

**PATRICK COPLAND 1748 - 1822**  
**CONNECTIONS OUTSIDE THE COLLEGE COURTYARD**

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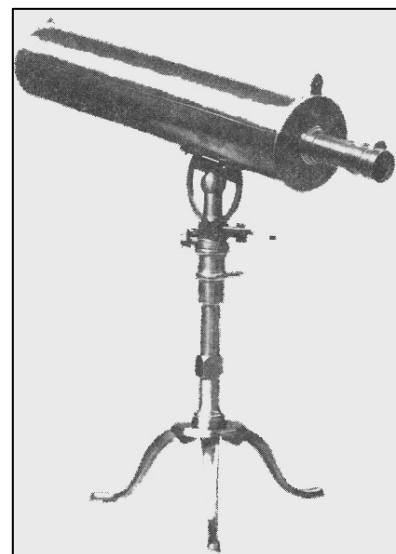
*1.1 Introduction*

**T**HIS is not a story about big science and national fame; it is not even a story about the most successful aspects of Patrick Copland's career. It is just a story, or rather a number of short stories, of science applied outside the college precincts at Aberdeen some two hundred years ago. Taken individually the events are simply incidents in Copland's career. Taken together they show that quite early in the industrial revolution there was not only a growing need by commerce and industry for scientific advice but there was some effective communication between academic natural philosophers and those who had need of scientific ideas in practice. The profession of 'physicist' had not yet emerged in the evolution of science. However, if anyone two hundred years ago was looking for a precursive illustration of the way things were going, they should have taken note of Patrick Copland's approach.

Copland was exceptional during his time, both for the narrowness of his specialization and for the interest he took in popularizing the usefulness of physics. As was mentioned in an earlier article<sup>1</sup>, little is known about his life before he became Professor of Natural Philosophy at Marischal College in 1775. Consequently we know little of why and when Copland chose to concentrate his effort into natural philosophy in general, and mechanics and astronomy in particular. Nevertheless two incidents prior to his appointment confirm that his enthusiasm was known both locally and more widely.

*1.2 Early experiences*

In 1769 one of the astronomical events of the century was to take place - the transit of Venus across the sun. Venus's path was so accurately aligned with the sun on 4 June 1769 that it would appear as a dark spot traversing the disc of the sun. The astronomer Edmund Halley (of comet fame) had pointed out that the exact position of its track across the sun would depend on the latitude of the observer on earth. From the difference in transit times for different observers, the sun's absolute size could be calculated in terms of the earth's size, which was of course known. Because astronomers were able to observe only angular positions with their telescopes, only the relative size of the solar system was accurately known. Once the sun's absolute size could be determined, the whole scale of the solar system would be quite accurately known. This was an exciting prospect at the time.



*(Plate 1: Marischal College's small portable Gregorian telescope)*

of 12 inches focal length<sup>107</sup> by James Short, a leading maker of the mid-eighteenth century) In 1769 Marischal College procured a small portable Gregorian telescope to supplement its fifty-year-old five foot focus Newtonian telescope in time to participate in the measurements. Copland, who had graduated at Marischal College three years earlier, assisted the new professor of mathematics, William Trail, for a month-and-a-half prior to the great date. He used to recount the events to his students<sup>2</sup>:

At the last Transit of Venus in 1769-Dr Trail and I had been at great pains for 6 or 7 weeks before in preparing some Instruments proper for Observing it. By his falling bad at that time, the Observations fell upon me and for two or 3 weeks before I had scarcely been in bed 2 hours in a night taking observations of the Stars for adjusting our Regulator to mean time and finding the rate of her going-on which depended the most material Part of the Observations. The weather had during most of that time been remarkably favourable so that we had everything adjusted, as well as we could wish. On the day of the Transit particularly (Saturday the 4th of June) there was not a Cloud to be Seen in the Sky. All our Telescopes in Order- the Sun's Limb perfectly defined, and the Place where the External Contact happened, marked out - I was stationed on the Observatory on the other Side of the Court at a large Newtonian Telescope-Dr. Trail at Gordons Hospital-and many Gentlemen in different parts of the Town with Telescopes and Clocks regulated by the Astronomical Clock in this Room. From our Calculations we knew that the Transit began at 1 minute past Seven at night. At Six o'clock the Sky was still quite clear-but at half an hour after then arose a black Cloud in the west which immediately obscured the Sun and we saw him no more that night.

There was great disappointment that evening in Aberdeen, for the transit of Venus would not recur again in the lifetime of any watching.<sup>3</sup>

By this time Copland was obviously well known locally as a natural philosopher. In a rare extant private letter of 1770, a friend, Jo: Honyman of Kinneff, remarks<sup>4</sup>:

Let me know what you are reading- in Divinity, I mean, for as to Natural Philosophy, I might as well pursue the flying storms or ride on the volley'd lightning thro' the heavens as attempt to keep pace with your soaring Genius.

What is surprising is to find the Astronomer Royal, Nevil Maskelyne, writing to Copland at his home in Fintray three years later on. Maskelyne asks for advice on local topography in connection with an experiment he is planning, measuring the gravitational attraction between a hill and a pendulum bob, and requests Copland to read the barometer for a few days to assist his traveling representative, Charles Mason. The extant letter from Maskelyne<sup>5</sup> is clearly not his first letter to Copland. How Maskelyne came to be writing to someone apparently outside the academic and aristocratic establishment is not at all clear. In the end Maskelyne did not come to the North East but conducted his famous experiment to measure the gravitational constant at Schiehallion in Perthshire, as every schoolboy used to have to learn. Copland visited the experiment when it was in progress in 1774.

### 1.3 Copland and Aberdeen's water supply

Aberdeen was a small place in the 1770s and Copland's reputation as a teacher would have extended well outside the college by the end of the decade. His name would have been widely known by 1782 when he set on foot a public subscription to buy astronomical instruments and as a result raised sufficient money and support to build a fully equipped observatory at the Castlegate<sup>6</sup>. After 1785 he would have been familiar to many social levels for he began his extensive and popular evening lecture course for working men and gentlemen, specifically aimed to take physics to its point of application. This course will receive an account of its own. It was, however, for none of these that he was officially honoured by the town: it was for his involvement with Aberdeen's water supply.

In the late 1780s Copland and Robert Hamilton (Professor of Mathematics at Marischal College) were co-opted onto the Town Council Water Committee. This Committee normally advised on routine matters connected with wells and watercourses but it became clear in the early 1790s that there would need to be a major reassessment and expansion of the town's drinking water supply. In the autumn of 1791, Copland, Hamilton and some other committee members measured the capacity of the existing springs and endeavored to discover what additional springs might most easily be brought into use. In 1792, Hamilton and Copland suggested that the Edinburgh water engineer James Gordon should be asked for his professional advice on what was clearly a matter of long-term importance to the town. Copland's role seems to have been that of a 'technical expert', familiar with the relevant concepts in hydrostatics and hydraulics, able to advise on possible water courses and calculate the flow of water expected from given pipework down a known slope.

For several weeks Copland and Hamilton daily accompanied Gordon "and afforded him every information and Assistance in their power where necessary in the taking of levels and other operations made by him".<sup>7</sup> The result of this effort was the Gordon Water Report of 1792,<sup>8</sup> and the improvements brought about by its implementation. The preamble to this report outlines the background just discussed. Further details of the committee's progress can be deduced from the Town Council Register.<sup>9</sup> For their services Copland and Hamilton were made Burgesses of Guild of the City<sup>10</sup>

with all the privileges and Immunities competent and enjoyed by any other Guild Brother both as to themselves and their families.

In a gesture of generosity, possibly never again repeated by the Magistrates of Aberdeen, this title was given free, allowing Copland and Hamilton such privileges as voting rights for Council members for which other citizens paid quite heavily. They were, in fact, neither Honorary Burgesses nor Paying Burgesses.

It was, therefore, with a knowledgeable eye that Copland viewed the Den Burn in his daily travels from Fountainhall House to Marischal College in the summer of 1804. He was appalled to see bathing in water which could later be used for drinking "boys with scrophulous and other sores" as well as "mothers bathing scrophulous children in the same place".<sup>11</sup> Opposite Fountainhall, waste chemicals from a manufactory of coloured threads were piped into the burn and people brought their dirty clothes to be washed. Elsewhere "ashes and other nuisances" were thrown into the burn.

He made his observations to the Commissioners of the Police (then responsible more for public amenities such as water, roads, lighting etc., rather than law and order) in the hope that something could be done. The Commissioners decided that although legal measures should be introduced, the best plan was to collect the water nearer its source and to consider filtration. On both these matters they asked Copland for his advice.<sup>12</sup> In a reply of great clarity and good sense<sup>13</sup> Copland pointed out that filtration in this case could only remove impurities mechanically mixed with the water and "little or nothing of what may be dissolved or chemically united with it". He continued:

As I have never seen an instance nor recollect any account of Filtering so large a supply of water as would be here necessary, I cannot with such confidence answer your last query relative to the best method of constructing such a Filtre, as the preceding ones: but I would hope that the following method would be found sufficiently simple and effective.

Let a dam be built across the stream, where the water can be raised perhaps 4 feet. On the north side of this, a covered chamber is to be constructed, communicating with the water of the dam by a small sluice at the bottom; for regulating the quantity of water introduced. This chamber is to be filled first with a stratum of small pebbles, to allow the water to spread easily over its bottom-next one of coarse gravel, and so finer and finer till the top is formed (perhaps) a foot in depth, of fine sea sand; the upper surface of which must be below the level of water in the Reservoir. Its pressure therefore will gradually raise the water through the gravel and sand, from above the surface of which it is to be conveyed into the Pipe.

This part of Copland's reply has been quoted at length because it must be one of the very first practical suggestions for a gravel and sand slow filtration bed for a town's water supply. For example London's water supply, in desperate need of filtration, did not receive any on a large scale until 1829 and it was not made compulsory until 1855.<sup>14</sup> The Commissioners appeared enthusiastic and resolved to make a trial of the proposed filtering system under the auspices of Mr Blackie, Superintendent of the Wells and Water courses.<sup>15</sup> However, they gave higher priority to the creation of a dam and reservoir at Gilcomston for the Gilcomston spring and agreed that officially, at least, the Den Burn water was only to be used for drinking in the emergency of a dry summer when normal sources became insufficient. The matter dropped out of discussion at their regular meetings.

It is perhaps not surprising that May 1806 finds Copland digging a well within his own garden.<sup>16</sup> The supply issued from a fissure in the rock and was found "extremely pure and fit for every purpose on being drawn, its temperature from 46 degrees to 48 degrees Fahrenheit".

The commissioners returned to the question of a filtering machine in February 1807, when they were of the opinion that<sup>17</sup>:

a small piece of ground, above the source of the springs and the Gilcomston Dam should be procured from Mr. Skene of Rubislaw, enclosed with a stone wall, and a proper building erected in it, with the necessary apparatus for filtering water, necessary as a supply in the dry season, from the Denburn, or Rivulet which passes from the Den of Rubislaw.

In May of that year, "A letter was received from Mr Skene of Rubislaw, granting to the Board, in the most handsome manner, the ground necessary for the site of a Filtering House".<sup>18</sup> All seemed ready to embark on a small pioneering venture.

Nothing happened. In September 1807, Copland appeared in person before the Commission but merely to ask whether his tenants (to the South of Fountainhall House) could be connected up to the new water mains.<sup>19</sup> In March 1809, the Overseer and Blackie were directed to stake off ground 100 feet square for the filtering machine.<sup>20</sup> Nothing further happened. In eight years' time another committee inspected the site for a filtering machine on the spot granted by Mr Skene of Rubislaw<sup>21</sup> and a Plan was published by the city surveyor showing its location.<sup>22</sup> The filter had certainly not been forgotten because in 1818 a local Act of Parliament was passed for improving the paving, streets and access roads, their lighting, cleaning and watching and also for supplying the inhabitants of Aberdeen with water.<sup>23</sup> In several sections of this act relating to water, it is clear that the provision of 'Filtering Machines' was well to the fore of the consciousness of those who drafted the act.

In April 1819, about fifteen years after the original proposal, the Commissioners began to move. By now the novelty had gone. Blackie was dispatched to Glasgow to examine their filters. Skene began discussions on compensation for laying pipes and loss of water

from his land, amicably at first but when agreement was not reached, arbitration was abandoned in favour of a formal jury. Gilcomston Brewery added an unexpected twist to the story by obtaining, in the Court of Session, an interdict against the Commissioners because they feared a significant loss of power to their water wheel. Copland was called in by Skene this time, asking him to calculate the expected flow through the take-off pipes and how this might be regulated.<sup>24</sup> The compensation wrangle continued until finally the Commissioners threw in their hand, somewhat piqued, abandoning the scheme to seek alternative supplies.<sup>25</sup> Aberdeen's first filtered water did not occur in Copland's lifetime.

Perhaps the story of a failure scarcely deserves the space it has just been given. However, the lessons of history are not confined to the successes of our predecessors and in this case it seems fairly clear that the Commissioners must take most of the blame. They were dilatory, failed to do their homework properly on the water supply rates and misjudged their public relations. The role of Copland is interesting because it is a rather early and well documented example of an academic 'physicist' acting as a consultant on a matter of public concern.

In fact Copland was once more to be called as a consultant on water, for the pollution of the Den Burn had continued since he drew the Commissioners' attention to it in 1804. Skene and Maberly (the manufacturer at fault) were engaged in a law suit in August 1820. Skene's factor wrote to Skene that he would get Professor Copland and Dr Davidson to examine the water.<sup>26</sup> The case came up in October 1820, and the astonished factor was forced to write to Skene (in France) stating that they had lost the case because although the jury were quite satisfied that the water was polluted they thought Skene had not personally sustained any actual damage thereby.<sup>27</sup> Hence Copland's involvement with Aberdeen's water supply ends with something of a whimper.

#### *1.4 Measuring and surveying*

##### *1.4.1 ABERDEEN'S STANDARDS*

There is no doubt that clearly defined standard measures are essential for a nation which is to depend for its survival on technology and trading. The force of this fact was being felt in Britain at the end of the eighteenth century both at national and local levels. First there was the matter of fair trading. The standards required were usually not of great precision but they had to be clearly stated and accessible. Secondly, there was the problem of making accurate machinery or composite articles using parts made by different craftsmen, possibly in different places. Finally there was the problem of measuring land.

In all three areas, Aberdeen was finding that the standards it had inherited from earlier in the century were inadequate for the more sophisticated requirements of the late eighteenth century. In academic terms, only two standards were involved, mass and length. In basic practical terms, there were four, namely weight, volume, length and angle. In reality there were a very considerable number because the standard used depended on the commodity being measured. Standard weights were least likely to age because they are virtually unaffected by atmospheric conditions, temperature and denting. Unfortunately, rather a lot were required as trading standards. For example, a set of six weights, starting at one quarter pound and doubling in size are necessary to cover the modest range from one quarter of a pound to eight pounds. In Aberdeen, Scots troy

weight (the legal weight in Scotland), sometimes called Amsterdam weight, was generally used to sell country produce such as butter, cheese, wool, tallow, lard, etc. ; English troy weight (the legal weight in England) was used only for gold, silver and apothecaries' measures while avoirdupois was widely used everywhere.<sup>28</sup> The units in each system were significantly different.

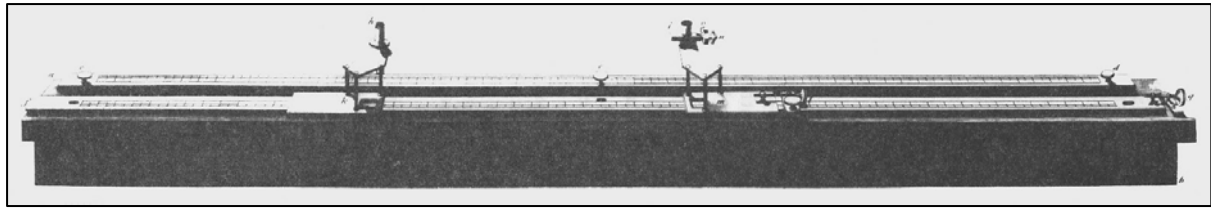
A number of items now sold by weight were then sold by volume. For example, potatoes and turnips were sold by sleeks and pecks, wheat and rye by bolls and firlots, all ultimately related to the Aberdeen pint jug. Unfortunately, there was plenty of scope for confusion because the wheat firlot contained twenty-six Aberdeen pints, the oats firlot thirty-four Aberdeen pints and the lime and linseed firlots thirty-two Aberdeen pints. The Aberdeen pint (about three of today's pints) was defined by a container a little larger than the widely used 'Stirling jug' but not as large as it used to be owing to an injury of its rim. One can summon up a little sympathy for the Aberdeen potato merchant of 1787 whose measure was required by the Magistrates to be smashed at the town cross by the hands of the public hangman on account of its being too small.<sup>29</sup>

According to Baily, the country never possessed a legal standard of length prior to 1824, when an Act of Parliament apparently established Bird's yard of 1760 as the standard of length.<sup>30</sup> Aberdeen did not possess any bar whose length was known relative to either Bird's yard or the standard measures in Edinburgh. The town possessed one or two plaiding ells (about thirty-seven inches). This kind of standard consisted of a bar with upright end markers. A rod to be tested was placed between the markers and if it was short it was rejected. If it just fitted or could be shaken down it was passed by the inspectorate and officially stamped (thereby destroying any precision it may have had). One such Imperial Yard standard (possibly dating to 1824) can be seen in Provost Skene's house and an earlier Aberdeen Dean of Guild standard yard and ell are in the Town House. Copland himself had probably the best measure, a one-foot rule by Sisson (now in the Natural Philosophy Department). However, a standard foot in a glass cabinet is no reference between contenders in a dispute involving the siting of boundary markers on an estate. The town possessed no standard chain nor had the county been surveyed. Plans of Aberdeen and its surroundings were produced in 1746 by G. and W. Paterson, in 1773 by George Taylor and in 1789 by Alexander Milne. A comparison of identifiable features with a modern ordnance survey shows them to be wanting in precision.

This, very briefly, is the background against which Copland's involvement with measures and surveying must be seen. A fuller account of the national problem affecting all weights, measures and coins is given by George Skene Keith, Minister of Keith-Hall and Kinkell in Aberdeenshire, who campaigned for many years to have the standard of length referred to the seconds pendulum.<sup>31</sup> A most detailed summary of local weights and measures is given in a long quantitative section of William Kennedy's *Annals of Aberdeen* which appears to be a reprint of George Skene Keith's 1795 report to the Dean of Guild.<sup>32</sup>

About 1800, Copland suggested to the town (i.e. the Dean of Guild and hence to the Dean of Guild Court) that a very accurate divided brass scale of five feet be purchased from Troughton because from it any measure which has been compared with the English yard could be taken with great accuracy. Troughton made the scale in 1801 as the last of only three similar scales and the Town Council accounts show a payment.<sup>33</sup> It is described briefly by Copland<sup>34</sup> and further by Francis Baily in a comprehensive survey of standard measures in existence in 1835<sup>35</sup> where the Aberdeen scale is found wanting by

about 0.001 inch on the Imperial Standard Yard. This error is commensurate with that of other scales though larger than some (*see Plate 2: A standard 5 foot measure very similar to the Aberdeen scale that was made by Troughton in 1801, used by Copland in his comparative study of 1811 and kept by him in the Marischal College observatory. Two traveling microscopes (clearly visible in the plate), one with a micrometer screw, allowed reading to 1/10,000th part of an inch<sup>108</sup>*).



Clearly the purchase of Troughton's scale was an overkill to the immediate problem of commercial standards in Aberdeen. However, as a long-term solution to what was clearly a long-term problem it was a very sensible move, the equivalent of which ought to have been made by the authorities in Edinburgh. Copland suggested that a standard chain be marked out along a granite wall in a public place in the town.<sup>36</sup> This was later done on a granite step in Trafalgar Square (London) but it is not known to have been done in Aberdeen.

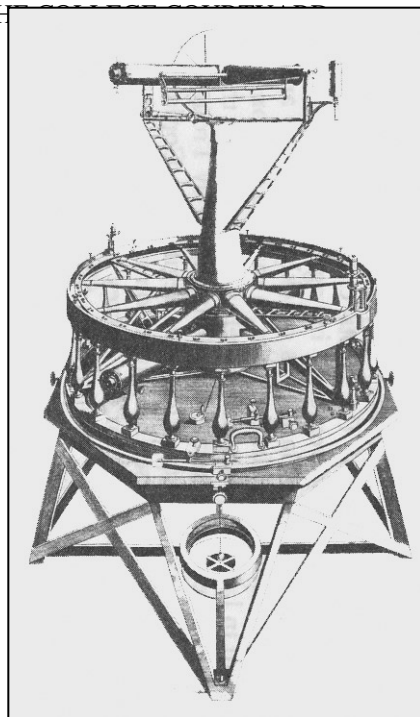
In 1811, the Dean of Guild made a concerted effort with the Town Council to improve their standards of weight and volume. They ordered new sets of avoirdupois weights from London, new Scots troy weights from Edinburgh, new firlots for barley, wheat and oats (all different), new liquid measures and apparently others besides.<sup>37</sup> Copland and George Skene Keith “whose knowledge and accuracy in such matters are universally acknowledged” were asked for a comparative study of these new measures and the old ones, including those of length. It is Copland who presents the comparisons and since he had the apparatus we can take it he actually did the work. The results of this study are transcribed in the Town Council Register.<sup>38</sup> The report shows clearly the accuracy to which Copland worked and the accuracy achieved by the makers at that time: it may also be of some interest in a historical study of weights and measures. The whole exercise again shows Copland in the newly emerging social role of ‘consultant physicist’.

In addition to the Aberdeen standards, Copland was also sent the standard measures of length in Edinburgh for comparison with the English yard. This was at the insistence of some of the Lords of Session who were unable to resolve legal cases concerning the demarcation of land for want of a precise measure of the Scots chain in yards. In Aberdeenshire, with the great improvements in agriculture as the eighteenth century closed, the value of land was quickly increasing and the lack of adequate maps strongly felt. In the town, a rapid expansion of the street plan was begun in late 1790s and it is surely no coincidence that the city purchased a very large and accurate theodolite made by Troughton in 1801, just as this major reconstruction was beginning. Copland gives an account of this theodolite<sup>39</sup> describing it as “on the same plan as the great Theodolite made by Ramsden for the Survey of Great Britain” (*see Plate 3: The great theodolite made by Ramsden to survey the large triangles upon which the ordnance survey of Great Britain was based. This theodolite<sup>109</sup> was brought to Aberdeen by Colby in 1814 to locate the Belhelvie baseline and again in 1817 on the ill-fated Shetland expedition mounted jointly with the Bureau de Longitude.*). It was no instrument for everyday use. Since Copland was given the safe keeping of it, it seems likely that he had something to do with its purchase.

Referring back to the introduction to this section, it can be seen that in ten years Aberdeen went from being impoverished in standards to surely the best equipped city in Scotland. In this improvement, Copland played a significant part.

#### 1.4.2 SURVEYING

There were, in addition, four other matters concerning surveying of the countryside, in which he played a small part and which must be mentioned here for completeness. The first is quickly disposed of for lack of knowledge. A letter addressed to Copland in 1808 from the 'Landholders of Aberdeenshire' thanks him "for the Assistance which you have already afforded in promoting a Topographical Survey of the Counties of Aberdeen and Banff", and hopes that the County will continue to receive his advice and assistance "in the further prosecution of so desirable an undertaking".<sup>40</sup>



Perhaps it was a related exercise that in July, August and September 1810, Copland kept at Fountainhall House a daily record of the barometric pressure to compare with simultaneous observations that the Rev. Dr Skene Keith made on a portable barometer taken up many of the upper Deeside hills.<sup>41</sup> From the difference between their barometric readings they could determine, to moderately good accuracy, the heights of the upper Deeside hills. Apparently it was the first systematic attempt to find the heights above sea level of the Deeside mountains and their results were later incorporated in a popular Deeside guidebook.<sup>42</sup>

#### The Belhelvie baseline

In 1814, Thomas Colby visited the Aberdeen area looking for a site where he could measure a Scottish baseline for the trigonometrical survey. Copland, and probably others, went with him to the Belhelvie links a few miles north of Aberdeen. In a letter to Copland, Colby confirms that it was the best situation he had yet seen in Scotland<sup>43</sup> and in fact it was the one finally chosen by Colby. In 1817, Colby returned with Ramsden's sector (the one illustrated in Plate 3) and steel chain, spending from 5 May to 6 June making measurements.<sup>44</sup>

Another visitor to the measuring site was John Cruickshank, a former pupil of Copland who was later to occupy Copland's chair of mathematics at Marischal College. In a short biography of Cruickshank there is an account of Colby's work at Belhelvie as observed by Cruickshank.<sup>45</sup> The result of the measurements confirmed the excellence of the trigonometrical survey.<sup>46</sup> Each end of the baseline was temporarily marked by a post with a tripod support, with an engraved brass plate on top of the post. Two gun barrels were dispatched to Aberdeen by sea later in the year with instructions on how to sink them into the sands to replace the wooden posts. This information was transmitted to Copland by Olinthus Gregory and Colby.<sup>47</sup> It would appear that the matter was not attended to immediately but was taken up again by John Cruickshank in 1820.<sup>48</sup> Unfortunately it was found that the temporary posts had been uprooted in ignorance by the local proprietors while erecting game-keepers' lookouts<sup>49</sup> and thus precisely the same base line could not be re-measured at a later date. The baseline, slightly in excess of five miles, is still shown on the modern ordnance survey map.

The contribution of Copland and his fellow professors to the highly professional surveying team under Colby was undoubtedly slight. Nevertheless, Colby had the courtesy to write, “I cannot better testify my gratitude for the honor done by the Professors of Aberdeen than by evincing my attention to their advice.”<sup>50</sup> His respect for Copland may have been coloured by the fact that he had some hopes of Copland becoming his father-in-law. The one-armed and enthusiastic Colby proposed to Copland's only daughter, Mary, but was not accepted. Even after this, Colby was to name Copland amongst other academics as a reference in his successful application for the post of Director of the Ordnance Survey upon the death of William Mudge in 1820.<sup>51</sup>

### Biot's Shetland trip

In 1816, co-operation was planned at the highest level between the French and British geodetic surveys (only a year after the battle of Waterloo) and in 1817 a joint expedition organized to the most northerly part of Britain, the Shetland Isles. For the French, Jean-Baptiste Biot was to take Borda's pendulum that previously had been used in France and Spain by the Bureau de Longitude. He arrived in Aberdeen where “he experienced the most marked hospitality”.<sup>52</sup> In fact he was made an honorary burgess by the town and given an honorary LL.D. by Marischal College, the latter ceremony being *in absentia* on 4 September.<sup>53</sup> Copland lent him some [now unknown] instruments to take to Shetland and received upon their return a present of barometer tubes.<sup>54</sup> Amongst Copland's apparatus inventoried in 1822 was a portable compass gifted by Biot. It was said that when Biot saw Copland's apparatus,<sup>55</sup> he expressed

his surprise that such a fine collection of instruments and machine models should be allowed to remain in a provincial town, and said that in his country the whole would be conveyed at once as by royal mandate to the metropolis.

A better start there could not have been for a joint venture. At Aberdeen, Biot met the ordnance contingent of Captains Colby and Richard Mudge accompanied by Olinthus Gregory of the Royal Military Academy. Gregory had already been presented with an honorary Doctor of Law by Marischal College (on 7 December 1806) and Colby was also to receive an honorary doctorate along with Biot. They were therefore all brought together in the house of a well disposed host. Unfortunately Colby and Biot “reacted like oil and water”<sup>56</sup> and, according to Colby's biographer, “Biot detested Dr Gregory”.<sup>57</sup> These feelings of enmity were entirely personal but they nonetheless served to reduce the value of the whole operation. Upon arriving in the north, at the end of July, the British camped on one Shetland island and Biot on another, thereby making impossible the intended simultaneous observations with Ramsden's sector and the Borda pendulum in the same place. Biot stayed for two months making his own observations, returning southward in October at his own initiative and without coming again to Aberdeen.

An anonymous author sent the Caledonian Mercury a report that Biot was “entirely abandoned” by the ordnance.<sup>58</sup> Gregory and Colby immediately denied the allegation<sup>59</sup> and Biot later denied sending the original report. Gregory's feelings for Biot (that he “has turned out a very contemptible fellow”<sup>60</sup>) were amplified in two letters to Copland written in October and mainly concerned with other matters. “Though it must be the bitterest of all potions for a man of honour and integrity to swallow his own words, it is a potion which M. Biot will gulp without difficulty.”<sup>61</sup> Although these feelings of pique between Biot and some of the British party obviously took a long time to die down, Biot's appreciation of his good treatment while at Aberdeen remained unimpaired.<sup>62</sup>

An account of Biot's trip to Scotland has been given by David F. Larder in the *Review*<sup>63</sup> but he did not have access to the Copland correspondence and he does not mention the controversy that clouded the expedition.

### 1.5 *The introduction of bleaching by chlorine*

The introduction of chlorine bleaching into this country has been well documented by Musson and Robinson as an example of rather close co-operation between academic science and industrial practice.<sup>64</sup> The only recognition Copland has been given so far by modern historians of science has been because he and two Aberdeen bleachers were contestably the first to introduce commercial chlorine bleaching into this country. For example, Singer *et alia* in *A History of Technology* ascribe its introduction to Copland.<sup>65</sup> Samuel Parkes, in his *Chemical Essays* of 1815,<sup>66</sup> certainly believed that Copland was the first and when his account was challenged on behalf of Thomas Henry of Manchester, he quoted Copland's descriptive letter in full.<sup>67</sup> No claim is made by anyone in Britain for discovering the chemical reactions involved, this having been done by Scheele in 1774 and Berthollet in 1785.

In brief, Copland learned of the process from a practical demonstration by de Saussure, with whom he and the Duke of Gordon spent three weeks at Geneva in the spring of 1787, probably no earlier than the second week of May.<sup>68</sup>

Impressed with the idea of its importance to our manufacturers, and well acquainted with the chemical knowledge of the Mr. Milnes, I immediately on my return communicated it to them, and perfectly recollect our instantly trying it on a hank of yarn directly from the spinner, to which in less than an hour we gave a good white colour. To the best of my recollection this was about the *end* of July, 1787, and from that time I was frequently informed by Mr. Milne and his late brother that they always continued to use this new mode of bleaching in their manufacture... .

These are Copland's own words<sup>69</sup> but written almost thirty years after the event in response to a request from Samuel Parkes.<sup>70</sup> It is easy to believe that Copland had close industrial contacts for by that time his evening classes to artisans and others had already begun. His chemical knowledge would have been better than some years earlier for one of the purposes of these evening classes was to introduce the fairly recent work of Priestley on various gases. However, Copland never claimed in this context or in any other to be a 'chemist' and from a reading of his own account quoted above it seems that a substantial amount of the credit for the Aberdeen effort should go to Alexander and Patrick Milne, of Gordon, Barron & Co, cotton manufacturers.

One result of their efforts was to prevent a Parliamentary monopoly being granted to Messrs Bourboulon de Boneuil & Co of Liverpool in 1788 for the process of making liquid chlorine bleach, thereby aiding the spread of chlorine bleaching. Chlorine was so superior to other bleaching recipes that the priority of its introduction was a matter of some prestige. The other main claimant was James Watt, better known for his stationary steam engines, whose father-in-law, Mr MacGregor, was a Glasgow bleacher and to whom he introduced the method early in 1787. There was no rivalry between Watt and Copland on this score. In a letter about several matters, Watt remarks to Copland<sup>71</sup> :

I am much obliged to you for the trouble you have taken about the Manganese which as you rightly observe could not pay the expense of working so narrow a vein in Granite. I hope however you will be able to procure enough for your experiments, the vein of that mineral near Exeter is said to be nearly exhausted and its produce now not as good as it was. I shall thank you at your convenience to write me your results of its produce in D[ephlogisticat?]d air.

Manganese, along with common salt and sulphuric acid, was an ingredient in the production of chlorine for bleaching. The vein referred to was probably the manganese mine at Grandholm that students in Copland's time were taken to see.

Returning to the matter of priority, Thomas Thomson, the author of the extensive 1824 article in the *Encyclopaedia Britannica* on bleaching,<sup>72</sup> favoured Watt. The important point, if there is one now, is when the experiment was first transformed from a demonstration to a large scale commercial process. On this point none of the evidence is sufficiently precise that honour can unequivocally be bestowed.

### 1.6 *Aristocratic connections*

After Copland's introduction in the summer of 1779 to Alexander, 4th Duke of Gordon, a strong and genuine friendship developed that virtually wiped out the great social gap between the two. It is clear from the half of the correspondence that has come to light,<sup>73</sup> letters from Gordon to Copland, that in personal matters Copland was treated by Gordon as an equal.

The Duke was a most powerful national figure, well connected in the highest circles and possessing an enormous estate. On the whole he chose not to follow the path into politics taken by many in similar circumstances but to devote his energy to developing his land and improving the lot of his tenants.<sup>74</sup> It was the same Duke of Gordon who, assisted by his flamboyant wife Jane Maxwell, raised the Gordon Highlanders in 1797. His interest in mechanics and, to a lesser extent, astronomy was an integral part of his character, an antidote to a busy life and, no doubt, to the estrangement from his wife from 1800 onwards. He was an amateur in the obvious sense that he did not get paid but also in the sense that he did it purely for interest and pleasure. It is probably not the coincidence it first appears that both the custodian of his library, James Hoy, and his butler and now world renowned Scottish fiddle music composer, William Marshall, were also amateur mechanics with interests in astronomy. In Copland the Duke found someone who had not lost his sense of enthusiasm and fun and with whom he would share the pleasure of success after turning some fine piece of ornamentation. Their mutual interests ranged from pure entertainment to developments of the lathe. For example, George Gordon, one of the Duke's illegitimate sons who was brought up with the family, writing to Copland in 1802, remarks<sup>75</sup>:

I heard of your being lately in Glen Fiddich [one of the Duke's hunting lodges], and take it for granted that you and the Duke were playing your Old Pranks with Wheels and Brass Candlesticks, and frightening the Good Country Folk with Your Magick and Black Art... .

In more serious mood, the Duke writing to Copland in 1812<sup>76</sup> is obviously pleased that by adding two extra gearwheels to his lathe (“the plan is entirely my own invention”) he has been enabled to cut spirals in a single sweep. Some feeling for the Duke and his household is conveyed by Thomas Young (1773-1829) who visited him in 1795 and would gladly have stayed longer.<sup>77</sup> Copland acted as advisor on lathe developments, astronomical equipment and other apparatus. He gave recipes for staining ivory, making ink and so on, and gave plans for making a miscellany of devices such as a superior roaster (possibly Rumford's), a plumbed-in hot bath and Rumford's grates. He also passed jobs from the Duke to Aberdeen craftsmen. The Duke trusted his skill and his knowledge, for when the Duke broke his leg in 1805 upon falling from a horse and was suffering a great deal of pain, he wrote to Copland<sup>78</sup>:

... if you know the method of applying the Galvanick power, I should be very much obliged to you to take the trouble of coming here and to try your hand upon me... I am really in earnest when I ask you to come, if it is not inconvenient, and kill or cure I shall be most happy to see you.

Great pain engenders faith. In view of Copland's attitude to medical electricity (that it should be left to those experienced in the field and even then relieves symptoms rather than cures) it is likely that he declined, but we do not know.

In return for technical advice and companionship, the Duke obviously conferred on Copland a prestige he would not otherwise have had, dining with him and staying with him in the college when he might otherwise have stayed more sociably in the New Inn or other lodgings in town. The Duke offered Copland Glen Fiddich lodge for his honeymoon and when Copland began a family, the friendship spread to a lesser extent to both families, the Coplands being known at Gordon Castle to the other members of the Duke's household. Copland not only traveled with the Duke to Switzerland in 1787 but on other occasions too. For example in 1798 they both visited James Watt in Birmingham. The Duke helped Copland's sons John and Charles obtain jobs after graduating at Marischal College and undoubtedly gave Copland an entry into a social class he would otherwise have found difficulty penetrating. The Duke's legitimate son George Gordon, the Marquis of Huntly, who was for many years the active commander of the Gordon Highlanders, was quite at ease writing to Copland on personal matters. It was through Copland's promotion that Huntly was elected Chancellor of Marischal College in 1815, an appointment to the benefit of the college. Copland's friendship with the Duke himself would have increased the respect given him within university circles in Aberdeen on account of the Duke's own position as Chancellor of King's College from 1793 onwards. The Duke sent his technically minded son, the illegitimate Adam, to Copland's academic class in 1815.

Although the Duke's mechanical pursuits were purely for his own relaxation, his scientific interests encouraged him to take advantage of modern developments in the improvement of his estates. Thus, for example, Smeaton is consulted on water works, Telford on a bridge over the Spey (he built the one at Craigellachie but not the one at Fochabers) and, on a smaller scale, Rumford's grates (at least) tried in cottages. The application of technology by the Duke, and Copland's involvement with him and his family are worth further research because they are not brought out in the biography of the Duke and his family that has been published recently.<sup>79</sup>

A bundle of fifteen letters to Copland from Gray of Kinfauns (situated between Dundee and Perth) show that Copland also acted as a scientific advisor for Gray at times<sup>80</sup> The first letter in 1802 finds them already known to each other (the Duke of Gordon is a mutual friend), with compliments being exchanged between Mrs Gray and Copland's wife. The remaining letters cover the period 1815-17. Their tone is slightly less personal than the Duke of Gordon's, no doubt because personal contact was much more infrequent. Copland is asked for recipes and advice and spends time acting as liaison between Aberdeen craftsmen and Gray. His interests were slightly more wide ranging than the Duke's, being not only astronomical and mechanical but also encompassing meteorology and other branches of physics. His letters tend to concentrate on 'diversions', such as the storm glass, Chinese automatons, allantois balloons and moving slides of fireworks. None of this was ever intended to advance science in any way, the only results Gray obtained of interest to posterity being the regular meteorological observations he made.

Although Copland's dilettante friends did not advance science, they did have an effect of consolidating the role of science and technology as the base upon which changes in society were implemented in the nineteenth century. If an increasing number of the most powerful people in the land played with scientific toys, the vocabulary of the subject became socially acceptable and the practical application of the same concepts by industrialists and agriculturalists became more easily carried out. One should also not underestimate the power of the gentry as a cohesive and educated group in opposing the reaction of the clergy. The two factions can be seen most clearly aligned behind Marischal and King's Colleges respectively. The pressures on King's College and the inclinations of the ruling professoriate were to resist the specialized demands of science and medicine, even such minor innovations as a botanical garden, as out of keeping with established practice. With the means of advancement gifted into its hands, King's College still failed to respond. During the whole of the eighteenth century there were professors of medicine and civil law at King's and yet they were never called upon to give classes, or chose not to. With reaction like that, powerful opposition was required to effect any change.

In one sense, therefore, Copland's professional advice to the amateur experimenters of the aristocracy would have made a thin but definite contribution to consolidating the ingress of science into society. On occasions, Copland's contacts had a clearer influence. His meetings with the Earl of Bute, whom he visited several times at Luton-hoo, were responsible for the Castlehill observatory receiving two first-class instruments, including a four-foot transit telescope by Ramsden, and Marischal College receiving a donation of 1400 medical books in the late eighteenth century. It also sparked off the attempted merger of King's and Marischal Colleges in 1786.<sup>81</sup> Copland certainly had other connections with the gentry of North-East society but in the absence of the survival of correspondence, nothing definite can be added.

### 1.7 *A short miscellany*

In 1782, James Anderson (1739-1808) wrote to Copland<sup>82</sup> asking if he would evaluate for Admiral Sir John Lockhart Ross the capability of a "new invented shot" from a model of it. The new shot was particularly intended to destroy the sails and rigging of an enemy ship but it was not described, perhaps in the interests of security. Mention was made of the existing ball shot, bar shot, chain shot and case shot, all of which differed from the new shot. The need for effective shot is quite evident simply from reading the *Aberdeen Journal* of the period where it was not infrequently reported that 'privateers', usually French, had intercepted commercial shipping. Copland's reply is not known.

James Bruce (1730-94), the African explorer, wrote to Copland in 1788<sup>83</sup> wishing to know whether an eclipse of the sun had taken place at a particular location in Ethiopia in 1552 and another around 1689. It is likely that Copland could have supplied this information.

Copland corresponded with James Watt on several occasions. Although the letters that have come to light are interesting, Copland is usually asking for information rather than giving any. For example, in 1800 he enquires about the availability of pressure cookers that he would like to introduce into the newly opened public soup kitchen in Aberdeen to extract jelly from bones.<sup>84</sup> On other occasions he enquires about the costs and coal consumption of 4, 8, 10 and 14 horsepower steam engines, apparently for friends.<sup>85</sup> Several steam engines appeared in Aberdeen in the early nineteenth century.<sup>86</sup>

A number of letters from Thomas Telford to Copland suggest that Telford wished to collaborate with Copland, joining his own practical experience with Copland's academic knowledge. Unfortunately the letters have disappeared from sight and the result of this collaboration (if any) is unknown.<sup>87</sup> Telford was responsible for major improvements to Aberdeen harbour, proposed in 1802 but not begun until 1810 due to lack of money. He also made some minor suggestions for the design of the great granite bridge carrying Union Street over the Den Burn, in the construction of which Troughton's theodolite was used.<sup>88</sup>

Finally, in case the impression has been given that all Copland's correspondents are well-known, let me end with a memorable *cri-de-coeur* from Mr George Hepburn of Oldmeldrum, aged eighty and known to Copland from times past<sup>89</sup>:

I have now made out at last a modal of a perpetual motion which has the power of 4 to one, which I ashure you upon truth and honour, but now I am afraid Government will not give any premium.... [If not] I shall let some other man spend twenty or thirty years as I have done in search of it. Be so good as give me your Advice how I shall proceed and in so doing you will very much oblige Your most humble Servant and real weal wisher.

Perhaps this is the origin of the “attempted perpetual motion [machine], by an endless chain and fly” that was catalogued among Copland's apparatus.

### 1.8 Copland himself

Not much has been said in this article or the previous one<sup>90</sup> about Copland's intellectual contributions or his private life. His contribution to science must await another opportunity but it is appropriate to add here what little more we know about the man himself.

P.J. Anderson quotes William Knight,<sup>91</sup> a student of Copland's in 1800-1 and later his successor in the Chair of Natural Philosophy,

Professor Copland was a tall and handsome man, always dressed in coloured clothes, and when young was regarded as the principal beau in Aberdeen. His figure, when gowned, was striking and commanding; his elocution ready but inaccurate. He read little, and had a disinclination to writing.

All these traits tend to be confirmed by recorded events. For example, Copland's friend Jo. Honyman, mentioned earlier, writes in 1771 with some envy of Copland's charm with the ladies<sup>92</sup>:

Happy fellow! I have often called you; who are everywhere of good reception, and can revel in Beauty, that displays all its charms to please you. It makes me trouble for you, when I find you so combustible as to take fire with a single glance; even from Miss Gordon. What will become of you, when you live within the sphere of her attraction, have frequent opportunities of looking upon her, even in her full meridian blaze; and this too, when you are entirely at leisure, when your whole soul is perhaps dissolved with ease, luxury and pleasure. I may surely bless my stars, that I am out of the way of these murderous ladies.

Unfortunately we get no continuing insight into Copland's social life for the passionate Mr Honyman (“Heaven sells all pleasure; effort is the price”, as he wrote in a letter previously cited) left in 1771 to become a dissenting minister.

Although Copland cut a fine figure at Aberdeen's famous social balls, it was not until he was thirty-nine that he married Elizabeth Ogilvie, almost twenty years younger, the eldest daughter of Dr David Ogilvie who was for many years a surgeon in the Royal Navy. The

Ogilvies resided in Old Aberdeen but it has not been found out whether they were related to the talented William Ogilvie, Professor of Humanity at King's College. Three sons, Alexander, John and Charles were born in the next four years and a daughter, Mary, some eight years on.

Many years later Charles Copland was asked to write a column on his father for William Anderson's *Popular Scottish Biography*.<sup>93</sup> Charles included the following rather eulogistic details,<sup>94</sup> which were edited out by Anderson.

Dr Copland had a great taste for Painting. He was also well skilled in Music and unassisted built an Organ of large size and power, his professional duties however did not allow him much time to devote to these Objects.

He was of peculiarly mild and unassuming manner and his pleasing, agreeable and intelligent conversation in private Company may well be recollected by the Writer of this who had the pleasure of his Society. His habits were most abstemious and retired[.] It was very seldom and then only by persuasion that he could be induced to mix in general company. He was seen to most advantage when in the Society of one or two Scientific Friends.

It is certainly true that Copland was interested in music for he was elected a manager of the Aberdeen Musical Society for a year in 1779<sup>95</sup> and constructed his organ in 1789. He also enjoyed the theatre, an entertainment that Aberdonians in general appreciated, for there was more than one theatre in Aberdeen by 1800. Relics of the social life of Copland's times can still be seen in the Aberdeen street names Theatre Lane (behind the old commodious Theatre Royal in Marischal Street), Concert Court (where the Aberdeen Musical Society met behind the Town House) and Peacocks Close (where dancing master Francis Peacock lived and taught off the Castlegate).

With his family of four children Copland lived in college lodgings until 1803 when he purchased Fountainhall House from the estate of his predecessor in the chair of natural philosophy, George Skene. His family moved permanently to Fountainhall but he kept on his College rooms as his residence during the winter teaching months. Fountainhall House possessed a garden and some land that was rented out. The garden must have particularly pleased Copland for he and Professor Stuart had previously rented part of the College garden.<sup>96</sup> In 1807 Copland was elected a member of the Linnean Society.<sup>97</sup>

In comparative opulence and with no little respect from the citizens of Aberdeen he stayed at Fountainhall virtually until the end of his life, and the house came to be associated by later generations with his name.<sup>98</sup> Spectacles on his temples and growing a little deaf in old age, he continued his interest in making scientific apparatus of the highest quality until he was over seventy. As far as is known, Copland did not miss any teaching duties due to ill health. A room for Mary was made in his College apartments in 1817, suggesting that his wife and daughter returned to the College during some of his last years. In the winter of 1821, "a singular goitrous expansion took place under the chin, which gradually wasted him".<sup>99</sup> He completed his lecturing, but slowly deteriorated and finally died on 10 November 1822. The *Aberdeen Journal* published a fifty-seven line obituary notice on the day of the funeral, the length being an unprecedented departure from their usual two or three line notices.<sup>100</sup> Alexander Copland described the funeral procession in a letter to Charles<sup>101</sup>:

More than 200 students went first 4 × 4, followed by the professors who had not classes, and professors of K's Coll., the body, Dr M. & I, Mr D Milne & Mr Cock. The Company besides, were about 180. I never saw such a crowd looking at any funeral, the whole streets were filled and the windows. He was laid in the same grave with Dr and Mrs Gordon... The procession moved down Broad Street and up

Union Street, entering the Churchyard gate in front of the Church. The company met at 2; we did not reach the church yard till after 3.

Nothing was bequeathed to Marischal College. The family erected a white marble commemorative plaque inside the West Church of St Nicholas on the south wall.<sup>102</sup> The Town did not indulge in any official memorial until 1878, when a coat of arms representing Copland was added to the heraldic ceiling of the council chambers in Aberdeen Town Hall.<sup>103</sup> Apparently the heraldry of the coat relates him to the seventeenth-century divine, Patrick Copland, who endowed the Divinity chair at Marischal College<sup>104</sup> but in view of our Copland's humble local origins it is likely that the heraldic aspect is a piece of Victorian invention.

Lest I may be accused of excessive approbation in presenting such a long account of the professor, let me say that I have had negligible choice in the material available. No derogatory comments of any substance have been found. Alexander Copland, upon whose shoulders fell the task of looking after Copland's widow, complained upon hearing the will that his father in his later years had been excessively parsimonious towards him. That is quite possible, though he does not substantiate his case. William Knight damns a little by the comparative faintness of his praise, leaving the impression that he thought Copland got stuck in his ways. This seems highly likely, for the man was professor for forty-seven years. It does not, though, detract from his achievements.

Copland's contemporary reputation was based upon his Marischal College lectures, his demonstration apparatus and his evening classes: in the latter two categories he can rightly be called pioneering. However, as his contemporaries died, so did his reputation. For example he is not given a mention in W. P. D. Wightman's wide-ranging summary of North-East scientists<sup>105</sup> nor in W.E. McCulloch's biographical survey of worthy Aberdeen graduates.<sup>106</sup> It is appropriate, therefore, that at a time of increasing awareness of the University's past achievements, Patrick Copland should be remembered again.

### *1.9 Acknowledgements*

It is a pleasure to be able to acknowledge the valuable assistance given by Aberdeen University Library Manuscript and Archives Department, the staff of Special Collections and also the archivist on the staff of the Town Clerk. I am very grateful to Professor Copland's descendant, Patrick A. Copland, who has freely loaned to me for an extended period relevant parts of his collection of family papers.

### *Notes*

1. John S. Reid, 'Patrick Copland (1748-1822) Aspects of his Life and Times at Marischal College', *A U R L* (1983-4), 359-79.
2. Aberdeen University Library (AUL) MS M3123/2 fo.4<sup>v</sup>-fo.6<sup>f</sup>.
3. The next transit of Venus was in 1874, followed by one partially visible in Britain in 1882. There have been none since. The next was in the year 2004. 4. Letters by Jo. Honyman, Kinneff to Patrick Copland, The Manse, Fintray, dated from 19 Feb. 1770, to end Dec. 1770 and, from Aberdeen, 6 Sept. 1771 in the private collection of P. A. Copland (North Waltham, Hampshire). Patrick Alexander Copland has a book of family papers relevant to Professor Copland and references will be made from time to time to material in this collection.
5. Letter from Nevil Maskelyne, Greenwich, to Patrick Copland, The Manse, Fintray, dated 3 Aug. 1773 in AUL MS 2886.

6. John S. Reid, 'The Castlehill Observatory, Aberdeen', *Journal of the History of Astronomy*, pp.84--95 (1982).
7. Aberdeen Town Council Register (A.T.C.R.) 66, 2 Aug. 1792. fo.210<sup>v</sup>.
8. 'Act of Council relative to procuring an Additional Supply of Spring Water, for the Services of the Inhabitants of Aberdeen: Together with the Report of Mr James Gordon Superintendent of the Police of the City of Edinburgh, On That Subject', pp. i-iv, 1-9 (Aberdeen, 1792).
9. A.T.C.R. 66, beginning 22 Sept. 1789 on fo.53, water supplies are discussed on fo.57, fos.143-5, fo.158, fo.172, fos.195-197, fos.200-10<sup>v</sup>, fo.213 and fo.224.
10. A.T.C.R. op. cit. (7) fos.210v-11v.
11. Letter from Professor Copland [copy in his own hand?], Fountainhall to J. S. Forbes, Aberdeen, dated 24 July 1804 in AUL MS 2886.
12. Letter from J. S. Forbes, Aberdeen, to Professor Copland, dated 18 July 1804 in AUL MS 2886.
13. op. cit. (11).
14. 'Water Filtration', *Encyclopaedia Britannica* 19 (London, 1978), p.649. 15. 'Records of Commissioners of Police from June 1795 to May 1809', 6 Aug. 1804, p.315 (in Aberdeen Town House Archives).
16. From a note in the collection of Patrick A. Copland (North Waltham, Hampshire), op. cat. (4).
17. op. cit. (15) 2 Feb. 1807, p.432.
18. *ibid.* 4 May 1807, p.446.
19. *ibid.* 14 Sept. 1807.
20. *ibid.* 20 Mar. 1809.
21. Aberdeen Town House archives 'Records of Commissioners of Police from 23rd May 1809 to May 1821', Minute Book II, 26 Aug. 1817, p.252.
22. John Innes, 'Plan of Filtering Machine and Aqueduct leading thereto for the better supplying the City of Aberdeen with Water September 1817', see Aberdeen Town House Archives acc 9/2.
23. Local Act 58. George III. Cap lix, 23 May 1818.
24. Skene was an absentee landlord, living much of the time in Edinburgh and employing Charles Gordon as factor to his extensive Rubislaw estate. AUL MS 2720 contains over a hundred letters from Gordon to Skene and some other related correspondence. Letter 80, dated 22 Nov. 1819 includes a copy of the questions to Copland and his one-and-a-half page reply. Other letters relevant to the episode are 54, 78 and 81.
25. *ibid.* letter 85, dated 10 Dec. 1819 and letter 86, dated 11 Dec. 1819.
26. *ibid.* letter 108, dated 24 July 1820 and letter 109 dated 3 Aug. 1820.
27. *ibid.* letter 113 dated 12 Oct. 1820.
28. William Kennedy, *Annals of Aberdeen, from the Reign of King William the Lion, to the end of the year 1818; with an account of the City, Cathedral, and University of Old Aberdeen*, vol. II, pp. 293-300 (London, 1818).
29. Quoted from the *Aberdeen Journal* by Gavin Turreff, 'Antiquarian Gleanings from Aberdeenshire Records', p.278 (James Murray, Aberdeen, 1871).
30. F. Baily, 'Report on the new Standard Scale of this Society. Drawn up, at the request of the Council by F. Baily, Esq., F.R.S., &c., and one of the Vice-Presidents of the Society' in *Memoirs of the Royal Astronomical Society*, vol. IX (1836), p.150 and p.146. Baily quotes some of the Act which goes on to say that if Bird's standard is destroyed it shall be identically remade as 36/39.1393 of the length of a seconds pendulum at London. Clearly the bill's draftsmen did not fully understand the topic. The point is not entirely academic for Bird's standard was destroyed in the fire which consumed the two houses of parliament in 1834.

31. George Skene Keith, 'Tracts on Weights, Measures, and Coins', 6 tracts in 20 pages (London, 1791). A sequel is to be found in George Skene Keith, 'Different Methods of establishing an Uniformity of Weights and Measures Stated and Compared', 32 pages (London, 1817).
32. William Kennedy, *op. cit.* (28). He mentions that his account "was drawn up and published in the year 1795, by a gentleman who is pre-eminently distinguished for his scientific acquirements in such matters". In early 1795, the Guild Court were presented with a report on the weights and measures of the city of Aberdeen by George Skene Keith. They ordered that the report be published and distributed. See Aberdeen Town House archives 'Guild Court Book 1793-1833' minutes of meetings on 17 Jan. 1795 and 10 Feb. 1795.
33. Aberdeen Town House archives, account book 1801-6. The account of 1 Oct. 1802 shows a payment to 'Professor Copland-Instruments and St' £98.3.-plus an additional amount of £19.1.5 for freight, insurance, boxes, etc. It is presumed that this refers to Troughton's scale with its two traveling micrometer microscopes. It seems inadequate for the theodolite also made by Troughton in 1801.
34. In AUL Knight manuscript MS M167, pages unnumbered, "Instruments placed in the Observatory, under my care, and belonging to the Town of Aberdeen: copy of a paper by Professor Copland, dated Observatory Aberdeen, 23 September 1811".
35. F. Baily, *op. cit.* (30), pp. 85-86 contains a simple description of the scale; pp. 124-9 and 145 a numerical comparison with related scales.
36. Patrick Copland, *op. cit.* (34).
37. A.T.C.R. 69, pp. 198<sup>v</sup>-202<sup>r</sup>, 24 Sept. 1811, contains an extensive report by the Dean of Guild to which is appended Copland's report.
38. A.T.C.R. 69, fos.198<sup>v</sup>-202<sup>r</sup>.
39. Patrick Copland, *op. cit.* (34).
40. Letter from J. Menzies, Aberdeen to Patrick Copland, dated 29 June 1808 in AUL MS 2886. This survey may well have been the basis for *A New and Accurate Map of Aberdeenshire, from the Latest Surveys*, Tho. Brown Booksellers (Edinburgh, 'circa 1807'). No evidence has been found as to whether Troughton's theodolite was used.
41. [Alexander Cruickshank], *Vanishing Aberdeen*, pp.8-9 (Aberdeen, 1894).
42. James Brown, *The New Deeside Guide*, pp. 74-75 (Aberdeen, 1832).
43. Letter from Captain Colby, Mill of Alva near Banff, to Professor Copland, Aberdeen, dated 24 July 1814 in AUL MS 2886.
44. J. E. Portlock, *Memoir of the Life of Major-General Colby R.E., LL.D., F.R.S.L. & E., F.R.A.S., F.G.S., M.R.I.A., ETC. together with A Sketch of the Origin and Progress of the Ordnance Survey of Great Britain and Ireland, a work with which General Colby was connected for forty five years*, p.64 (Seeley, Jackson & Halliday, London, 1869).
45. Joseph Ogilvie, *John Cruickshank Professor in the Marischal College and University of Aberdeen*, pp.27-32 (Aberdeen, 1896).
46. W. A. Seymour, *A History of the Ordnance Survey*, p.37 (Dawson Sons, London, 1980).
47. Letter from Olinthus Gregory, Woolwich, to Professor Copland, Aberdeen, dated 17 Oct. 1817 in AUL MS 2886.
48. Letter from Thomas Colby, Ordnance Map Office, to Professor Copland, Aberdeen, dated 21 Aug. 1820 in AUL MS 2886.
49. Joseph Ogilvie, *op. cit.* (45), pp.31-32.
50. Thomas Colby, *op. cit.* (48).
51. W. A. Seymour, *op. cit.* (46), p.28.
52. J. E. Portlock, *op. cit.* (44), p.73.
53. P. J. Anderson (editor), *Fasti Academiae Mariscallanae Aberdonensis*, vol. II, p.102 (New Spalding Club, Aberdeen, 1908) quotes that Biot was awarded the honour because of his "illustrious merits as a philosopher and particularly as a successful asserter of the truth of Sir

Isaac Newton's doctrine in Optics". This sounds like Copland's adulation of Newton and, considering the reinterpretation of optical phenomena that had already begun, was an unfortunate citation. The wave theory of light does not seem to have reached Scottish Universities until well after Copland's death.

54. Letter from M. Biot, Denhom Green, to Professor Copland, dated 21 Oct. 1817 in AUL MS 2886.
55. Joseph Ogilvie, *op. cit.* (45), p.33.
56. W. A. Seymour, *op. cit.* (46), p.30.
57. J. E. Portlock, *op. cit.* (44), p.75.
58. *Caledonian Mercury*, 6 Oct. 1817; p.3 col.4.
59. *Caledonian Mercury*, 13 Oct. 1817, p.3 col.4.
60. Letter from Olinthus Gregory, Woolwich, to Professor Copland, Aberdeen, dated 11 Oct. 1817 in AUL MS 2886.
61. Letter from Olinthus Gregory, *op. cit.* (47).
62. AUL MS 30 B45/38. Letter from M. Biot, Glasgow, to Dr Glennie, Marischal College, Aberdeen, dated 22 Oct. 1817.
63. David F. Larder, 'Jean-Baptiste Biot in Scotland 1817', *AUR* XLIII (1969-70), pp. 165-7.
64. A.E. Musson and E. Robinson, *Science and Technology in the Industrial Revolution*, pp.256-9 (Manchester University Press, 1969).
65. C. Singer, E. J. Holmyard, A. R. Hall and T. I. Williams (editors), *A History of Technology. Vol. IV. The Industrial Revolution c1750 to c1850*, p.247 (Clarendon Press, Oxford, 1958).
66. Samuel Parkes, *Chemical Essays, principally relating to the Arts and Manufacturers of the British Dominions*, vol.IV, pp.42-47 (London, 1815).
67. Samuel Parkes, 'Reply to Dr Henry's letter respecting the Introduction of Bleaching by Oxymuriatic Acid', *Annals of Philosophy* 7 (1816), pp. 98-102.
68. In 1787 the Duke of Gordon wished to take his son and heir, George then aged seventeen, to France for three months to improve his education. This was a most natural step for a family that supported Scotland's traditional affiliations and, indeed, remained Catholic in an area almost entirely Protestant. However, it was a move that the Duke did not want to publicize for political reasons and hence some 'cover' had to be arranged. The Duke invited Copland to come on a tour with him through France to Switzerland with the intention of leaving George in a quiet part of France. He wished to set off early in 1787 but in the event delayed until Copland had finished his teaching. They must have left in the third week of April. The trip appeared to go according to plan with the Duke and Copland traveling to Chamonix and spending three weeks in Geneva with de Saussure, the Duke's former tutor. They returned about the end of July, giving George rather less than three months in France. The dates are of some interest because it was while he was at Geneva that Copland obtained Berthollet's recipe for chlorine bleaching which he introduced to the Aberdeen bleachers upon his return.
69. Letter from Patrick Copland, Marischal College, to Samuel Parkes, London, dated 27 Apr. 1814, quoted in Samuel Parkes, *op. cit.* (67).
70. Letter, from Samuel Parkes, 90 Goswell Street, London, to Professor Copland, Marischal College, dated 18 Apr. 1814 in AUL MS 2886. There is also in the same bundle a letter from Thomas Thomson, 1 Queens Square, Westminster, to Patrick Copland, Aberdeen, dated 13 Jan. 1816 requesting further information on Copland's meeting with de Saussure.
71. Letter from James Watt, London, to Patrick Copland, Aberdeen, dated 4 Dec. 1796 in AUL MS 2886. The vein of manganese near Exeter was where Watt obtained this material for his father-in-law's experiments on bleaching. ,
72. 'Bleaching' in the *Supplement to the Fourth, Fifth and Sixth Editions of the Encyclopaedia Britannica with preliminary dissertations on the history of the sciences*, vol.2, pp. 321-6 (Edinburgh, 1824). Subsequent editions of the encyclopaedia continue Thomson's assignment, with some justification.

73. The Scottish Record Office has bundles of estate papers relevant to the 4th Duke of Gordon which have not been searched. It is, however, quite likely that Copland's letters, if they were kept by the Duke, were destroyed in the fire which swept through his private apartments less than a month after his death in 1827.
74. George Gordon, *The Last Dukes of Gordon and their Consorts 1743-1864* (Aberdeen, 1980).
75. Letter from George Gordon, No. 15 Piccadilly, to Patrick Copland, Marischal College, dated 27 Sept. 1802, no. 29 in the collection associated with the Duke of Gordon, *op. cit.* (4).
76. Letter from Duke of Gordon, Gordon Castle, to Patrick Copland, Marischal College, dated 21 Feb. 1812, no. 52 in the collection associated with the Duke of Gordon, *op. cit.* (4).
77. George Peacock, *Life of Thomas Young, M. D., F. R. S., &c., and one of the eight foreign associates of the National Institute of France*, pp. 68-71 (John Murray, London, 1855).
78. Letter from Duke of Gordon, Gordon Castle, to Patrick Copland, Marischal College, dated 3 Oct. 1805, no. 37 in collection associated with the Duke of Gordon, *op. cit.* (4).
79. George Gordon, *op. cit.* (74).
80. In AUL MS 2886. The letters are generally from Gray at Kinfauns Castle to Patrick Copland, Aberdeen. The first is dated 2 Oct. 1802; the last, 17 Nov. 1817.
81. John S. Reid, *op. cit.* (1).
82. Letter from James Anderson to Patrick Copland, dated 10 June 1782, in the private collection of P. A. Copland, *op. cit.* (4).
83. Letter from James Bruce, Kinnaird, to Patrick Copland, Marischal College dated 13 Dec. 1788 in AUL MS 2886. Bruce had spent ten years in amazing travels in the Middle-East and in Africa from 1763-73, his account of which was believed to be fiction when first published. A discussion of African solar eclipses, including an analysis of Bruce's comments on the eclipse of 14 January 1553 and a relevant eclipse of 1680, is given by Richard Gray, *Eclipse Maps*, *Journal of Africa History* VI (1965) pp. 251-62 (reference by courtesy of Roy Bridges).
84. Letter from Patrick Copland, Marischal College, to James Watt, dated 15 Nov. 1800, now in possession of the Rt Hon David Gibson-Watt, Doldowlod, Llandrindod Wells, Radnorshire. This letter and several others (unspecified) were seen by Michael Donnelly, People's Palace, Glasgow, who supplied a transcript. More on the soup kitchen can be found in Alexander Walker, 'The Soup Kitchen 1800-1892', *Aberdeen Journal*, 2 May 1892.
85. Both letters are in the Boulton and Watt collection of the City of Birmingham Reference Library and are addressed from Boulton Watt and Co to Patrick Copland, Aberdeen. The first is dated 24 June 1799, contained in Office Letter Book no. 22, 1799-1800; the second dated 18 Nov. 1801 is in Office Book no. 25, 1801-2.
86. William Knight made a tour of some of the larger manufacturers in Aberdeen in 1815 and his notes in AUL MS M167 record that Forbes Low & Co, cotton spinners, had a 20-horse Bolton and Watt engine and a 12-horse engine by Fenton, Murray and Wood of Leeds; Milne Cruden & Co, flax spinners, had 16- and 30-horse Murray engines. Alexander Keith, *A Thousand Years of Aberdeen* (Aberdeen, 1972), p. 307 asserts that Alex Hadden & Sons, woolen mills, also had two steam engines.
87. The letters from Telford were among the letters collected by Charles Copland, *op. cit.* (4) but they became detached and were sold separately. They were purchased from Sotheby's by a London book-dealer who, due to an oversight, failed to record to whom they were re-sold.
88. A lithograph of the bridge under construction in 1805 showing the state of technology at that time was recently printed in the *Review* as plate 1 accompanying the article by John S. Smith, 'Lochs and Burns in Historical Aberdeen', *A UR L* (1983-4), 128-32. The balustrade was one place where Copland suggested a standard chain (22 yards) should be marked out to give easy access to a reliable measure of length for anyone laying out land. This splendid bridge, one of the largest single span granite bridges ever built, was

widened in 1907 and 1964 and is now almost completely submerged by insensitive inner-city development.

89. Letter from George Hepburn, Oldmeldrum, to Patrick Copland, Marischal College, dated 21 Sept. 1803 in AUL MS 2886.
90. John S. Reid, *op. cit.* (1).
91. P. J. Anderson, 'Professor Patrick Copland', *Scottish Notes and Queries*, 1st series, vol.III (1889), p.14.
92. Jo. Honyman, *op. cit.* (4).
93. William Anderson, *The Popular Scottish Biography: being lives of Eminent Natives of Scotland, Brought down to the Present Time, from the most Authentic Sources*, pp.793-4 (Edinburgh, 1842).
94. Charles' draft is in the private collection of P.A. Copland, *op. cit.* (4).
95. *Aberdeen Journal*, 8 Mar. 1779.
96. AUL MS M41 'Minute Book 1729-1790' on 9 Sept. 1785 records the unanimous approval of the lease of the college garden to professors Stuart and Copland for seven years. On 16 Feb. 1791 they relinquished some of the garden due to its being overshadowed by some buildings.
97. A formal notification from the Linnean Society, London, to Patrick Copland, Aberdeen, dated 7 April 1807 notifies Copland of his election as an associate member. A letter from Matthew Martin, Poets Corner, London, to Patrick Copland, Aberdeen dated 5 May 1807 confirms that Martin's proposal of Copland for membership was carried. Both letter are in AUL MS 2886.
98. John S. Reid, 'Fountainhall House', *Aberdeen Leopard* no. 70, June 1981, pp.25-27.
99. P. J. Anderson, 'Professor Patrick Copland', in *Scottish Notes and Queries*, series 1, vol. 1 (1887), p.124. Anderson quotes from a biographical collection by William Knight, the original of which cannot be traced.
100. *Aberdeen journal*, 20 Nov. 1822, p.3 col. 4.
101. Letter from Alexander Copland, Aberdeen, to Charles Copland, London, dated 20 Nov. 1822 in AUL MS 2886. According to a receipt, *op. cit.* (4), the will was drawn up by David Hutcheon, Advocate, Aberdeen. No search has been undertaken to see whether it or other documents of the estate are still extant.
102. The plaque, set in an ornamental black stone surround, reads:

In the burying Ground near this Place  
Are interred the Remains of  
PATRICK COPLAND, LL.D.  
Who was Professor of Natural Philosophy  
In the Marischal College and University  
Of Aberdeen:  
Where he taught with much reputation  
During a period of nearly Fifty years.  
He was born in 1749,  
And died the 10th of November 1822.

The year of his birth is wrong, according to the Fintray parish register, as mentioned in ref. 1.

103. *Aberdeen journal*, 28 Apr. 1878.
104. P. J. Anderson, *op. cit.* (99).
105. William P. D. Wightman, 'Scientists of the Region', pp.240-52 in *The North-East of Scotland* (British Association for the Advancement of Science, Aberdeen, 1963).
106. W. E. McCulloch, *Viri Illustres Universitatum Abredonensium* (Aberdeen University Studies, no. 88, Aberdeen, 1923).
107. It was purchased second-hand by Marischal College in 1769 for eight guineas, almost certainly to observe the transit of Venus. The objective speculum was reworked in 1819 by

the London instrument maker William Cary. This telescope is the oldest dated piece still surviving in the Department of Natural Philosophy.

108. The illustration is of Troughton's other standard 5-foot scale, made for Sir George Shuckburgh as described by him in 'An Account of some Endeavours to ascertain a Standard of Weight and Measure', *Phil. Trans. Roy. Soc.*, 88 (1798), pp. 133-82 and Tab. V, fig. 1, p.182. The whole consisted of a finely engraved brass scale soldered onto a piece of cast brass mounted on a mahogany beam. The Town's scale continued to be kept at Marischal College 'for safety' but no mention of it has been found after a remark by James Ross that "the instrument is now [1889] in the custody of the Senatus of the University" - see James A. Ross, *Record of Municipal Affairs in Aberdeen since the Passing of the Burgh Reform Act in 1833*, p.96 (D. Wyllie & Son, Aberdeen, 1889).
109. Print from William Roy, 'An account of the Trigonometrical Operation whereby the Distance between the Meridians of the Royal Observatories of Greenwich and Paris has been determined', *Phil. Trans. Roy. Soc.*, 80 (1790), plate III, p.272. The theodolite made by Troughton in 1801 for the Town of Aberdeen was on the same plan as Ramsden's, only much smaller. Nonetheless it was a large instrument that could be used not only as a theodolite but as a boning telescope (measuring elevations in the same vertical plane) and a precision level. It was also kept by Copland in the Marischal observatory but its fate is unknown after the old Marischal College building was demolished in 1838.