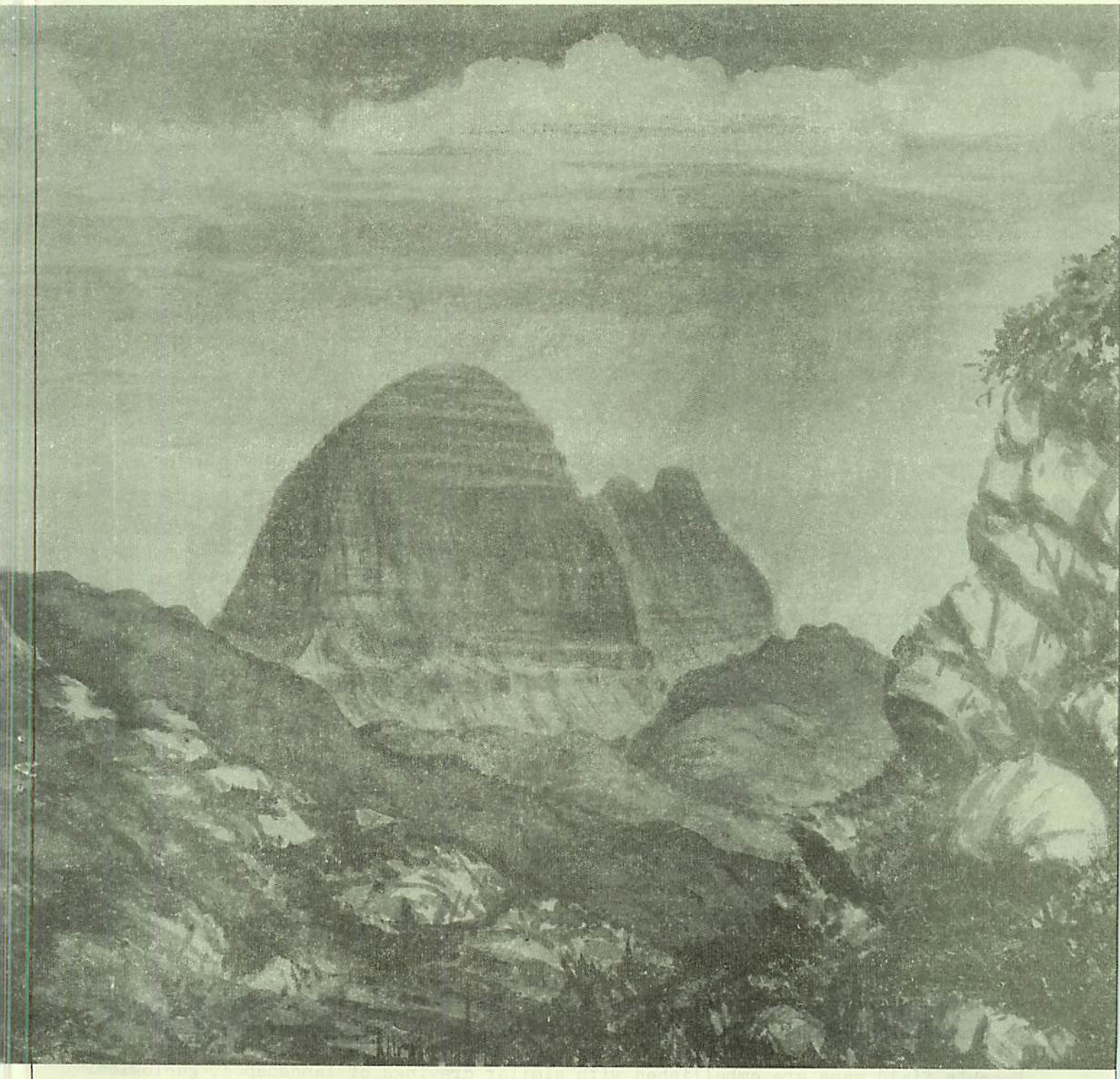
The Edinburgh Geologist



November 1977

Cover Picture. This view of Suilven, one of the isolated west Sutherland peaks of Torridonian Sandstone resting on a pavement of Lewisian Gneiss, was drawn in 1888 on the back of a Geological Survey field map by Dr B N Peach. Many of Peach's field maps are embellished with similar drawings of landscapes, geological sections, animals or rustic scenes.

HISTORY OF THE SEARCH FOR GOLD VEINS
IN THE LEADHILLS-WANLOCKHEAD DISTRICT

> "No charges whatsoever should be spared, till mountains and mosses were turned into vallies and dales . . . . and to turne brookes, rivers and cloughes from their courses, and so to run over mountains. And they hoped in that manner to find out the bedd or vaine of Gold in Scotland".
>
> Stephen Atkinson, 1619.[1]

That part of the Southern Uplands, in the vicinity of the Leadhills and Wanlockhead lead-zinc mining district, was anciently the location of the "gold mynes in Scotland". Mounds of debris, old watercourses, the "gowd scaurs" along the valleys of the Glengonnar, Shortcleuch and Wanlock Waters testify to the large scale exploitation of the river gravels during the 16th Century.

The degree of success of these early operations can be judged from the documentary evidence extant. The Treasurer's Accounts for the years 1538 to 1542, for example, relate that the gold mines, while under the management of John Mossman, produced 41¼ ozs of gold for a crown for the King and 35 ozs of gold for a crown for the Queen[2]. Much of the gold coinage of James V and Mary Queen of Scots was minted from gold from the district[3]. Bevis Bulmer, the Great Elizabethan mining expert[4], is reputed to have employed 300 men at Leadhills and that in three summers' work obtained gold valued at £100 000 sterling[5].

However successful the alluvial deposits had proved to be, it was the possibility of the existence of gold veins in the district that pre-occupied the adventurers in the closing years of the 16th Century. In 1619[6], Stephen Atkinson, goldsmith in the Tower of London, produced his treatise "Discoverie and Historie of the Gold Mynes in Scotland" with a view to interesting James VI sufficiently to grant him a royal patent to work the gold mines of the district. With a large degree of optimism, Atkinson describes the exploitation of the river gravels, but it is evident that his aspirations lay, not in the working of the river gravels, but in the finding of the source of the gold . . . . "that vaine of gold which God hath placed in desert places, as in crevices and holes, for the use of mankinde in the earth within the kingdome of Scotland"[7]. Atkinson reasoned that gold quartz veins must occur in the district since pieces of quartz float containing gold had been found by Bevis Bulmer: "browne sparr some like unto sugar candy, which, after it was broke, had in it an

ounce of gold"[8]. Gold "linked fast unto the sapper stone[9], even as vaines of lead ewer and white spars doe growe together"[10] was cited as irrefutable evidence that gold occurred in quartz veins in the same manner as lead was observed to occur in the veinstone of the neighbouring lead veins.

A manuscript in the British Museum Library, dated c. 1603, and apparently written by the English mining expert George Bowes, or one of his party, before he undertook the search for the gold veins at Wanlockhead, sets down in a scholarly fashion the case for and against the existence of veins of gold in the district.

Bowes pointed out that, although in the previous 80 years gold to the value of £100 000 had been extracted from the river gravels of the district, no vein of gold had been known to have been found. Since the occurrence of the gold was widespread, having been found in localities as far apart as the Pentland Hills and the Megget Water, the writer reasoned that either the gold is generally dispersed in the drift, or many veins of gold occur. Adits had been driven for considerable distances through the country rock of the district to drain the lead mines and had failed to cut any vein of gold. Similarly, no vein of gold had been found in any of the natural exposures in the valleys and cleuchs. "Theis Reasones make me doubtfull that the gold is not in vaynes bet rather lyenge dispersed in Chevore rockes[11] neere the topes and heights of the mountaynes"[12].

Nonetheless the writer reckoned that the formation of the rocks of the district were of a disposition favourable for the formation of veins: "I doe conceave the rocks in collore and substance to be very myneralle houldinge their course southeste and by south in their assente and piche or discente pendantly some of them in shewe more than 100 fadam"[13]. In some of the veins had been found the "metalls of golde" or the minerals with which the gold was associated, e.g. sparr, keele, and brimstone[14]. The existence of "blueshe and yellowe collerede leaderes, I am persuaded are leaderes to vaynes of golde either at a depthe or in their progressyne"[15]. Like Atkinson, the writer had noticed gold in vein float, "myxed with spar and some with keele and some with brimstone - wch shewe thear are vaines of gold from whence thos peeces weare torne by the force of wateres either at Noes flood or by the vyolence of wateres synce that tyme"[16]. "Theis Reasons perswade me that theare are vaines of Gold in sondry parts of Crawforde More"[17].

Atkinson in his book relates the discovery and exploitation of gold quartz veins by Bevis Bulmer at the Longcleuch Burn and by George Bowes at Wanlockhead.

"From Short-clough water (Mr Bulmer) removed unto Long-clough-brayes, or head, up the great hill, to seeke gold in solidd places: where he discovered a small stringe thereof. This vaine had the sapper stone plentifull in it, which sometimes held naturall gold, a little, not much"[18].

Bulmer is reputed to have set up a stamping mill at the Longcleuch to crush the quartz[19]. George Bowes, on the other hand, is said to have extracted gold to the value of £140 sterling from his vein at Wanlockhead but had the shaft filled in and his men sworn to secrecy[20]. Bowes was later killed by an accident while inspecting a copper mine at Keswick and never returned to resume operations at Wanlockhead. Atkinson looked for Bowes' gold vein but without success.

Atkinson's account of Bowes' discoveries do not accord with that contained in several letters written by Bowes from Wanlockhead in the spring and summer of 1604. It is apparent that Bowes was convinced of the existence of veins of gold in the Wanlockhead district and that this was the sole objective of his operations: "my travaile onelye tending for discoverie of a vaine of gold"[21].

The lack of rock exposures and the absence of any surface expression of veins in the district caused Bowes to employ the methods of costeaning and hushing to facilitate the removal of the overburden and so uncover the outcrops of the gold veins. Costeaning involved the excavation of trenches along the conjectured outcrop of a vein, and Bowes dug three trenches "266 yards long and much therof 7 feete broad and 6 deepe, all wrought to the rockes, much therof walled"[22]. However, it was with the use of hushes that Bowes made most of his discoveries. This involved the release of large quantities of water down the hillside along a pre-dug channel or hush gutter. The water necessary for this process was conducted to dams at intervals along the hill from a reservoir which Bowes built, 66 yards long, by 40 yards broad and 5 feet deep which held 2000 tons of water[23]. Bowes reports that he excavated hushes or "furrowes" 548 yards long and had "dreeven away by violence of the water issueing out thereof, above 500 tunnes of earth"[24]. By this method, Bowes appears to have systemmatically examined the bed rock in the vicinity of the Wanlock Water and the neighbouring Whytes Cleuch. The impact of such operations on the landscape was no doubt quite devastating with the removal of such vast quantities of soil and vegetation. It is therefore not surprising that Mr White, an old gold prospector and owner of a meadow at Wanlockhead "will rather reveale what he knoweth" about the existence of a gold vein on his

property, "than suffer his meadowe to be so torne with water"[25].

On the 13th June 1604, Bowes discovered a "leader or mother, the substance whereof was white, yellow, watchett, blacke earth and clay with some hard and soft keele and brimstone, and much white and readd sparr"[26] in which on washing a sample of this vein, small quantities of gold were found. However, Bowes was not certain "whether that gold did growe in that leader there, or driven from whence it was fixed by violence of waters from my furious dammes into the saide leader"[27]. It is likely that Bowes had discovered the gossan or oxidised outcrop of one of the lead veins. In view of the presently held belief that the presence of gold is not connected with the lead-zinc mineralisation of the district, it would appear that Bowes was correct in his assertion that his hushes had washed the gold into the outcrop of the lead vein. Could this be Bowes' gold vein alluded to by Atkinson?

However, Bowes did discover many of the lead veins which were later worked to good effect. He reported "9 several leaders to vaynes of lead, wherof sundry doe hould lead and 3 others to coppir vaines"[28] and "two very large leaders, wherein I find fixed lead ore, and some marquesitt, accompanied with keele, sparr and brimstone, and other strange myneralls stones but not any gold fixed or growing in those leaders or mothers"[29]. Apparently, in such discoveries of lead, Bowes had little interest.

By the middle of July 1604, Bowes had to admit that his operations had failed to locate the veins of gold and he had indeed collected only a small quantity of gold. He had spent all of his allocation of over £300 and his workmen had left through want of wages and ill health. The particularly bad spring weather had made working conditions difficult:

> "The golde works have been much hyndered by frosts and snowe continuing till the mydst of Aprill for wch time till the 12th of May ye winds and raine weere soe tempestuous that four tymes the tent was blowne downe, the ropps broken and myself and 7 of my officers and workers are sicke of the scurvie"[30].

In winding up his operations Bowes wished to "receive directions" before his departure "whether to retourne this decayed tent to Sir Henry Sackford as unmeete to be used in this tempestious place"[31].

Bowes appears to have been the last adventurer to apply large scale operations in the search for gold. Atkinson was eventually granted the privilege of working the gold mines in 1616, but he does not seem to have met with any success, for, in 1621, a lease was granted to Dr John Hendlie but he also was unsuccessful[32].

From the preceding account, it is apparent that by the close of the 16th Century, mining men like Bulmer and Bowes were applying a certain degree of rational observation and thought to the question of the gold veins. It was reasoned that the gold had not originated in the river gravels but had been weathered out of veins in the vicinity. The identification of the associate minerals of gold showed a knowledge of elementary mineralogy. Indeed, it was this rise of scientific awareness as applied to the natural environment that distinguished the latter half of the 16th Century from an earlier period of belief in alchemy and the power of magic. However, Atkinson, writing in 1619, still thought it necessary to denounce those that believed that gold could not "engender in so cold a clymate without the heate of the sonne, or moone and stars"[33].

In a district where both lead and gold were found, it is not surprising that mining interests tended to find a possible genetic connection between the two metals. It is likely that Bulmer and Atkinson realised that the gold occurred only in the quartz veins and was therefore not to be found in the lead veins of the district. Bowes, on the other hand, seems to have operated on the preconceived idea that the gold occurred along with the lead and its associated minerals. The possibility of an association between lead and gold was held until comparatively recent times.

During the last quarter of the 18th Century, John Taylor, who was then manager of the lead mines at Wanlockhead, undertook the superintendence of an attempt to work the alluvial gravels for gold. Williams,[34] in his "History of Minerals", relates that Taylor found that the gold was always most abundant near the outcrops of the lead veins. "He was so satisfied of this circumstance that he could tell, merely by the quantity of gold increasing or diminishing, when they approached to a vein, or receded from it". Williams poses the question: "Does this fact show any connexion between metallic veins and the formation or deposition of gold?"[35]

John Nevin, who was manager of the Leadhills Mining Company, writing in 1864, takes the possible association of the gold with the lead veins a step further. He says that there is "sufficient data to prove that the auriferous quartz veins become degraded as they descend into veins of lead, for in the immediate vicinity of Leadhills where the veins are now rich in lead, gold in large quantities has been obtained from the sides of the streams traversing the same. This fact can be accounted for by supposing that these deposits have been washed off from the surface of the veins which now at a lower depth produce lead"[36].

In 1956, A K Temple introduced the currently held view that two entirely different types of mineralisation occur in the Leadhills and Wanlockhead district. One consists of the quartz veins with which are associated small quantities of gold, pyrites and muscovite, which he tentatively assigns to the Caledonian orogeny. The other comprises the lead-zinc mineralisation, probably of Hercynian age, in which "gold has not been recorded or observed"[37].

In retrospect, it seems unlikely that the 16th Century gold adventurers appreciated that economic gold placer deposits are not necessarily derived from veins of economic value. Indeed, it is often the case that the gold from a low value vein only becomes of economic value once it has been concentrated through time in the river deposits. On the other hand, it is possible that the gold quartz veins were richer when the land surface stood at a higher level and that the quartz veins at present are, as Nevin suggested, the degraded lower portions of the veins. It is therefore conceivable that the large nuggets found in the 16th Century were weathered out of the quartz veins at some geologically distant period, so that perhaps Atkinson and Bowes were not far from the truth in asserting that the gold was weathered from the veins at the time of 'Noah's Flood'.

While, at the present time, it is appreciated that the gold veins and the lead veins are genetically quite separate, the early interest in the gold veins grew up along with the infant lead industry, and the two were, to some degree, interdependent. The early lead mining activity attracted the mining expertise necessary for a proper search for the gold veins. In 1576, for example, Thomas Foulis brought Bevis Bulmer to Scotland to work his profitable lead mine at Leadhills[38]. However, Bulmer soon turned his attention to the search for the more valuable metal - gold. The search for the gold veins, in bringing about the discovery of numerous lead veins in a district where surface indications of veins are virtually absent[39], no doubt lent considerable impetus to the growing lead mining industry.

In 1637, some fifteen years after gold mining had ceased to be economic and all notion of the working of the gold veins had been forgotten, the lead mine that had been worked by Thomas Foulis passed to the Hopetoun Family[40]. During the following 200 years this mine remained one of the richest ever worked in Scotland, thus bearing out Foulis' contention that "he who works a gold mine becomes poor, while he who possesses a copper one acquires a fortune"[41].

Footnotes

1. Stephen Atkinson, "Discoverie and Historie of the Gold Mynes in Scotland", 1619, Ballantyne Club, (Edinburgh, 1825).
2. Constitutes the Regalia of Scotland.
3. R W Cochran-Patrick, "Early Records Relating to Mining in Scotland", (Edinburgh, 1878), p. xv.
4. Bevis Bulmer, a Yorkshireman, attained considerable skill in mining, and worked mines in various parts of England and Ireland. Subsequent to his operations at Leadhills, he was employed in the working of the Hilderstone silver mine, near Linlithgow. He passed on much of his knowledge of mining to Stephen Atkinson and was responsible for encouraging Atkinson to leave his gold refining business to search for gold in Scotland. Bulmer operated in the part of the Leadhills district still known as Bulmer Moss.
5. Rev. J Moir Porteous, "God's Treasure-House in Scotland", (London, 1876), p. 42.
6. Probably written some years previously in 1616.
7. Atkinson, op cit., p. 13.
8. Ibid., p. 39. This piece of quartz weighed 2 lbs.
9. Sapper stone was probably quartz, e.g. "gold linked fast unto the sapper stone".
10. Atkinson, op cit., p. 15.
11. "Chevore rockes" suggests sharp angular folding of the country rock, cf. chevron folding.
12. Cochran-Patrick, op cit., p. xxix.
13. Ibid., p. xxx. "houldinge their course southeste and by south": the writer is probably referring to the mineral veins of the district rather than the structure of the country rock. The lead veins of the district are characterised by two trends, i.e. NW-SE and N-S. "piche" is an old term for dip. "in shew more than 100 fadam" probably meaning that the veins had been proved for more than 100 fathoms along the strike.
14. Sparr is the old term generally applied to gangue minerals such as quartz and calcite. Keele is an oxide of iron, e.g. limonite, and is still locally regarded as an associate mineral of gold. Uncrystallised yellow pyromorphite was probably mistakenly thought to be brimstone or sulphur.
15. Cochran-Patrick, op cit., p. xxxi.
16. Ibid., p. xxxii. Atkinson states that from Noah's Flood to the year 1619 were contained 3926 years.
17. Ibid., p. xxx. The Leadhills district was anciently known as Crawford Muir.
18. Atkinson, op cit., p. 37.
19. Ibid., p. 39. See Agricola's "De Re Metallica" for description of a stamping mill.

20. Ibid., p. 30.

21. Cochran-Patrick, op cit., p. 108.

22. Ibid., p. 108.

23. Ibid., p. 110.

24. Ibid., p. 109.

25. Ibid., p. 107.

26. Ibid., p. 112. Refers to minerals typical of the oxidised outcrop of lead veins in the district, e.g. cerussite, pyromorphite, limonite, manganese. "Watchett", a pale blue colour, may refer to the copper mineral, chrysocolla.

27. Ibid., p. 112.

28. Ibid., p. 109.

29. Ibid., p. 114. Marcasite, the orthorhombic form of iron sulphide, was in the 16th Century a term applied to all forms of crystallised pyrites.

30. Ibid., p. 108.

31. Ibid., p. 115.

32. G V Irving, "The Upper Ward of Lanarkshire", 1864, Vol. 1, p. 60.

33. Atkinson, op cit., p. 23.

34. John Williams, a native of Wales, was engaged for a time at Leadhills in charge of extracting silver from lead. For a number of years he was manager of the Gilmerton Colliery when, in 1789, he wrote his important "History of Minerals".

35. John Williams, "Natural History of the Mineral Kingdom", Second Edition, (Edinburgh, 1810), Vol. II, p. 365.

36. Irving, op cit., Vol. III, p. 196.

37. A K Temple, 1956, "The Leadhills-Wanlockhead Lead and Zinc Deposits", Trans. Roy. Soc. Edin., Vol. 63, Pt. I, No. 5.

38. Porteous, op cit., p. 42. This profitable lead mine was the famous Susanna Mine.

39. G V Wilson, 1921, "Lead, Zinc, Copper, and Nickel Ores of Scotland", Spec. Rep. Min. Res. Vol. XVII, p. 13.

40. In 1637, Anne Foulis, granddaughter of Thomas Foulis, married Sir James Hope of Hopetoun. The mines at Leadhills have been the property of the Hopetoun Family down to the present day.

41. Quoted in Porteous, op cit., p. 66.

R J GILLANDERS

EARLY SCOTTISH GEOLOGICAL LITERATURE

Geology is the most literate of all the sciences; in no other subject field, save literature itself, are the very earliest works referred to as often as the most recent.

The early literature on Scottish geology is of an astounding richness, and so any description can only be a cursory sketch. I shall limit myself therefore to discussion of some books published prior to the first Geological Survey memoir on Scotland (Edinburgh district, 1861). All of the books and maps mentioned are held in the IGS library in Edinburgh, and are available for public reference at Murchison House. There are many omissions, for some of which I apologise.

PENNANT T.

A tour in Scotland and voyage to the Hebrides, 1772, Parts I and II. This contains a description of Staffa by Sir Joseph Banks, who was on his way to Iceland at the time. Throughout the book, the engravings are superb. This was Pennant's second voyage; the earlier being in 1769, published 1771, omits Staffa.

HUTTON J.

Theory of the earth, with proofs and illustrations vols I and II, Edinburgh, 1795, vol III, edited by A Geikie, was published in London by the Geological Society in 1899.

This was its first publication in book form, although a part had appeared in 1788 in volume I of the Transactions of the Royal Society of Edinburgh. Deservedly famous, the book is not clearly written. Hutton's descriptions of the significance of unconformities at Loch Ranza, Jedburgh and Siccar Point are detailed if somewhat florid. The first volume contains a beautiful plate showing a coach travelling along a road, beneath which is a section depicting vertical strata overlain by horizontal beds. Huttonian stylists and present-day jargonauts should note that one picture is worth 1000 words. Hutton's own "lost plates" are to be published very soon, thus completing the work begun two centuries ago.

JAMESON R.

An outline of the mineralogy of the Shetland Islands, and of the island of Arran.
Edinburgh, 1798.

This is a tedious and repetitive travel journal which cries out for a decent geological map to put the descriptions into some geographical framework.
A field note-book without sketches.

PLAYFAIR J.

Illustrations of the Huttonian theory of the earth.
Edinburgh, 1802.
For the most part, the book is exactly as the title suggests - a popularly written explanation of Hutton's theory. It deserves much more credit than this, however, because of the numerous examples Playfair selects to illustrate some of Hutton's obscurer points.

HEADRICK J.

View of the mineralogy (etc) of the island of Arran.
Edinburgh, 1807.
The descriptions are much more detailed than Jameson's, and bring the geology of the island to life. The Rev Headrick's mixture of astute observation, nationalistic political statements and religious bigotry combine to make this one of the most entertaining and readable texts in Scottish geology.

WILLIAMS J.

The natural history of the mineral kingdom, 2nd edition.
Edinburgh, 1810, 2 vols.
IGS Edinburgh library does not have the first edition, published 1789.
The author was a Welsh miner, who later worked at Leadhills. He prospected for lead near Edinburgh, then for coal in the Highlands, before becoming manager of the Gilmerton coalworks. The book contains graphic accounts of coal-bearing strata, and good descriptions of other economic minerals, including some interesting speculations on mineral veins.

MACCULLOCH J.

A description of the western islands of Scotland, including the Isle of Man: comprising an account of their geological structure.
London, 1819, 3 vols.
This is one of the germinal works of Scottish geology. Still sometimes read, and very often cited, it contains a mass of facts and interpretations of the geology of the islands. The third volume comprises plates and coloured geological maps, with explanations. The maps are of a very high standard, and are obvious precursors of MacCulloch's superb "Geological map of Scotland".

BOUE A.

Essai geologique sur l'Ecosse.
Paris, 1820.
In the main, the book is a summary of the work of Jameson and MacCulloch, but it also contains Boue's own descriptions of Midland Valley volcanics.

NECKER DE SAUSSURE L A.

Voyage en Ecosse et aux Iles Hebrides.
Geneva et Paris, 1821, 3 vols.
Necker spent three months in Scotland in 1807, and completed a manuscript geological map. A facsimile of this map was published by Edinburgh Geological Society in 1939. The above work is an account of his researchers in Scotland. The third volume contains a lithostratigraphic table of Scottish rocks, and the first volume is notable for its "Carte geologique des environs d'Edimbourg".

MACCULLOCH J.

A system of geology, with a theory of the earth.
London, 1831, 2 vols.
The examples cited in this abstruse theoretical work, whilst covering world-wide geology, still concentrate mainly on Scotland.

MACULLOCH J.

Geological map of Scotland.
London, 1836 (library copy 1840).
MacCulloch died in 1835, having completed his great geological survey of Scotland, but before the fruits of his labours could be published. The base map was by Samuel Arrowsmith, Hydrographer to the King, and was of surpassing accuracy and beauty compared to earlier Scottish maps, but MacCulloch continually criticised it. This was a great pity, for seldom has such a brilliant geologist been served by an equally brilliant cartographer. The geological map itself was the most complete and detailed statement on Scottish geology then available, and it remained so until the Survey's Ten-mile map was published. It must be seen to be appreciated.

MACCULLOCH J.

Memoirs to his Majesty's Treasury respecting a geological survey of Scotland.
London, 1836.
This work was published in the year following MacCulloch's death by the same Samuel Arrowsmith whose map MacCulloch used. It is both a report to his

employers, and a geological explanation. The first chapter contains his scathing attacks on the base map, but his publisher wisely makes no apology, instead merely inserting a dignified and subtle paragraph as a preface. By the end of the 1830's the groundwork had been completed, and the succeeding period led to the painstakingly detailed accumulation of data in a systematic manner by the Geological Survey. The first Scottish memoir published was that on the Edinburgh district, appearing two years after the one-inch map in 1861.

COLIN D WILL

EDINBURGH GEOLOGIST, PART 3.

It is hoped that Part 3 of the "Edinburgh Geologist" will be ready for distribution at the meeting of 1st March 1978. Contributions are now invited for this part and articles by amateur members will be particularly welcome. We would also welcome comments and critisisms about the first two parts of the "Edinburgh Geologist" and also suggestions about items (eg book reviews) which might be included in future issues.

The Editor is Mrs H M Butler, 49 West Saville Terrace, Edinburgh EH9 3DP, but the Secretary of the Society and the members of council will also be willing to accept your contributions and comments.

OVER THE SEA TO RUM

The island of Rum, which has been in care of the Nature Conservancy Council since 1957, was the venue for an EGS week-long excursion during May 1977.

A Note on the Geology

There can be few islands of comparable size which contain such a wealth of classic geology. Severe glacial and periglacial activity has produced a rugged terrain in which Pre-Cambrian, Mesozoic and Tertiary rocks are well exposed.

The main mountain mass of the island which exposes the uplifted roots of a Tertiary volcano is composed of plutonic basic to ultrabasic rocks surrounded by a ring fault. The Cnapan Breaca area composed of explosion breccias, tuffisites, felsites and patches of Lewisian gneiss and Torridonian arkose forms an intricate area between the northern margin of the plutonic complex and the main ring fault (see Dunham, 1968). The occurrence of Lewisian gneiss within the area enclosed by the ring fault indicates upheaval of several thousand feet. Today the mountains of Askival (2663 ft), Hallival (2365 ft), Trollaval (2300 ft) and Barkeval (1924 ft) represent the remnants of at least 15 rythmically banded units of ultrabasic plutonic rock which form the Eastern Layered Series. West of the Long Loch north-south fault in Glen Harris 4 main rythmic units are exposed. The base of each unit is composed of an olivine-rich peridotite which passes upwards into a plagioclase-rich allivalite. The origin of these units was formerly ascribed to alternate intrusion of magmas of peridotitic and anorthositic composition (Harker and Barrow, 1908) but it is now generally agreed that the units represent repeated intrusions of a single magma in which the heavier ferromagnesian minerals, notably olivine, have crystallised and concentrated at the base of each layer, leaving a less dense plagioclase-rich rock at the top (Brown, 1956 and Wadsworth 1961). This process of crystal settling may be referred to as gravity differentiation and the units so formed as cumulates. Convolute and slump structures seen within the units may provide further evidence for the cumulate hypothesis.

The southern mountains of Ainshval (2552 ft) and Sgurr nan Gillean (2503 ft) are composed of felsite, gabbro, and granophyre together with associated explosion breccias and intrusive tuffs (see Hughes, 1960). It is thought that the acid intrusions, which have invaded Torridonian arkose, pre-date the emplacement of the plutonic complex. Patches of Lewisian gneiss flank the southern mountains and again are found within the main ring fault. The western part of the island including Orval (1872 ft) and Ard Nev is

composed mainly of granophyre and microgranite (see Black, 1954). The granophyre is in places overlain by olivine basalt and mugearite lavas. The latter form the summit of Bloodstone Hill (1273 ft), Fionchra and part of Orval.

Areas to the north, east and south of the main ring fault are mainly composed of Torridonian arkoses dipping gently westwards (see Black and Welsh 1861). Near the margins to the ring fault, however, the strata are upturned and shot through with cone sheets and dykes associated with the igneous centre. A small area of Triassic strata is exposed on the north west coast.

Glacial and post-Glacial phenomena include deep corries, roche moutonnées, raised beaches and wave cut platforms (McCann and Richards 1969) around much of the island. Remarkable deep weathering particularly of the Tertiary basic and ultrabasic igneous rocks is an outstanding feature. Physical disaggregation has resulted in places in the formation of a regolith of olivine sand. References on the Quaternary of Rum include Peacock, 1976 and Ryder and McCann, 1971.

The EGS Excursion

On Monday 23 May a party of 19, fully equiped for the rigours of a western climate, congregated at Mallaig Pier, before embarking for Rum on the 'Loch Arkaig'. For some it had been an early start from Edinburgh; for others who had spent an EGS geological weekend at Fort William time was afforded on the way to aquaint themselves with the complexities of the Moine under the expert guidance of Mr Scott Johnstone. After a pleasant voyage via Eigg the party arrived safely on Rum and was 'exchanged' with hoards of weather-beaten campers bound for the mainland. While most of the party installed themselves in luxury in Kinloch Castle, an Edwardian castellated extravaganza built by Sir George Bullough a past owner of the island, some more hardy (or thrifty?) types set up camp around Kinloch. The evening saw a discussion of forthcoming events and there were unofficial tours through the ill lit passages of the castle to admire the plumbing, the mechanical organ and the displays of oriental weapons of war and other curios.

Day 1. The whole party made an ascent of Hallival in fine weather. The more energetic members took in Askival before returning to Kinloch via Coire nan Grunnd. Fine views stretching from the mainland to the Outer Isles were ample reward for the uphill work. On Hallival the erosion of the sub-horizontal ultrabasic layers has produced an impressive step-like form to the mountain and the unusually severe weathering on the shoulders and in the corries has left a barren stony terrain. The upper slopes are the home of the Manx

Shearwater, a nocturnal sea bird. Efforts to find these birds in their deep burrows proved almost totally unsuccessful (one tail feather was reported). Later that day a small group of intrepid explorers stumbled up the mountain again, this time in the dark, determined to catch a glimpse of these evasive creatures as they flew home from the sea. Sightings were rare but the air was full of the haunting screeches of the returning birds.

Day 2. The continuance of fine weather allowed the party to make the round traverse of the western coast via Harris Bay and Bloodstone Hill. Some, by courtesy of the NCC, were transported in land rovers to Harris and spent a leisurely hour while waiting for their colleagues, attempting to feed a herd of highland cattle and admiring the views of the central and southern mountains. After the rest of the party had arrived, a brief homage was paid to the Bullough family mausoleum at Harris, built in classical Grecial style.

Well rounded pebbles of harrisite, distinguished by its unusual crystal texture, were plentiful on the beach. These pebbles are also a common constituent of the well preserved nearby late-Glacial raised beaches. The rough cliff top path to Bloodstone Hill afforded excellent views of the wave-cut platform (55 to 65 ft OD) in the western granophyre and microgranite. In places the cliffs exhibited a columnar jointing which from a distance resembles the more familiar basaltic columns. From Bloodstone Hill the views of Canna and the Cuillin of Skye were superb and were well worth the long treck back to Kinloch via Glen Guirdil.

Day 3. A slightly less demanding excursion, traversing the Cnapan Breaca complex proved to be one of the geological highlights of the week. The geology in fact provided a useful excuse for frequent breaks and was welcomed by those weary from the previous day's exertions. Furthermore, the lochans in the area presented a good opportunity to cool off.

The patchwork of Lewisian gneiss and Tertiary explosion breccia was perhaps too complicated to follow in detail in the short time available but the glacial phenomena such as whaleback structures were most impressive. Particularly interesting igneous intrusive breccias known as tuffisites were observed near Kinloch. These breccias are composed of a matrix of glassy volcanic particles enclosing angular fragments of country rock and are believed to have been intruded as a suspension of fragments in hot gas, a condition similar to the industrial process of fluidisation. Networks of dykes and cone sheets also caught the attention and many inconclusive but amusing discussions were held on time relationships of various intersecting intrusions.

Day 4. The eastern side of the island was explored on the final day, yet again in glorious sunshine. On the way to Dibidil, thermally metamorphosed limestones of Mesozoic age containing the mineral tilleyite were examined. At the foot of Glen Dibidil there were superbly exposed outcrops of the Lewisian basement. Under the sweltering afternoon sun some of the party laboured their way up the glen and then on to the top of Trollaval; another two climbed the southern mountains Ainshval and Sgurr nan Gillean while the sensible remainder cooly retraced their steps along the coastal path to Kinloch.

The following morning, the party left the island having thoroughly enjoyed a most successful excursion. Our grateful thanks is due to the Nature Conservancy Council for their hospitality and for allowing us to stay in Kinloch Castle, to Drs Mykura and May and Mr Rock for their geological guidance and to Mr Hogarth who, as Excursion Secretary, saw us safely there and back and arranged the perfect weather. It was a week to remember.

Summary of Excursions (with National Grid References)

Day 1 Traverse of Hallival (396 964) and Askival (394 953) - return via Coire nan Grunnd (404 958) - about 6 miles geology includes rythmically banded ultrabasic rocks of Eastern Layered Series.

Day 2 Harris (338 959) - west coast to Bloodstone Hill (315 006) - Fionchra (339 003) about 15 miles including walk to Harris from Kinloch. Raised beach terraces, gabbro-granophyre contact and harrisite at Harris, western granophyre, wave-cut platform, Tertiary basalt and mugearite lavas.

Day 3 Long Loch (364 987) - Loch Bealach Mhic Neill (375 988) - Meall Breac (386 982) - Kinloch about 5 miles including outward walk up Kinloch Glen to Long Loch. Cnapan Breaca Complex.

Day 4 Path to Dibidil (394 928) returning by Glen Dibidil, Bealach on Oir and Bealach Baise - mheall - about 10 miles not including mountains taken in on the way. Thermally metamorphosed Mezozoic limestones, Lewisian gneiss. Southern Mountains Igneous Complex.

Day 5 (This was originally planned as a fifth day, but had to be cut out). Glen Shellesder (340 017) - Monadh Dubh (34 03) - Kilmory (359 039). Torridonian - Tirassic unconformity; Triassic sequence and fossil beds; sedimentary structures in Torridonian.

MAPS

Ordnance Survey 1:50 000 Sheet 39 (Rhum and Canna), or 1 inch to 1 mile Sheet 33.

Geological Survey 1 inch to 1 mile Sheet 60 (Rhum).

Department of Geography, University of Glasgow, 1:20 000 geomorphological map of Rhum.

SELECTED PAPERS AND BOOKS

BLACK, G.P. 1952. The Tertiary Volcanic Succession of the Isle of Rhum, Inverness-shire. Trans, Edinb. geol. Soc. 15, pp 39-51.

_____ 1954. The Acid Rocks of Western Rhum. Geol. Mag. 91, pp 257-72.

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BROWN, G.M. 1956. The layered Ultrabasic Rocks of Rhum, Inner Hebrides. Phil. Trans. R. Soc. Series B 240, pp 1-53.

DUNHAM, A.C. 1968. The felsites, granophyres, explosion breccias and tuffisites of the north-eastern margin of the Tertiary igneous complex of Rhum, Inverness-shire. Q. J. Geol. Soc. London 123, pp 327-52.

_____ and C.H. EMELEUS. 1967. The Tertiary Geology of Rhum, Inner Hebrides. Proc. geol. Ass. 78, pp 391-418.

HARKER, A. and BARROW, G. 1908. The Geology of the Small Isles of Inverness-shire. Mem. geol. Surv.

HUGHES, C.J. 1960. The Southern Mountains Igneous Complex, Isle of Rhum. Q. J. Geol. Soc. London 116, pp 111-38.

MCCANN, S.B. and RICHARDS, 1969. The coastal features of the Island of Rhum in the Inner Hebrides. Scott. J. Geol. 5, 15-25.

PEACOCK, J.D. 1976. Quaternary Features of Rhum, Inner Hebrides, Report of Field Meeting. Quaternary Newsletter, No. 20.

RICHEY, J.E. 1961. Tertiary Volcanic Districts (3rd Edition). Regional Guide, Geological Survey.

RYDER, R.H. and MCCANN, S.B. 1971. Periglacial phenomena of the Island of Rhum in the Inner Hebrides. Scott. J. Geol. 7, pp 293-303.

WADSWORTH, W.J. 1961. The layered ultrabasic rocks of south-west Rhum, Inner Hebrides. Phil. Trans, R. Soc. B 244, pp 21-64.

WAGER, L.R. and BROWN, G.M. 1968. Layered Igneous Rocks. Oliver and Boyd.

The Nature Conservancy Council has also produced a booklet dealing with the geology of Rhum.

ANDREW A McMILLAN

INSTITUTE OF GEOLOGICAL SCIENCES, FORMAL OPENING OF MURCHISON HOUSE

Murchison House, the new Scottish headquarters of the Institute of Geological Sciences, was formally opened on 14 June 1977 by Sir Frederick Stewart FRS, Chairman of the Advisory Board for the Research Councils and Regius Professor of Geology in the University of Edinburgh.

The Institute, a component body of the Natural Environment Research Council, incorporates the Geological Survey of Great Britain, the Museum of Practical Geology, Overseas Geological Surveys, and research units in seismology and geomagnetism which formerly operated under a number of separate organisations. The Geological Survey, formed in 1835, has operated in Scotland since 1854. At first the very small staff of surveyors was based in London, but in 1867 a Scottish organisation was formally set up, the staff was considerably increased - to no fewer than 10 geologists - and a headquarters was established in Edinburgh, in the Museum of Science and Art, the forerunner of the Royal Scottish Museum. The first Director for Scotland was Archibald Geikie, who had served in Scotland since joining the Survey in 1855, for much of the time as the sole member of staff. He was later to be the first occupant of the Regius Chair in Geology in Edinburgh University, founded at the instigation of Sir Roderick Murchison and with his considerable financial support. A succession of offices in the George IV Bridge and George Square areas served as headquarters for the Survey in Scotland during its first 60 years, but in response to the need for more accommodation the move was made in 1928 to the spacious Victorian villa known as Southpart, in the Grange district of the southern suburbs of the city.

The increase in staff in the years after the Second World War led to a renewed need for increased accommodation. A new building was authorised in 1964, a site on the King's Buildings campus was leased by Edinburgh University to NERC in 1967, and the construction of the building, designed for the Institute by architects of the Department of the Environment, began in 1971. The economic difficulties of the nation and of the building industry, and inter alia the unexpected depth of boulder clay above the Carnethy Basalt at the site, delayed the construction, but some of the staff were able to move into their new accommodation towards the end of 1975.

The building takes its name from Sir Roderick Murchison, eminent geologist and traveller of the 19th century, founder of the Silurian, Devonian, and Permian systems, founder-member of the Royal Geographical Society and the British Association, friend of monarchs and prime ministers, and promoter of

many great scientific enterprises. As President of the Geological Society of London he played a leading role in influencing the Government to establish the Geological Survey. Twenty years later he was appointed its Director-General, a post which he filled with distinction for 16 years, until his death in 1871.

Murchison House was designed to serve as office, laboratory, and store-house for the three Scottish field units of the Geological Survey, the Continental Shelf Unit North, the Marine Geophysics Unit, the Global Seismology Unit, and the Geomagnetism Unit, as well as the Scottish staffs of the Palaeontological, Petrographical, and Hydrogeological departments, and of the Industrial Mineral Assessment and Engineering Geology units. A significant representation of the Computer Unit and its equipment is accommodated and there is a well equipped Drawing Office and Photographic Department. The Library contains the largest single collection of geological literature and maps in Scotland, primarily for the use of the staff but available also for public reference. The range of functions performed by the scientific staffs is very wide, including geological and geophysical survey of the land and the continental shelf, an advisory service to public bodies, industry, private individuals, and schools and universities, studies of seismic wave propagation, of natural earthquakes and their hazards, of the changes in the earth's magnetic field, and of problems of water supply, the stability of foundations, mining for coal and metals, and the supply of bulk minerals such as gravel and roadstone. The Institute is also a depository of all available geological records and maintains large collections of fossils, minerals, and rocks for reference and study.

On the afternoon of 14 June the opening ceremony took place in the open air outside the main entrance before a company of over 100 invited guests representing national and local government, universities, research organisations, industry, and geological science in general. The staff were happy to meet again many retired colleagues and their wives as well as many colleagues from other offices of the Institute. Speakers from the platform were Sir Peter Kent, Chairman of NERC, Dr A W Woodland, Director of IGS, and Mr R A Eden, Assistant Director for Scotland. At the end of a speech embodying reminiscence, congratulations, and good wishes Sir Frederick Stewart unveiled a plaque by which the occasion is commemorated. The ceremony was completed by the presentation of a bouquet to Lady Stewart by Sarah Cunningham, grand-daughter of Mr R W Lucas, Chief Draughtsman and Superintendent of Maps. The platform party was then conducted round the building by Mr Eden and Mr G S Johnstone,

where they were shown demonstrations of the history and work of the Institute and its component units in Scotland. The invited guests also had the opportunity to see these demonstrations, and all assembled later for afternoon tea in the Staff Common Room.

The staff and their guests celebrated the occasion in the evening at a ball in the Assembly Rooms, attended by over 300 people.

The 15th and 16th of June were open days for friends and associates of the Institute and for the general public, and special arrangements were made for visits by the Edinburgh and Glasgow geological societies on the evening of the 15th and by school parties on the 17th. These open days were very well attended, to a total of rather more than 1000 visitors altogether. The staff were greatly encouraged by the interest shown in their work, and enjoyed the opportunity to talk about it to so many attentive guests.

D C GREIG

NEW PUBLICATIONS OF THE SOCIETY

Two new postcards have been added to the very popular Hutton caricature by Kay. One is a reproduction of Prosper Merimée's caricature of Murchison and the young Archibald Geikie mapping in the Highlands in 1860. This card is reproduced with permission of the National Library of Scotland by courtesy of the Institute of Geological Sciences, Edinburgh. The other card is a reproduction of Sir John Flett's photograph of Horne, Peach and Clough on the pillow-lavas at Tayvallich. This photograph was reproduced with permission of Sir Martin Flett also by courtesy of the Institute of Geological Sciences, Edinburgh.

These cards are priced at 5 p each.

As announced in the first issue of our Newsletter, the second part of the Scottish Journal of Geology for 1977 was devoted to the Dalradian of the south-west Highlands and took the form of seven guides and an introductory article on the geology of the area.

These guides and introduction are now available as offprints with paper covers as follows:

Introduction - 30 p
Roseneath, Cowal - 20 p
Knapdale, North Kintyre - 30 p
Tayvallich - 20 p
Jura - 20 p
Lunga, Luing and Shuna - 20 p
Northern Loch Awe - 20 p
Loch Leven - 30 p

POSTAGE EXTRA

Available from: Mr I Bunyan
Publication Sales Officer
c/o The Royal Scottish Museum
Chambers Street
Edinburgh EH1 1JF

PUBLICATIONS AVAILABLE FROM PUBLICATION SALES OFFICER, ROYAL SCOTTISH MUSEUM

Ardnamurchan Guide	£1.33	to members
Ardnamurchan Map (flat and folded)	.50	"
Assynt Guide	.50	"
Guide to Lothians and South East Scotland,		
Hard Cover	2.00	"
Paper Cover	1.33	"
Glasgow Guide	1.00	"
Arran Guide	.65	"
Geological Museum Booklets Volcanoes	.25	"
Story of the Earth	.20	"
Booklet - The Bass Rock	.15	"
Booklet - Elgin Reptiles	.15	"
Geological Timescale published by Manchester Museum	.15	"
Proceedings of Edinburgh Geological Society, Numbers 1-6 inclusive	free	"
Hutton, Murchison and Geikie, Horne, Peach and Clough postcards	.05	"