SCOTTISH CARTOGRAPHY IN THE LATER STUART ERA, 1660–1714

This paper aims to investigate aspects of the land and maritime mapping of Scotland in the half century following the Restoration of Charles II. Although the period saw the appearance of the second edition of Blaeu’s atlas of Scotland, Geographiae Blavianae, in 1662 and was latterly dominated by the work of John Adair, the era as a whole has tended to be neglected. In fact, students of the history of cartography have concentrated until recently on certain stages of high activity and development, thereby creating an impression of a pattern of advance and recession. Scottish literature has stressed interest in two specific fields of enquiry; the surveys of Timothy Pont at the end of the sixteenth century which were eventually published as part of the fifth volume of the great atlas, Theatrum Orbis Terrarum, by the Dutch firm of Blaeu in 1654 and the efforts of the estate surveyors of the eighteenth and early nineteenth centuries in providing large-scale plans for the improving agricultural landlords. Inevitably, the intervening years have been seen as a time of relative inertia but such would be an unfortunate conclusion as the evolution of mapping is better seen as a continuum influenced by the varying abilities of individual practitioners. Certainly, the century 1650–1750, with few exceptions, has been described as ‘not a major period in English cartography’.1 Within Scotland, the religious and civil disorders of the time tend to make conditions appear unsettled. On the other hand, Charles II’s reign provided an order and degree of stability which improved the conditions for commerce. In the rural areas, improvements in the agricultural system took far longer to be effected than those of contemporary England and Holland. Such delay is not easily explained but may have been linked to low levels of demand relative to increased supply and undoubtedly led to the later appearance of the land surveyor, as a professional group, in Scotland, with relatively few early maps being produced.

It has been claimed by Adams that the rudimentary nature of the Scottish economy accounted for the absence of large-scale plans and that the stimulus for making such was delayed even beyond the improving Acts of the Scottish Parliament for the straightening of marches and enclosing of grounds (1669) and the division of commonty and runrig (1695).2 Examples of English surveyors working north of the Border (e.g. Laud, for the Duke and Duchess of Buccleuch, and Thomas Winter, for Sir Archibald Grant) have been cited to support the argument that Scotland had no large-scale cartographic tradition before the eighteenth century. Inevitably, many plans have been lost through a variety of circumstances and our knowledge can only be partial but such an assertion ignores much contradictory evidence from surviving documents, contemporary writings and almanacs which show that, although localised and hesitant, surveying was being carried out by a variety of individuals. In his diary, Andrew Hay of Craighethan, a country gentleman, records on the 9th September, 1659, ‘after breakfast I took my square and compasses and drew a draught of the white comon of Culter’.3 Apart from his editorial work for the Blaeu atlas, James Gordon, the pastor of Rothiemay, produced two elegant town plans of Edinburgh (1647) and Aberdeen (1661). Most notably, John Adair was active throughout the second half of the period as a county surveyor and marine hydrographer, particularly along the North Sea coast.

Although the Restoration era is characterised by a spirit of scientific enquiry which took its lead from the monarch – Charles himself appointed John Ogilby to the newly
created office of 'His Majesty's Cosmographer' in 1671 and actively encouraged such projects as the establishment of the Royal Observatory at Greenwich and a mathematical school at Christ's Hospital — it was also a time of grand design, much activity but only limited progress. This was as true of cartography as of any branch of the 'new' sciences. Rodger lists only 26 individual county surveys for the whole of England and Wales for the period, 1650–1750, and several were 'cheap one-sheet maps purveyed by an assortment of stationers, printers, print sellers, instrument makers and engravers'. In her study of the mathematicians of the time, Taylor quotes Arbuthnot, who observed in 1701 that 'we see those affairs carry'd on and managed by those who are not great Mathematicians: as Seamen, Engineers, Surveyors, Gaugers, Clock-Makers, Glass grinders, etc. and that the Mathematicians are commonly Speculative, Retir'd, Studious men, that are not for an active Life and Business, but content themselves to sit in their Studies and pore over a Scheme or Calculation'. The situation in Scotland reflects the increasingly important role of the practical surveyor. Pont, Robert and James Gordon and Robert Edward were all graduates of the Universities of Aberdeen and St. Andrews, as was John Geddy, the supposed author of the fine town plan of sixteenth century St. Andrews. However, high levels of accuracy need not have been attained solely by graduates, for once the basic rudiments of survey are mastered, the relatively mechanical mathematics could be performed quite easily, particularly using Napier's revolutionary invention of logarithms. Overall, it must be realised that it was only in London itself that a climate existed for the healthy development of such sciences and that, elsewhere, other practitioners experienced marked isolation (e.g. James Gregory, who felt himself in an increasingly hostile environment as professor of mathematics at St. Andrews).

At first glance, the evidence for the growth of mathematical sciences in Scotland is quite meagre. As late as 1662, James Corss was bewailing the lack of mathematicians, blaming ignorance, prejudice and lack of encouragement for such a state of affairs. However, before investigating the results of the surveyors' labours, the background and standard of competence may be judged by a consideration of the contemporary literature. Certainly, the existence of texts and treatises alone can give little proper reflection of the 'state of the art' in a particular place at a particular time but it does help to indicate what may have been achieved. It is instructive to record a remark by John Newton, a Restoration mathematician, of 1677 in which he stated that he had never heard of any grammar school in England in which mathematics was taught.

In 1624, Alexander Huntar published A Treatise of Weights, Mets and Measures in Edinburgh as an elementary text. It included a section on land measuring, but the technique described — a knotted, resined cord between two staves — was no more advanced than those of a century earlier. Nearly sixty years later, John Reid was to cover chain survey measurement and division of land in his Scots Gard'ner (1683), but by far the most significant text of the day was the Englishman, William Leybourne's Compleat Surveyor, first published in 1653. Although it added little new to surveying, it was of great influence on the practitioner because of its clear style, resulting in it passing through four editions. Leybourne preferred the use of the plain table and circumferentor or theodolite, stressing the value of plane trigonometry and the importance of a field book in mensuration. By the closing years of the century, the whole practical literature shows a marked lack of originality and, although a great variety of textbooks on navigation, survey
and other practical skills existed, they were largely derivative or reprints. Two valuable sources of information for Scotland are the annual almanacs published by a succession of mathematicians in Aberdeen, Edinburgh and Glasgow and the extracts of the Burgh Records. Textbooks were expensive and for a limited market, whereas more almanacs were probably sold every year than any other type of literature, annual sales of Forbes's Aberdeen almanac reaching 50,000 copies alone. These chapbooks — the first surviving is for 1623 — clearly fed a wide demand, providing a range of information on tides, markets and weather, as well as carrying advertisements for a variety of services. Given that the population of Scotland at the end of the seventeenth century was about one million people, the impact of such literature cannot be understated. James Corss, the first of a series of mathematician-compilers, produced his first Glasgow almanac in 1662, dedicated to the Lord Provost and Council and earning him a fee of 'ten dollores'. His career had begun at least four years earlier, however, for an entry in the Edinburgh Town Council records for 30 April 1658 indicates the commencement of his teaching mathematical subjects:

‘Admitts and receives James Corse to keip a publict schooll within this burgh for instructing of gentlemen and uthers in Arithmetique Geometrie Astronomie and all uther airts and Sciences belonging theirto as horometrie Planimetrie Geographie Trigonometrie and siklyk for instructing of children in reading and wrytting or in any or all of the former sciences as their parents sall desyre’.

Returning to Edinburgh in 1663, he was admitted a burgess and guildsman the following year, being specifically designated 'mathematician'. He continued to produce almanacs until 1679 and published at least two mathematical works, including Practical Geometry (1666), in which the geometrical quadrant and its use in survey are discussed. During the 1670’s he taught gauging, ‘dyalling’ and navigation 'in the Cowgate, at the foot of Niddries Wynd' and in his pupils' homes. A later almanac records him 'at the signe of the Golden Sea-Quadrant and Cross-staff' (1679). He was succeeded by James Paterson, another mathematician and geographer. His 1681 almanac advertises him at the ‘Sign of the Sea Crossstaff and Quadrant, in the Cow-gate of Edinburgh’, suggesting that he may have been Corss's successor in accommodation as well as career. As a companion to this issue, he published A Geographical Description of Scotland — a brief booklet of fairs, tide-tables and itinerary of the country. In addition, Paterson advertised other service:

‘Such as desire any mathematical instruments made of wood, as scales or the like, with the use thereof may find me over against the foot of Peebles-winde in the Cowgate of Edinburgh, where they shall have scales of my forming that shall resolve mathematical questions both speedily and exactly’.

This side of his business was to expand, as later advertisement for 1686 shows:

‘Those who desire any Mathematical Instruments, as Crossestaffes, Quadrants, Scales, Spiral Lines, Nocturnals, Dials, either Universal or Particular, Uncels for weighing money, or the like; Portable Ink, Sea Compasses made or drest, or any Mathematical or sea-Books. Also, who
desires to be taught in any part of the Mathematicks, as Navigation, Gunery, surveying, Guaging, Dialing, Architectory, &c may find me at the sign of the Sea-Crostaffe and Quadrant: my Arithmetick Book is to be sold at Edinburgh'.

Yet another Edinburgh almanac publisher, John Man, Paterson's nephew, was to continue the mathematical element in his teaching and sale of instruments 'at the Sign of the Glob, Cross-staff and Quadrant'. In 1699 he moved to Leith to teach navigation at Trinity House. The post had been founded in 1680 from a levy of five shillings from the shipmaster brethren of the port. George Drennan, the first master appointed to the post, was expected to teach six hours a day between March and September, dropping to four hours during the winter months, for a salary of £120 Scots per annum. Man received removal costs and an allowance of £40 Scots annual house rent — a reflection of the importance of the post. However, he continued to issue almanacs and advertise as a teacher of navigation. The Edinburgh Gazette for 23—27 July, 1702 carries the following notice:

‘Navigation in all its parts. Expeditiously taught by John Man, he also Makes and Sels all Sorts of Mathematical Instruments, and Touches Sea Compasses which have lost their vertue, at his house a little above the Court of Guard Leith’.

In Aberdeen, Edward Raban, James Brown and John Forbes, father and son, published similar works throughout the century occasionally with a strong nautical input (e.g. Mariners everlasting Almanack of 1683). Forbes also printed the first and only Scots work on navigation of the age in the same year — John Marr’s Navigation in Coasting, or the Sea-Mans Instructer. Again, this work, though written by a practical seaman, brought no new revelations. However, certain issues relevant to charting are discussed, such as a compass variation, the finding of latitude, and courses and distances along North Sea shores. It is highly probable that the mathematical information for the Aberdeen almanacs was provided by Duncan and George Liddel, successively professors of mathematics at Marischal College. The elder Liddel had taught, geometry, navigation and gunnery in London before returning and presumably continued such practical education in the city. Glasgow almanacs seem to have been the sole preserve of the Sanders family but, despite the growth of the trading community in the west, they carried little in the way of practical science. Such literature, although containing much pirated material, had a universal appeal to many levels in Scots society and, inevitably, a wide audience was reached. Thus, James Moxon's advertisement for his three maps of England, Ireland and Londonderry in the 1690 Paterson almanac was using the best contemporary medium to reach his market.

A study of the various Extracts of Burgh Records shows that ‘workers of mathematical instruments’ first appear in Edinburgh in 1643. However, from a later entry, it would appear that such business was not being conducted by native Scots, as on 1 December 1647 the Council

‘Grantis libertie and licence to Robert Devinport Englishman maker of mathematical instruments to exercise his trade and calling of making of the saids mathematical instruments and making or mending of watches within this brugh and liberties thairof and to keip his abode

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and residence heir... for serving his Majesties liedges and teaching of his trade to such uthers as sall enter to his service". 

It is doubtful whether this enterprise developed into a business of any great scale and major purchases of instruments tended still to be made in London or abroad (e.g. Gregory's equipping of the new observatory at St. Andrews in 1668). Despite this, the journeyman remained to be catered for and, in 1674, Edward Buird (or Baird) petitioned to open a chandler's shop in Leith to sell, among other items, 'compasses of all sorts, hailf and halff watch glaisses, ludge and ludge lynes, minut and halff minut glaisses, aismouth compasses, equinoctiall dials, and other mathematicall instruments, quad racks, Jacob stafes, astro labes, sea pleats, sea draughts, cairts, atlases... and all uthers necessaries for the use of shipping'. In his submission, he pointed out the lack of such an establishment in Scotland, such being a danger to shipping and a disadvantage to trade. The Town Council of Edinburgh maintained an interest in and support to cartography from the time of its commission to James Gordon to draw a draught of the city, for which he was paid £50 sterling. In 1683, a sum of £30 sterling was voted to Captain Greenville Collins for 'ane oblignement' in his Coasting Pilot. Two years later, he was to be elected burgess and guildsman. The records also refer to the encouragement of George Sinclair in his teaching of mathematics, navigation and astronomy. As late as September 1715, the Treasurer was ordered to purchase 'geographical maps for use in the high school, the cost of which is not to exceed £24 Scots'.

Mathematics was being taught by James Corss in Glasgow by 1660 but the first mention of a more practical application was in 1681 when Hugh Saffley was appointed professor of navigation at a salary of £4 sterling per annum. This was increased to £80 (presumably Scots) for salary and house rent with the appointment of Robert Whytingdale fourteen years later. Although the burgh's commercial activity was beginning to expand, particularly with the creation of the harbour at Port Glasgow, it appears to have had little influence on the development of surveying or charting at this time. No plans of the harbour or town appear to exist and the whole west coast was to remain poorly mapped until the following century. In August 1689, during the French wars, the Privy Council was to order the magistrates of Glasgow to send to Leith 'four pyllots most expert and knoweing of the islands and coasts from Orkney to the mouth of Clyd... for serving four of his Majesties men of warr in their voadge about the north and westerne coast, the captanes of the men of warr obielding themselves to restore and redeliver the saids pyllots at the mouth of Clyde after completing the said voadge'. Given the complexity of the coastline, such provision was essential for a safe circumnavigation but emphasises again the rudimentary nature of Scots hydrography at this time.

Apart from the mathematical teachings of the Liddels, Aberdeen has little record of any practical education along such lines. However, James Gordon's plan of the two cities again set a high standard in urban cartography. The city presented him with a silver piece or cup of twenty ounces, a silk hat and gown, in addition to twenty pounds sterling in gold as payment. An accompanying Description of Bothe Toues, possibly reflecting his father's chorographical influence, was also intended but remained in manuscript until printed by the Spalding Club in 1842. Gordon's preliminary work for this depiction dates back to certain enquiries drawn up in 1646 and it is possible that the answers were to be used in the text sections of the Blaeu atlas. Nearly forty years later, Alexander Skene
(as Philopiteius) was to publish *A Survey of the City of Aberdeen* (1685) with a detailed description of the town but no map.

The later years of this period also saw several newspaper notices, similar to those of the almanacs, advertising a variety of services. Hence, in the Edinburgh Courant for 28–30 April, 1708,

> ‘These who desire to learn any of the Mathematical Sciences, ... apply’d in Surveying, Gauging, Dialling, in measuring Heights and Distances, and in solving the most usefull bases of Geographie, Astronomy and Navigation &c. They may be instructed in these by Mr. William Smart Minister of the Gospel, to be found at his house in the Head of the Head of the Cannongate in Coul’s Close’.

Later in the same year appeared:

> ‘To all Noblemen, Gentlemen who have Lead or Coal Mines, &c and have Occasion for Compasses, and all Sorts of Mathematical Books and Instruments, Very useful for all Merchants, Skippers and Traders. As likeways a pair of Fine Celestial and Terrestrial Globs, fifteen Inches Diameter, and a large Toloscope useful both for Day and Night: Are to be Sold by the Relict of John Man’.

These illustrations are undoubtedly individual examples of a quite sophisticated network of suppliers, teachers and practitioners. Although it was rudimentary and limited, it is clear that the dismissal of any development of the surveying profession prior to 1700 can no longer be maintained. Within a European setting, Scotland was a small and relatively insignificant country. Her trade was slight and her mercantile marine inconsiderable. In addition, until the very end of the seventeenth century, Scotland had little in the way of a naval establishment which could have co-ordinated any hydrographical effort. For much of the period under consideration, European military and political affairs were to damage trade and distract the monarch’s attention. Charles II had no particular affection for Scotland and, during the whole later Stuart era, the only royal visitor was his brother, James as Duke of Albany and York between 1679 and 1682. This lack of royal concern for the northern kingdom was most noticeable during the reign of William III. His continental wars with France had a most damaging effect on Scots shipping, via privateering, and business activity, which had been suffering from high foreign tariffs. The nation was to be further hit by the double blows of the failure of the Darien scheme, in which it has been estimated that between one-sixth and one-quarter of Scotland’s total available liquid capital was lost, and famine – the so-called “Lean Years” of the 1690’s. Although the effects of the famine were regionally variable and not continuous through the decade, such events did have a serious effect on a society where the market sector was weak and the subsistence system still dominant. Furthermore, the economy remained dominated by a comparatively small number of nobles whose control of influence created a remarkable variety of personal and institutional patronage in several fields, including surgery, engineering and cartography.23 An assortment of policies to aid trade, industry and agriculture were the result of the activities of both the Scots Privy Council and Parliament in the last decades of the seventeenth century. While it is true that Scotland lacked an established
middle class capable of commissioning surveys at this time, such work was being carried out.

The second Latin edition of Blaeu’s atlas was issued in 1662. Although there were textual revisions and certain artistic additions to the maps, no new cartographical information was introduced, merely a repetition of the original 1654 depictions. Gaps in the national coverage remained (e.g. no map of Angus appeared until Edward’s of 1678). Recent studies, particularly by Stone, have indicated that the role of Robert and James Gordon as editors of the original Pont manuscripts has been exaggerated. Consequently, it is now reckoned that much of what the maps show dates from the latter years of the previous century. Scotsmen were quite aware of the need for revision and two attempts, involving the same cartographer, were made to produce an atlas of Scottish maps. In response to a petition from John Adair, the Scots Privy Council gave him authority to survey the shires of the kingdom, promising a grant of £100 over two years. This submission had been prompted by a request from Moses Pitt, the London bookseller, to prepare maps of the Scottish counties for his intended Great Atlas. Adair was to cover areas missing from Blaeu as well as revising the original atlas maps – an undertaking ‘which seems to be very necessary’. A specimen map of Clackmannanshire was included with the submission as evidence of his ability, which, given the commission to survey is dated 4th May 1681 and that Adair was born in 1660, shows his almost precocious talent as a draughtsman. It is possible that Adair, growing up in Leith, was given some practical tuition by a local mariner in the use of instruments but there is no record of this. The only early reference to him is in 1676 when he was in the company of fellow Scot, John Ogilby, cartographer of the road-book Britannia, and Robert Hooke, curator of experiments at the Royal Society. Although Ogilby’s death in that year cut short any potential interest he may have had in his young compatriot, it is again possible that Adair learnt at least some skills from the Cosmographer Royal.

On receipt of his licence, Adair published an advertisement calling for information and embarked on an intensive period of survey which resulted in the three Lothian counties being mapped by 1682. Unfortunately, this venture was to be constantly harrassed by business and financial difficulties. In particular, Sir Robert Sibbald’s involvement was to cause much distress. Through the influence of his patron, the Earl of Perth, Sibbald had been appointed ‘His Majesty’s Geographer for Scotland’ and given an exclusive patent to compile a description and atlas of Scotland, dated 30th September 1682. Clearly, the Privy Council’s assent to Adair’s work pre-dates the Sibbald scheme by well over a year but it is likely that the arrangements for the latter proposal were made during the visit of James, which had ended earlier that year. Whatever the background to this complication, Sibbald’s project had royal authority and, in 1683, he issued An Account of the Scottish Atlas, in which he claims Adair’s surveying as relating to the larger scheme. In a private contract, Adair was bound to provide Sibbald alone with maps and to have no business ties with any other person. Despite this, the atlas was never published, Sibbald’s work appearing in 1684 as Scotia Illustrata sive Prodromus Historiae Naturalis, without maps. Throughout their business relationship, Adair appears to have been hampered by problems of finance. Merchants’ bills failed to be paid and, in May 1686, he had to complain to the Privy Council that he had received only half of the promised £100 grant. The Council responded by ordering the balance to be paid and by passing an act of
tunnage in his favour to provide funds for a hydrographical survey, felt to be ‘most necessary for navigation, and may prevent several shipwrecks, the want of such exact maps having occasioned great losses in tyme past.’ From this date, Adair was to turn his attention increasingly towards marine charts and spend less time on land survey. The ability to finance such work by the tunnage levy could well explain this change of direction but it did lead to a duplication of effort, since Captain Greenville Collins had begun surveying the whole British coast in 1681. However, before considering the coastal charts and surveys, the discussion of the various land maps and plans is best concluded.

Only one new county map of Scotland was engraved during Charles II’s reign. In 1678, the Rev. Robert Edward, minister of Murroes parish, published his Latin description of the County of Angus which was accompanied by a map engraved in Amsterdam by Waesberghe, Pitt and Swart. Angus had been omitted from the Blaeu atlas because of the loss of the original manuscript and, although it is not certain whether Edward was the cartographer, this map filled a significant gap. The Privy Council was well aware that revision was as important as completing the national coverage — the wording of the original licence to Adair mentions ‘reformation’. It also understood that such a survey would be expensive in time and money, but, of all Adair’s county work, only The Mapp of Strathern, Stormont and Cars of Gourie was engraved during his lifetime. This map first appeared in 1685, dedicated to Sibbald’s patron, Perth, now Chancellor of Scotland, and engraved by James Moxon. Despite this dedication and a further proposal to raise subscriptions for county maps, Adair was to have little success with the finishing of his work. The possibility of the changing fortunes of patrons and patronage should not be overlooked, particularly during the reign of James VII, but this failure was only part of a general malaise in British cartography at the time. Pitt’s atlas project failed after only four volumes were produced, Pitt himself being imprisoned for debt in 1689. John Adam’s scheme for a survey of the whole country was similarly unsuccessful. Sibbald was unable to provide or procure the proper finances for the work and in 1691 Adair was freed from his contract. One of James’s most prominent protégés in Scotland, Sibbald was something of a political trimmer who briefly converted to Catholicism and it is possible that the Privy Council was seeking to punish him for his ‘envy, malice and oppression ... contrary to the public interest of the nation’. He was ordered not to impede Adair in any way. However, traces of the animosity can be seen to recur, perhaps, in later years, particularly through two third parties, John Slezer and Martin Martin. Slezer had been connected with Perth’s brother, Melfort, and had worked with Sibbald in his scheme for the Scottish atlas. Sibbald wrote the Latin letterpress for Slezer’s Theatrum Scotiae which first appeared in 1693 (although, against the latter’s wishes). It is possible that he lent support to Slezer in his constant and, at times, vicious confrontations with Adair over funding. Even without it, Slezer, as a Dutchman, found favour in the Scotland of William III. Martin Martin, author of A Description of the Western Islands of Scotland (1703), travelled with Adair on his expedition to the north west in 1698. In a letter to Sir Hans Sloane, Secretary of the Royal Society, in the December of that year, Sibbald was to write of Martin’s description of the Isle of Skye, ‘It heth him coast much paines & expense, and John Adair in steed of rewarding him as he promised, heth treated him scurvily’. Adair’s appointment as Geographer for Scotland cannot have eased the situation. Personalities and antagonisms apart, such constant friction and petitioning can not be seen as the sole reason for Adair’s inability to
see his work completed but these difficulties, combined with the lack of any influential patron, may well have militated against his eventual success.

One major difficulty in an assessment of Adair's merit as a cartographer is that many of his maps have not survived. In 1684, Sibbald's house in Edinburgh was burned and it is possible that some of Adair's copies were lost for, although contracted to make copies, only that of East Lothian remains in duplicate. More importantly, much of his work was handed over to the Edinburgh Exchequer Office in 1723 by his widow in exchange for an annual pension. It has long been assumed that they were subsequently lost in a fire which destroyed the building in 1811. However, it is valuable to note that the maps were consulted at least once prior to their destruction. In a letter to his brother, Sir John Clerk of Penicuik, Hugh Clerk wrote in May, 1730,

"I was honoured with your most Acceptable favours of ye 10, covering ane order to Mr. Bogle which has made ye Capt. very happy by seeing & taking off some surveys of John Adairs. I was present with him yesterday in ye Exchequer though I find none of Adairs work in those surveys compleat & they cann be of no service Either to ye publck or others, for publishing, but for ye Assistance & some help to a mann going to make a Compleat survey as Capt. Erskine is upon now".

Discoveries of other Adair maps continue to be made and, despite his failure to acquire any, the topographer Richard Gough did ascertain that Adair's descendants had retained some of his manuscripts. From lists compiled by himself and his widow, it is known that Adair worked in Angus, Dumfriesshire, Renfrewshire, Ayrshire and Lanarkshire but none of these surveys appear to have survived. What remains of his topographical work is mostly centred on the east coast, particularly Fife, Perthshire, Stirling and the Lothians. Such a concentration is quite understandable given the generally poor condition of the roads of Scotland and, more particularly, the lack of vehicle roads in much of the Highlands prior to the work of the military engineers in the 1720's. In addition, the bulk of the population, especially those potential employers or patrons, lived or near the east coast. For one brief period Adair did have some success with an engraver. In the summer of 1687 he visited the Netherlands to study the methods of printing and production of their leading geographical houses. At the Privy Council's request, he invited James Moxon, son of Charles II's hydrographer and a notable engraver, to return with him to Edinburgh. Although the nation was in the turmoil of revolution, 1688 was to be an auspicious year for Adair. In the November he was elected a Fellow of the Royal Society and his association with Moxon was to produce at least four engraved maps. Apart from a second issue of the Strathearn map, Moxon was responsible for a general map of Scotland copied from the Nicolay map of 1583 and later to appear in Adair's sea atlas, a map of England and one of the parish of Tranent. Moxon was not tied to working for Adair alone during his stay in the capital. He engraved the map which accompanied Walker's True Account of the Siege of London Derry (1689). His sojourn, however, was comparatively brief and, whether through financial difficulties or sheer lack of business, he soon returned to London. The map of Tranent, dedicated to George, Earl of Winton, is something of a paradox in the known body of Adair's achievement. Whether a local commission or a speculative display of advertising to attract support, it is a rare example of an engraved
barony plan showing both the cartographer’s and engraver’s skill.

Adair was to enjoy more success in his long association with Sir John Clerk of Penicuik, first dating from 1687. They shared an interest in natural philosophy and Roman archeology.³⁹ In the February of 1687, Adair drew a plan of Penicuik House and its parks (RHP 9369). Other plans from the family muniments show that this was only one of a whole series prepared over the following thirty years. Clerk himself is credited with a plan of Mavisbank park (RHP 9372) of 1697 and it is possible that Adair gave him some instruction in surveying techniques. Certainly, a plan of the marches between Newhall and Brunston of 1713 (RHP 3840) is now recognized as done by one of John Adair’s scholars and not, as once thought, John Adam’s. Such plans clearly show that the need for boundary demarcations was already beginning to provide employment for surveyors. Early processes of division of comonnty produced plans of Halls (RHP 3833-35) and Penicuik, James Stewart, Andrew Sympson and Whitehead being employed on these and other sketches. Increasingly, references are found to people described as land surveyors or sworn measurers (e.g. William Byres at Lilliesleaf).⁴⁰ Although no plan of his survives, some depiction of division can be assumed to have accompanied his work. Again, there are records of placing and setting of march stones between commonties and farmlands (e.g. at Newtonlee),⁴¹ suggesting the need for measurers or surveyors. Adair himself was responsible for drawing up the dimensions of Lasswade barony in 1695. Elsewhere in the country, plans exist of Mertoun (RHP 22521), the lands of Tillicoultry (CS 96/1/17), Park in Wigtownshire (RHP 44700) and Brechin Castle and its grounds (RHP 35167-69). Adams has recorded plans relating to early divisions of comonnty for Belhelvie (c.1711) and Hill of Ardoch (1713), the latter by James Murray, a later overseer of the Duke of Atholl’s coalworks.⁴² In addition, there are examples of Paterson, the almanac publisher, at work in Edinburgh,⁴³ of amateurs sketching or copying maps (e.g. sketches found on the backs of playing cards, dated c. 1693)⁴⁴ and estate plans (e.g. Glendorch, Lanarkshire).⁴⁵ This latter plan, drawn by John Davis in 1712, can also be taken as an example of a growing concern in mining, for it indicates a copper vein. Other plans from the Clerk papers map coal seams at Penicuik, Lasswade, Drongan and Clackmannan. George Sinclair, later first professor of Mathematics at Glasgow, carried out practical studies of the geological structure of several coal mines and acted as advisor to certain coal owners. Of greater significance are two hitherto undiscovered town plans of Kelso, by John Slezer and dated 1684, and Inverness, by James Gordon. The former⁴⁶ was drawn as a record of the disastrous fire which destroyed much of the town in that year while the plan, Nova Invernessa, is a pencil sketch included in the manuscript English text of Sibblad’s Atlas Scoticus.⁴⁷ Slezer also provided sketch plans of Dunottar and Dumbarton castles for this work. Hamilton was another burgh to be early mapped and a beautifully detailed plan of Alloa exists, dated c. 1710, attributed to John, Earl of Mar (RHP 13258). Plans of other military locations were produced by army engineers, particularly Beckman and Theodore Dury, Chief Engineer in Scotland, whose work ranges from Stirling, Blackness and the Bass Rock to Fort William and Kirkcudbright. Like the work of their successors on the Military Survey, their plans were for a specific purpose of controlling a frontier region and were not available generally to other concerns. Despite this, they form a valuable section of the cartographic heritage of this period. Other professional figures to produce plans were Dr. Thomas Garth (of Mellerstain), the architect Robert Mylne, and the Rev. James Wallace
(of Orkney). Sibbald himself is credited with a historical map of the Roman wall between the Forth and Clyde appearing in his *Historical Inquiries*.

Following the Union of 1707 and the end of both the Scottish Parliament and Privy Council, Adair’s source of funds from the tunnage dues virtually dried up. Very few maps or plans by him post-date the year of his sea atlas (1703). Illness prevented him from drawing a map to accompany Penneucuck’s *A Geographical and historical description of the Shire of Tweeddale* which was published in 1715 and cast doubts on the dating of a map of the northern islands to this year. His last field work would appear to be for his plan of the River Tay at Perth of 1716 relating to a dispute between the town and Sir Thomas Moncrieff. Two years later, Adair was dead with very few assets to his name. Of his methods of operation, a proper scientific approach is suggested by his expenditure of over £1,000 on instruments, especially a sixteen foot telescope, and by his observations made to join maps of the east and west coasts. However, despite a large surviving archive of material relating to him and his maps, very little is known of the surveying techniques of the era. Given his speed of mapping in the Lothians, it is probable that compass traverses along major routes using a ‘waywiser’ (an invention of Robert Hooke), chain and quadrant helped produce the results rapidly. His achievement in land survey alone distinguishes him from his contemporaries as the only true career cartographer of his day. This distinction was recognised by the Fellowship of the Royal Society and William Paterson was to suggest him in a representation to Queen Anne regarding draughts of docks at Edinburgh. Apart from his maps and sketches, it is known that Adair was also responsible for, at least, one geographical description of Stormont and parts of Angus. He was Scotland’s Geographer Royal and the leading figure in the hydrography of his day. This aspect of Scots mapping has tended to be neglected or, at best, briefly included in more general accounts. Despite several important papers on specific maps or hydrographers, the history of the sea chart in Scotland remains to be written. The concern of this paper, however, is the later Stuart era and, again, a brief discussion of the position at the Restoration may best indicate the stage of development.

The marine chart is an entirely separate creation from a land map and is designed for one major purpose alone — to assist navigators to find their way at sea. At the end of the seventeenth century, many mariners continued to rely on traditional methods based on experience and trusted set courses. Plain charts, which ignored the convergence of meridians, were adequate for many needs. This rule-of-thumb approach was not to be altered seriously until the middle of the following century, despite a continual loss of tonnage by shipwreck. In Scotland, there was still a marked concern with charting the east coast and its ports, reflecting the continued importance of the North Sea trade to the national economy. Despite the hazards and intricacies of the western seaboard, accurate charts of these waters were not available until the 1750’s. As earlier stated, the creation of Port Glasgow, the teaching of navigation and the gradual expansion of the Glasgow fleet did not produce any expansion of coverage at this time. Collisions and strandings occurred in several of Scotland’s small and difficult harbours and few ports had any organised piloting service. In the absence of any Scottish network, the Navy Board was continually troubled by the need to provide pilots for its ships operating off Scotland. The authorities made several efforts to solve the many difficulties. A beacon was kept alight on the Isle of May at the entrance to the Firth of Forth. In
Aberdeen, the Shore Work Accounts record the sounding of the correct channel and the setting up of 'fyrbits' (beacons) in the harbour in 1630-31. The Convention of Royal Burghs was regularly involved in helping to finance harbour improvement up to the Act of Union but this does not appear to have resulted in any extant harbour plans.

Scotland appears to have made little contribution to hydrography during the great age of exploration and travel associated with the century prior to the Restoration. With one notable exception, the rutter and chart produced for James V's circumnavigation of Scotland in 1540, the Dutch dominated the sea chart business. Their skill in copper plate engraving allowed easy mass production which met the demand of their fleets who, in turn, fed back information to the great geographical houses. The century following the publishing of the printed map of Scotland by Nicolas de Nocolay (1583), based on the Lindsay rutter of 1540, has fifty-eight marine charts of various sections of the Scottish coast listed in the standard Scottish cartobibliography.\(^{54}\) Of these, fifty-three are either directly attributable to a Dutch cartographer or are copies based on a Dutch original. It is doubtful if navigators would have relied on land maps of coastal areas (e.g. those of the Blaeu atlas), for, apart from their limited detail on such features as rocks and shoals, the Dutch engravers often had great problems with the spelling of place names and introduced their own copying errors.

Of the standard contemporary texts, Edward Wright's *Certaine Errors in Navigation*, published in 1599, was the most influential of its time. It faced the problems posed by the practicalities of chart construction and had sections on contemporary instruments, particularly the use of the cross-staff. Handson's *Trigonometrie* of 1614 included a discussion on finding compass variation — a fundamental source of error in dead reckoning — and a second edition considered the use of logarithms. Edmund Gunther devised several instruments including a new cross-staff, bow and basic slide rule which became popular but his books, although important source material, were of little immediate influence, being too academic for most navigators. These texts pre-date the period considerably but Taylor has shown that a study of the catalogues and booklists of the nautical book-sellers in the last decades of the century clearly indicates how little had been the advance since their publication.\(^ {55}\) It is estimated that something like nine-tenths of their stock consisted of reprints or new editions of works that were anything from twenty to a hundred years old.

One major problem in an assessment of hydrography is that similar instruments were used in navigation as in map construction. Where there is evidence of the use of compass, chain and quadrant with land maps, it is relatively safe to assume the work of a cartographer. With sea charts, however, instruments may be employed merely to plot courses on existing works. In addition, such surveys were practical working documents, which were often discarded when outdated. Few manuscripts survive to indicate the method of survey. Whereas navigational instruments may be discovered at shipwreck sites, the sea has been naturally thorough in its destruction of charts. On the other hand, naval officers were encouraged to sketch and chart unfamiliar coastlines, doubtlessly using the same instruments as in course work. Apart from the standard compass and dividers,\(^ {56}\) the period saw a gradual change away from the mariner's astrolabe to the cross-staff and, later, the back-staff. Quadrants, metal quarter circles with plumb bobs, were used to estimate elevation but had limited use in high latitudes, whereas the
mariner's astrolabe was a small but heavy version of the Arabic instrument with a strong swivel thumb-ring for use on board ship. It was made up of a metal graduated circle with pivoted alidades pierced by sighting holes. The astrolabe ordered from Elias Allen for the St. Andrews' observatory was graduated to measure to 12° of an arc but such accuracy could never be expected at sea. Such devices are first mentioned in the 1550’s and the earliest surviving example is now held in Dundee City Museum, once in the possession of Andrew Smyton, a Dundee shipmaster of the 1680’s. If Smyton was still using this instrument at this date, it may be an example of the slower development of techniques in Scotland. A less clumsy and somewhat transitional adaptation of the Arabic kamal was the cross-staff, also known as the fore or Jacob’s staff. It was formed by a sectional staff, with varying cross piece transoms to measure distances and angular elevations. However, it called for looking in two directions at once, did not fit the eye easily and necessitated sighting into the sun. The improvement of this to the backstaff or Davis quadrant, first introduced in the 1590’s and popular for nearly two centuries, allowed observers to stand with their backs to the sun by adding a shadow vane. Again, another Scottish example – the Kilrenny tombstone of James Brown who died in 1672 – suggests Scots mariners still tended to rely on the older methods of astrolabe and cross-staff. Apart from these variations, there was a growing acceptance of Gunther’s scales and sectors for calculating triangulation problems by using logarithmic and trigonometrical functions.

Plagiarism was rife in the map business of the seventeenth century and this was particularly true for sea charts. The attempt by John Seller to gain a footing in the chart trade had foundered on lack of finances, forcing him to use out-of-date Dutch plates touched up for his purposes. Inevitably, this resulted in inaccuracies and much criticism. The inadequacies of Seller’s work only served to emphasise the weakness of British coastal mapping and was to lead to parallel efforts at producing charts of the Scottish east coast from both sides of the border in the last decades of the century. In both instances, the resulting sea atlases proved to be the cartographers’ only published volume of work. Yet, whereas the Englishman, Greenvile Collins is renowned as a coastal surveysor, his Great Britain’s Coasting Pilot re-appearing in at least twenty editions up to 1792, the Scot, John Adair, has tended to be overshadowed and his Description of the Sea-Coast and Islands of Scotland was limited to only one edition. The growing conviction of the need for some form of official survey resulted in Charles II appointing Collins in 1681 ‘to make a survey of the sea coast of the Kingdom by measuring all the sea coast with a chain and taking all the bearings of the headlands with their exact latitude’. Collins clearly had influence at court, particularly Sir John Narbrough and the Duke of Grafton, but he was also an experienced naval officer who had drawn several charts while serving in the Mediterranean. The Admiralty was to provide a vessel, crew and provisions, and support, albeit lukewarm, was won from Trinity House. Despite this institutional involvement and the promise of sufficient funding, interest gradually waned and the resulting financial stringencies affected the progress and accuracy of the charting. Collins took eight years to complete his work, producing over 100 manuscript draughts of the whole of the English coast, the east of Scotland and the principal harbours of Ireland. He relied on local knowledge on one occasion, when John Marr’s survey of the coast between Fife Ness and Montrose was used. Little is known of Marr except for his book on navigation and his map of the east coast in Doncker’s atlas of 1696. The Edinburgh
Courant of March 16–19, 1705 records, 'another ship the Neptune of Dundee, Laden with Iron and Dales from Norway, John Marr, Commander'. It is possible that he was a working skipper whose skill and local knowledge enabled him to produce a chart superior to those of a more general survey.

Forty-seven charts subsequently appeared in Collins’s *Coasting Pilot* published in 1693 but the atlas was severely criticised by Trinity House, the Royal Society and Pepys, who noted, ‘Mr. Hunter tells me that Trinity House itself complains of Collins’s ill performance of his Book of Carts; and yet he dedicates it to them as well as to the King.’ Despite the strictures, it was to remain well used throughout the following century, but again it emphasised the need for a properly organised official survey. Five years after Collins’s original commission – the Scottish Parliament passed an Act in favour of Adair in June 1686 which marks the change in his concentration to hydrographical survey. The duplication of effort is unusual and it is possible that Adair assumed Collins would not publish his Scottish charts but more probable was the need to improve on the inferior quality of the latter’s work. Funding was to be a similar problem for Adair and the Records of the Scots Privy Council tell a discouraging story of his petitioning to enforce the tunnage dues and of ships’ captains unwilling to pay. In spite of a fourfold increase in the rate in 1695, the division of the levy between Adair and John Slezer, a Dutch artist, was to cause further setbacks and antagonisms. Slezer was eventually to accuse Adair of not fulfilling his commission – receiving money without publishing a single sheet of ‘this pretended Sea Atlas’. On the face of it, the claim appears to bear much truth. As early as 1692, Adair was accepting money from Sir John Clerk of Penicuik as his subscription to copies of ‘The first part of the Mapps and Description of Scotland’. The chart of Montrose Basin which eventually appeared in his atlas is dated 1693 and, by the following year, he is recorded as having surveyed the coast from Sunderland Point to Buchan Ness, with ten charts ready for inclusion in a first volume. Promises to have maps ready continued to remain unfulfilled and, yet, Adair could find time to produce elegant receipts with map vignettes for duty paid. By this time, Moxon had returned to London and, ironically, was employed by Collins as an engraver. In spite of the need, the atlas did not appear for another ten years while Adair turned his attention to other stretches of the coast. In 1696–97, he was surveying the Firth of Clyde and, the next year, he hired a ship and crew to spend the summer charting the Western Isles and Ross coast. His atlas was eventually published in 1703 with only five large scale charts of the east coast to Aberdeen in addition to a copy of the Nicolay map of over a century earlier. After such a passage of time, the end result could well have been a disappointment for all concerned, particularly as several instances of incompleteness are noticeable on the maps. More significantly, Adair’s own surveys could well have updated the Nicolay map. On the other hand the sheets are of a high quality of draughtsmanship and accuracy, showing up well in comparison with those by Collins. Detailed piloting instructions in the text suggest that Adair may have navigated the passages during his survey. Although later volumes were to cover the northern and Western Isles, the Clyde and Solway Firths, nothing came of the scheme and despite the existence of several manuscripts, this other work appears never to have been widely available.

Finally, of other coastal maps, there are harbour surveys by the military and naval engineers, particularly John Naish’s work for the Navy Office in 1709 covering Leith and
Queensferry. However, in spite of the efforts of Collins, Adair and others, an unwillingness to change old methods and a lack of survey technique prevented any real advances in charting standards until the end of this period. As Pepys observed: 'It is clear also that rather than show their differences, for fear of showing their mistakes, masters will conceal their differences and so let the charts remain forever as they be'.

Throughout this discussion, the evidence increasingly has indicated that Scotland had a sophisticated, if comparatively weak, network of people involved in making maps at this time. Certainly, by the last three decades of the seventeenth century, there was a marked improvement in the mathematical teaching of such practical skills as navigation, gunnery and surveying. Chairs in mathematics had been established at all four universities by 1700 and Sinclair, the Gregorys and Liddels had advanced the subject well beyond the discredited links with astrology. It cannot be overlooked that much of the work was isolated, somewhat crude in style and could still be the province of the amateur. The example of John Adair as a career cartographer was exceptional in the extreme. Nor can too many claims be made for the achievement of the age. Much of the evidence is limited and the surviving documents can only give a patchy impression. It is possible that the actual number of practitioners may have been no more that two or three dozen in many walks of life from the country gentlemen (Clerk, Mar) to mathematical publishers (Paterson, Man) and the specialist. Agricultural improvements were slower to gather pace in Scotland and the surveying profession took time to develop into a strongly identifiable body. However, when change did take place, it occurred in an environment where the necessary skills of mensuration were understood. It is important to consider what was achieved in the light of contemporary problems, particularly in the case of accuracy and its relation to finance. Neither Collins nor Adair were poor cartographers. Given the technical limitations, their ability and application were most impressive. Any weakness was not theirs alone but was associated with an establishment with limited finances and organisation for the tasks required. Standards of completeness or draughtsmanship varied in response not only to ability but also to the requirements of the patron or public. Profitability may again be seen to have been hampered by geography. As Harley has commented, 'it was often the organisation of the market, rather than technical feasibility, which inhibited cartographical progress'. Here may be the true reason for such limited success.

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NOTES

3 A.G. Reid, ed., The Diary of Andrew Hay of Craignethan, 1659–1660 (Edinburgh, 1901) 131.
43 SRO RHP 35997/1–2, “Draught and measures of the lands of wrights' houses near Edinburgh”, 2 Nov. 1693.
44 SRO RHP 35216/1-3.
45 SRO RHP 3848.
46 SRO RHP 42577.
49 Royal Scottish Geographical Society, op. cit., 72.
50 National Register of Archives (Scotland) survey 1275, 23, bundle 1166.
51 A. Mitchell and J.T. Clark, eds., Geographical Collections Relating to Scotland made by Walter Macfarlane v.3 (Edinburgh, 1908) 221–3.
56 For a discussion of dividers found in the ruins of Ellan Gheirrag Castle see D.J. Bryden, “Two pairs of dividers and The Mariner's Mirror”, Mariner's Mirror, v.54, 1968, 77–84. Dividers have also been found at the sites of the Kennermerland and Lastdrager wrecks.
60 Adair had drawn a hydrographical chart of the Firth of Forth in 1683 which later appeared in de Ram's atlas of c.1690.
61 National Library of Scotland, Mss. 5.581 (48).
62 The Leith plan is housed in the Public Record Office, MPHH 32 (W.O.78/1830); the Queensferry chart is in the British Library, Add. Mss. 61630A.
63 E. Chappell, op. cit. 127.
9 *Extracts from the Records of the Burgh of Glasgow, 1630–1662* (Glasgow, 1881) 469.
10 *Extracts from the Records of the Burgh of Edinburgh, 1655–1665* (Edinburgh, 1940) 93. Hereinafter referred to as *Edinburgh Extracts*.
13 Ibid., 136.
14 In 1674 Gregory ordered a plain table and its ‘furniture’ from John Marke for £3.10s. Taylor op. cit., 252.
18 *Extracts from the Records of the Burgh of Glasgow, 1663–1690* (Glasgow, 1905) 308.
19 *Glasgow Extracts, 1691–1717* (Glasgow, 1908) 187.
20 Register of Privy Council of Scotland, 3rd ser. v.14, 1689 (Edinburgh, 1933) 38.
31 Ibid., 68.
33 Edinburgh University Ms. Dec.8.35, f.9.
34 From 1692 there is regular mention of two maps of East Lothian. See “Papers relating to the Geographical Description, Maps and Charts of Scotland, by John Adair”, in *The Bannatyne Miscellany* v.2 (1836) 351. Manuscript copies of the county sheet are held in the National Library of Scotland and the Bodleian Library.
35 Scottish Record Office (SRO) Clerk of Penicuik Muniments GD 18/5321/37.
38 British Library. Example maps 1175 (119).
40 SRO Register of Deeds, RD 12/42/533 (1702).