliffs' and cut a fresh edge which would give an average loss of around 0.5 m. (In some parts the net erosion was nil, while in others small bights up to 2 m were cut).

Near Findhorn Village, where erosion by homo sapiens has stripped off most of the vegetation, the land is seen to be formed of old storm beach shingle ridges capped with blown sand, and in between the ridges are the low-lying 'greens' (fig. 2). These greens lie below the level of the present storm beach ridge marking high water mark and during the very high tides waves washed over the ridge and flooded some of the low ground, once again prompting "calls for action". During severe storms large waves flatten the protecting shingle ridge and both flooding and erosion are much more severe. It is interesting to note that on a map dated 1858 one of the 'greens' is marked as 'The Muckle Loch' and is open to the sea to the west. Points of weakness are marked by arrows in Fig. 2, and there elementary levelling brings out the nature of the problem. Stand at any of these spots and speculate!

Some work has been done in partially filling in one hollow at the west end of the stretch to give protection to property there, and concrete survey markers have been built on some of the ridges. One cannot comment on the Canute-like confidence with which one such marker has been built a mere 2 m from the newly eroded edge.

During this period a considerable amount of material was washed away from the point in the Culbin Sands opposite Findhorn. Here the culprit was tidal scour. The exit-channel to Findhorn Bay now runs hard against the Culbin shore

and the sandy point there is rapidly disappearing. (See M.F.G.P. 32 of 1979). Over the year 8.2 m were lost along the north side of this point and 10.9 m from the eastern tip. Here more than 7 m were lost in one day (24/10/80). At this rate the point will vanish within three years.

* Farther west at the Buckie Loch there was severe erosion during this period and the planing away of a bulge in the coastline resulted in the loss of some 10 to 13 m. As timber which falls into the sea is rendered useless by sand, the Forestry Commission is now felling some of the threatened trees on the seaward side of Buckie Loch. With the removal of this screen, the view from the Loch of the open beach with the twisted tangle of fallen trees is very depressing as is the realisation that the days of this most interesting botanical site are numbered.

* Editorial Notes It is understood that the trees have no role in binding the sand: indeed, because of the turning moment once they have begun to lean, may accelerate the process. It is also not so much that timber is ruined by sand but that it is very expensive on chainsaws and bandsaws to cut sand coated wood.

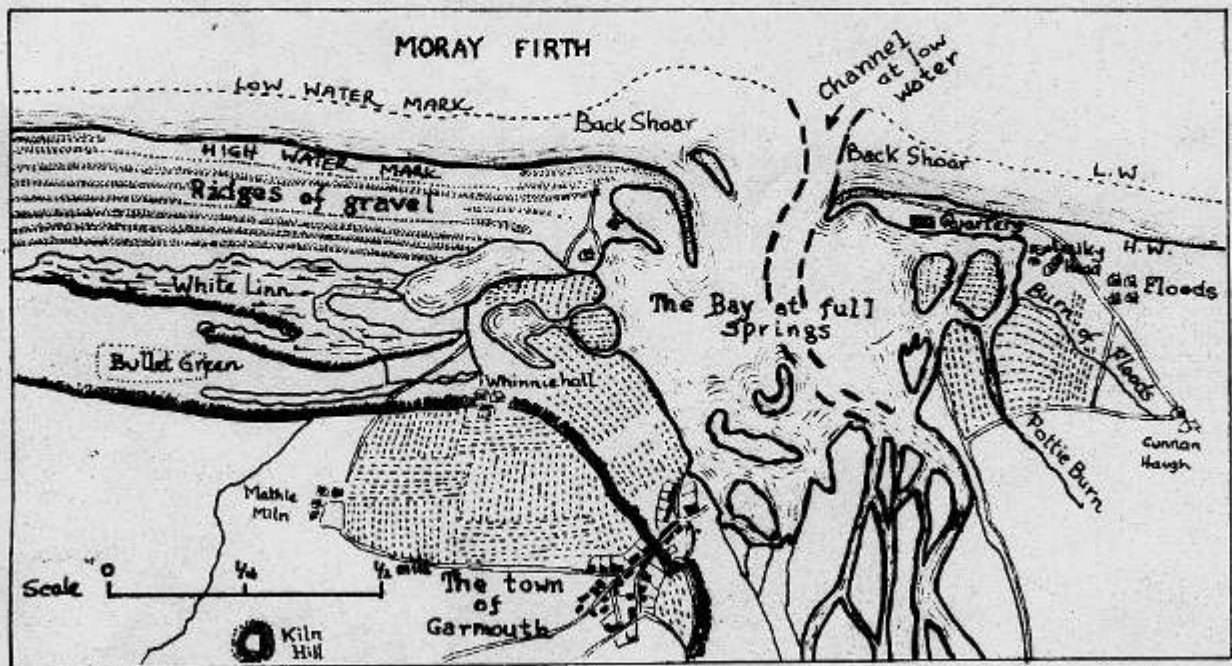


Fig. 1 The Mouth of the River Spey in 1760.

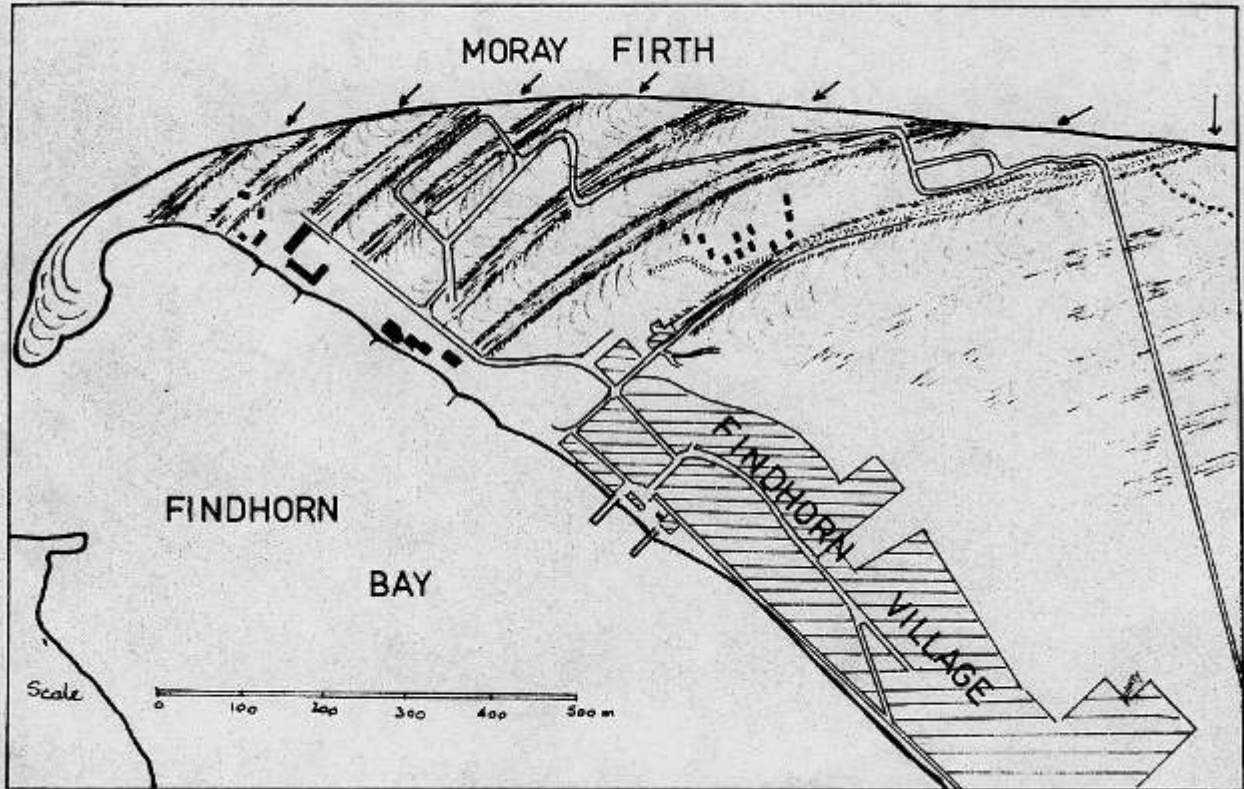


Fig. 2. Simplified sketch of the old storm beach shingle ridges at Findhorn. Arrows indicate the troughs or 'greens' between the ridges.

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PUBLICATIONS 1981

Alistair Scott's BRIDGES IN MORAY (delightfully illustrated by Crispin Worthington) was published during the summer. It breaks new ground, is a credit to author, illustrator and club, and has sold well. At one stage there were doubts as to whether the club could finance the project, and many members kindly offered short term loans. However, when the time came, the Treasurer had somehow found funds - and is to be congratulated on her financial wizardry. Also out this year is Ian Keillar's ELECTRICITY IN THE NORTH. Dr. Roland Richter's definitive account of Mosses and Liverworts in Vice County 95 (Moray and round-about) is in the publishing pipeline with the Centre for Scottish Studies, Aberdeen University.

ALISTAIR SCOTT

The Moray Field Club sadly said goodbye to Alistair when he left Moray for a new appointment with the Forestry Commission in North Wales. We owe him a big "thank-you" for his contributions to the club as secretary, editor, author and "think tank". He took with him our gift of a sketch of Dulsie Bridge by Mary Wilson. It is good to hear that the bridges in Wales are of a high order! Greetings and good wishes to Alistair, Barbara, Meg, Janet, Sandy and Mrs. Mackintosh in their new home in Aberystwyth.

living plants while others, closely resembling modern springtails, fed on fungus-infected dead plants. All this around 380 Ma!

Of the many researchers in Britain and elsewhere who have studied the chert in recent years, the best known is Dr. A.G. Lyon, who has worked on the plants for some 30 years. He has made many contributions to our understanding of the reproductive cycles and forms of the plants as well as having described a new species (*Nothia aphylla*). One of his discoveries, which appeals to your recorder's "microscope eye", was his recognition that a small, finely striated patch, just over 1 mm across, in a section of the chert was in fact a cross section through the lung books of a tiny arachnid.

Dr. Lyon has now retired to Rhynie, where in 1962 he took the precaution of purchasing the land within which the Rhynie Chert lies, thus preserving the site for science.

In a very fine gesture W. & R. Remy, who have recently discovered a new plant species in the chert, named it *Lyonophyton rhyniensis*.

In 1981 a similar chert outcrop to the one at Rhynie was discovered in New York State and many interesting plant forms are being discovered. There is also a very rich insect fauna which includes the earliest known centipede. The deposit is probably slightly younger than or the same age as that at Rhynie.

Coastal Erosion in 1981

With all the big tides coinciding with conditions of fairly light winds it has been a good year for the coast. A few exposed parts had small losses as did the weak points, but on the whole erosion was largely confined to the removal of accumulated blown sand from earlier in the year. The point in the Culbin Forest opposite Findhorn continued to be scoured away by the tide, (see M.C.F.P. No. 32 of 1979 and No. 39 of 1980). Along the northern edge 8.0m were lost and at the eastern point 10.9m during the year. The highest tides of the year are due three days after this note is being typed.

A new book on Hugh Miller

"Hugh Miller - Outrage and Order" by George Rosie (Mainstream Publishing) offers an up to date analysis of Miller's life and work. It does not reveal any geological gems of note but paints a fascinating account of the man and his problems with life, the church, his conscience and his health.

The Annual Prize for the best Geological Specimen

This years prize again goes to Ian Keillar who, as well as producing a selection of lavas from the Faeroes, came up with fine samples from the andesitic lavas of Esha Ness in Shetland.

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2. FLINN, D., 1981. A note of the Glacial and Late Glacial History of Caithness. *Geol. Jl.*, Vol. 16, 175-179.
3. KESEL, R.H., & GEMMEL, A.M.D., 1981. The 'Pliocene' Gravels of Buchan; a Reappraisal. *Scott. J. Geol.* 17(3), 185-203.

M.F.C.P. 41 - SINCLAIR M. ROSSTHE 'COSTA DA SAND'

50 km of the 70 km of the coastline between Cullen and Fort George is made up of unconsolidated materials - reworked fluvio-glacial sands and gravel in the form of fossil and modern storm-beach shingle ridges and spits, sandy beaches and wind-blown sand.

From the agricultural point of view this is low-quality land, and the parts not under afforestation are given over to golf courses, caravan sites, recreation, etc. No houses are seen along these stretches save for small clusters at the mouth of the Spey, at Findhorn and at Nairn - villages built in times gone by when the river mouths were the harbours. This coast is under constant attack by the sea, and where erosion is most active, the loss of land averages out at about 1 m per year. This means that along the 50 km of coastline anything from 2.5 to 5 hectares could disappear each year. What is the value of this land, which promotes so many seasonal "Letters to the Editor"? How much would it cost to fully protect this coastline?

The Forestry Commission might, at 1981 prices, value a stand of mature timber 60-70 years old at £3,000 per hectare, but a low density or poor stand might fetch only £1,000. The value of stunted marginal trees as a windbreak to a main forest is a difficult problem, as is that of open dune/shingle/heath-covered land. The latter might be acting as a protection zone to a site or it might be virtually wasteland. At £3,000 per hectare the value of the land lost along the 50 km of coast could be between £7,500 and £15,000 per annum.

The costing of coastal defence works is also difficult due to the variety and complexities of designs and the presence or absence of firm foundations. Figures quoted recently for a stretch of defences on the east side of Burghead could be expanded to come out very approximately as £500,000 per km length of rough stone revetment or £1m per km of solid concrete/stone sea-wall. To raise the standard to include closely spaced groynes and foundations suitable for the full protection of sandy beaches could raise the cost by 2 or 3 times. The processes of coastal erosion are well understood, and to protect one point such as Findhorn, defences would have to be built back along the length of Burghead Bay - some 10 km at a cost of £20m to £30m. Similar defences for the full 50 km of coastline would therefore cost £100m to £150m.

At a valuation of £15,000 per annum (maximum) for the land lost along the entire coast means that it would take 10,000 years to break even. Added to this is the cost of annual repairs and maintenance, which might come out at 4% of the capital cost - i.e. £6m per annum, which is 400 times the value of the land lost each year.

There is the complication that if erosion were completely halted, no new beach material would be produced and the sea would slowly remove the sand from round the foundations and the defences would inevitably be destroyed. Would they last 1000 years? Would they last 100 years?

Even if the arithmetic is in error by a factor of 10, the bill would be enormous. However, Matthew, Chapter 7, verses 26 and 27 refer.

REFERENCE

VALENTIN, H., 1971. Land Loss at Holderness 1852 to 1952. In Steers J.A. (ed)., Applied Coastal Geomorphology. Macmillan.

M.F.C.P. 42 - SINCLAIR M. ROSSRECENT BOREHOLES FOR WATER IN MORAY

In June 1981, the Regional Water Board had a borehole sunk on the south side of Forres in the gully of the Chapleton Burn (NJ 047 579), about 30 m OD.

The choice of the site saved drilling and casing some 9.0m of the overburden of fluvioglacial sands and gravel. The bore passed through a further 10.0m of these materials before entering a pale yellow-brown, weathered sandstone with occasional deep red-brown bands. The rock contained many red and green clay galls and was similar in most respects to the rocks exposed farther east at Burgie. There some two years earlier two boreholes had been sunk into soft sandstones of Middle Old Red Sandstone age, and a good water supply obtained for the distillery. Water was found in plentiful supply at Chapleton from 50m down to the bottom of the bore at 78m and pumping was maintained at 250,000 gallons per day for four days. The quality of the water was found to be disappointing with too high an iron content for use as drinking water.

In July 1981, the same rig was set up in Roseisle Forest near Burghead at a point (NJ 123 682) 14.6m OD. Here after penetrating 7m of blown sand, the bore entered soft, deeply weathered sandstone with bands of pebbles and clay galls similar to the Triassic Burghead Beds seen at Burghead Pier. From 15m down to 50m, friable sandstones of a deep yellow to orange colour were found. These contained nodules of iron oxide which changed to pyrite with depth, and some bands of pebbles of white quartzite. These beds resemble the Sandstones of Hopeman, which are of Upper Permian or Lower Triassic age.

Below 50m reddish sandstones with deep red-brown silt layers and some thin white sandstone bands were taken to be of Upper Old Red Sandstone age. Cores taken at 50 to 53m and 83 to 86m showed the rock to contain many fissures filled with red fault gauge. The fissuring was also borne out by the length of time air continued to bubble into the bore after the compressor was shut off. Theories on the rate of flow in wells have largely been developed in the U.S.A. where the oil - and water - bearing beds of sedimentary rocks are largely undisturbed. In Scotland, where the rocks are generally much-faulted, there is strong evidence that fissuring is of greater importance than permeability.

The bore was discontinued at 98m. On coring out the hole to 12" diameter a pocket of natural gas was encountered at 63m. However, a good water supply was obtained and pumping maintained at 700,000 gallons per day for a week. A second borehole sunk in the following month a little farther westwards into the wood, and used for monitoring purposes, encountered similar but softer formations. A point of interest here was that this bore after passing through the cover of blown sand entered broken sandstone which consolidated by 9.0m and then went back into shingle at a depth of 10.3m as though it had passed through a ledge or overhang. This suggests the possibility of a small cliff edge in the sandstone at about 4.3m OD, a level approximating to the post glacial high sea level and the associated raised beach which is seen round much of the Moray Coast.

The unfortunate end to this programme was that the drilling rig was completely destroyed by fire which started when sparks from a minor welding repair ignited grass under it. The fire brigade arrived in time to prevent the fire spreading into the forest canopy but could not save the rig.

The previous year several boreholes had been sunk at the site of the Roseisle

Maltings just over 2 km to the south. Six bores were to establish the depth of the rockhead, which was found at 16 to 17m below ground level under a cover of sand or sandy silt with very little clay. This level is approximately 10m below sea level and lends support to the theory that a rock channel is continuous at this level eastwards to Spynie Loch, and which would have at one stage been an arm of the sea. Another bore was sunk into the rock to an unknown depth and a good supply of water for the Maltings was found. No details of the rock types are yet available but this bore is of great interest as it lies on the other side of a fault line from the Burghead bores and could contain Jurassic rocks let down by the fault.

It is of interest to note that all of these boreholes were sunk through a cover of sands and gravel into the sedimentary rocks below, and one cannot hide a sneaking suspicion that as well as finding water the bores very conveniently answered the question 'What sort of rock do we really have below all this sand?'