

The Scientific Apparatus of Professor Patrick Copland of Marischal College, Aberdeen

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Patrick Copland

Marischal College was an autonomous university of over 250 years standing when it amalgamated with neighbouring Kings College and University in 1860 to form the University of Aberdeen. This short paper is devoted to one of the stars of Marischal College. Patrick Copland was described by Edward Ellice, a Secretary of State for War in the 1830s, as "*The man who more fully opened the eyes of the student to this world than any teacher he had ever met*". Similar sentiments were echoed by others who had passed through Copland's classes, given for 47 academic sessions from 1775 - 1822. During this time, Marischal College earned a reputation as a progressive establishment, notably in the Sciences, in Mathematics and as a rising influence in local medical education. Copland's reputation as a teacher rested on the usual attributes of clarity, relevance, enthusiasm, audience rapport, etc., with the added ingredient that he was a pioneer in the Scottish Universities of the extensive use of demonstration equipment to illustrate his teaching. By the end of Copland's teaching one writer said of his collection of apparatus that it was "*generally considered as superior to any in Britain, and some deem it superior to any in Europe*".

Academic Context

The story of the introduction of apparatus into the subject of Natural Philosophy began in the 17th century. Early on, Galileo timed balls that he rolled different distances down an inclined plane and conducted other dynamical experiments but it was Isaac Newton's work on 'Opticks' that publicised how simple apparatus, designed and used in specific purposeful ways, could illustrate fundamental truths about the way nature behaved. The seed Newton sowed led to the growth of 'Experimental Philosophy' as a respectable part of Natural Philosophy. The Scottish Universities were well to the fore in introducing these ideas into their teaching in the late 17th and early 18th centuries. It is one thing, though, to talk at length about what Newton and others had learned from experiment but quite a jump to consider performing demonstrations in front of the class. Every generation works within the remit of its times and since apparatus cost significant sums of money it was not a practical proposition in those times for the Scottish Universities to indulge in extensive demonstrations, even had the Professors been minded to. In a few specialised areas, such as are covered by the use of the air pump, the hydrostatic balance and electrification by frictional rubbing, Colleges including Marischal bought equipment and used it on an occasional basis. That was the state of affairs when Copland took over the teaching of Natural Philosophy in 1775.

Building the Collection

Copland brought with him to the job not only a passion for demonstration but another singular skill. He was a first-class mechanic, in the broadest sense of the term. Like his contemporaries he lacked money (the College paid him an allowance of £3 per annum to maintain the equipment) but he became craftsman/professor. He recalled in 1790 "*I fell to work myself, and in a few years repaired all our Old Machines and executed several new*

ones, particularly for *Electricity and the late discoveries on air - for explaining which we had none*". Indeed he continued to make apparatus throughout the four-and-a-half decades of his tenure. His workshop was equipped with the tools of a professional craftsman, including taps and dies by Jesse Ramsden of London, whose workshops produced some of the finest instruments in the world, two impressive lathes and hand tools for working in glass, wood, metal and ornamental materials.

He employed other means of building the collection, too. In 1783 the College at Copland's request raised a grant of £50 per annum for 3 years from the Board of Trustees for the Encouragement of Manufactures in Scotland to employ a mechanic (John King was his name) to make models of industrial machinery. This was more money than Copland received from the College in his lifetime for maintaining his instruments. In the event, King stayed about 7 years. Arguably, he was the first technician ever directly employed by a British University. Copland described John King as a young man "*whose workmanship I have found equal, in both wood and metals, to that of the best London artists*". There is every indication that the same can be said of Copland himself.

Copland raised enough money from a public appeal he launched in 1780 to build an astronomical observatory and equip it with some of the best apparatus that the London makers could supply. This enterprise was greatly assisted by generous support from the Earl of Bute, the Chancellor of Marischal College at the time, who donated two very expensive telescopes. This was the first public, or semi-public, observatory in Scotland fitted out with distinctly modern equipment. Glasgow and Edinburgh followed suit in the 19th century. Finally, Copland began a course of evening classes to tradesmen, merchants and private gentlemen. These promoted the understanding that Natural Philosophy gave to the design of machinery and to the explanation of the natural world. They drew heavily on his collection of demonstration apparatus, and in turn funded its growth. Copland's classes were more extensive, longer and pre-dated those of Birkbeck, Garnett, Young and others considered pioneers in this field. They did not go un-noticed, for in 1803 he received a Royal Pension of £100 per annum, in part "*as a reward for the great service he had been in that part of the Country to tradesmen and the public by his lectures*". The evening classes continued until 1813.

Scope of the Collection

The collection supported all the areas of science then taught as Natural Philosophy. These included Mechanics (the most extensive area and Copland's personal favourite), Dynamics, Hydrostatics, Pneumatics, Acoustics, Static Electricity, Magnetism, Optics and Astronomy. Copland also had instruments to support the teaching of surveying, navigation and the use of globes, as was appropriate to the title of Professor of Mathematics, which he held for 39 years. Why he was not Professor of Natural Philosophy when he taught the subject is another story, outside the scope of this talk. We have an accurate knowledge of the final extent of Copland's collection because, shortly before his death, he arranged that all the apparatus in his personal possession should be bought by the College. Two lists were made by Copland, one of the apparatus that had been acquired by one means or another by the College and a second list of his personal pieces. Copland's successor was William Knight, who was not only an effective teacher but also a meticulous chronicler of College history and practices. Knight made a copy of Copland's lists and, moreover, with a committee of Faculty he inspected the entire collection that was in the College and drew up a third all-inclusive list with added

points of supplementary detail derived from an examination of the pieces. This final list, headed 'Catalogue of the Philosophical Apparatus in the Marischal College, Aberdeen' was dated 1st August 1823, 9 months after Copland's death. I have used this '1823 list' as the basis of a definitive account of Copland's scientific apparatus. With a few minor alterations and additions it runs to 531 entries, a significant number of which describe several objects. Lists made in 1790, 1828 and 1830 for other purposes also provide supplementary information.

Instrument Makers

Contemporary statements repeat the assertion that Copland made most of his apparatus himself (aided as we know by John King for several years). Would that he had signed his pieces! The lack of attribution of items to specific makers either in the inventory or on extant pieces supports this assertion. Exceptional in the inventory are 35 items that can be assigned to a total of 16 London makers. These are mainly items for the Observatory. The London makers represented are the cream of the trade, including (alphabetically) Dudley Adams, William Cary, Peter and John Dollond, John Cuthbertson, Thomas Jones, W & S Jones, Edward Nairne, Jesse Ramsden, James Short, Jeremiah Sissons, Edward Troughton and a few others. 9 items in whole or in part are attributed to the Aberdeen maker Charles Lunan and another 4 items to four different Scottish makers. These were mainly mathematical instruments and apparatus. Copland's splendid collection did not therefore bring great custom to the trade, though the observatory items were generally much more costly than the average demonstration piece. In number, named makers may represent barely 10% of the collection but in value they would account for significantly more. About two dozen local suppliers of materials and services are named in the 'Philosophical Receipts', so called, still in College archives. Copland was not the only person in the area purchasing Philosophical Apparatus, for there were interested gentry and some minor activity from neighbouring King's College. His work, though, could not have supported a local instrument makers trade or even generated enough local commerce to justify a specialist setting up. Precision work of the kind Copland himself undertook was done only, it seems, by a few local clockmakers that included Charles Lunan, John Gartly and James Dalziel.

Extant Remnants

Considering the size and quality of the original collection - all contemporary observers remark on the quality of the pieces - depressingly little remains. Of course it is natural that items in a collection intended as a working tool should sometimes be broken in use. The technical skill to effect repairs was not available in Universities until some 100 years after Copland was active, which perhaps underlines how far ahead of things he was. Of course repairs were contracted out to instrument makers and tradesmen in town, but contract work costs explicit money and there must have been a strong temptation in succeeding years to abandon broken pieces rather than repair them. Right through until the 1980s, it was still common practice to give demonstrations in elementary physics that differed little in principle from many that Copland showed. The charge of irrelevance can be easily refuted for perhaps 150 items in the 1823 list.

It is likely that about 10% of Copland's collection, in number of pieces, survives in whole or in part. The identification of extant items has to be based on probability. At one end of the scale, namely certainty, come named and numbered pieces, like the James Short reflecting

telescope. Almost equally certain are pieces like Dollond's four-foot focus equatorially mounted refractor, whose detailed description fits one of several telescopes in our collection. Unfortunately, most items are not inscribed with any identification at all. William Knight kept a list of all repairs, replacements and new acquisitions until his retirement in 1845. These showed that new acquisitions tended to be in areas of rising interest, such as electromagnetism, acoustics and optical developments. Replacements were not made in areas of strength of Copland's collection, probably because there was enough choice to cover loss. Following through this line of reasoning, if, for example, Aristotle's watering pot had been badly damaged, there would have been no call to devote scarce resources to procuring a nicely hand-crafted replacement. Hence, if such a watering pot on the 1823 list (item 233) still exists and it looks the part, then it is likely to be Copland's original. Other clues come from the style of the items and the materials used. In addition, some items have printed labels on their bases, or evidence of having had a standard printed label, reading 'The Property of the University of Aberdeen'. These labels seemed to have been put on (and again this is only a deduction based on probability) when all Natural Philosophy teaching was transferred from Marischal College to Kings College in 1860. These clues are, individually, weak but together the strands weave to build a likely picture.

There will inevitably be a few mistaken identities, because some apparatus has come down to us directly from the Natural Philosophy teaching that went on at Kings College in parallel with Copland's Marischal College courses. However, King's College was comparatively poorly equipped and obtained its equipment largely from different sources. I believe that with about 90% confidence, we can identify some 50 items, or remnants of items, given on the 1823 list. This is a very small fraction of our total natural philosophy historical collection, which runs to over 2000 items.

Conclusions

With some 90% of Copland's collection lost, it is useful to look at surviving contemporary collections, both to obtain a better idea of the original pieces and to assess the claims that Copland's collection was among the finest in Europe. The most accessible public collection in Britain is the George IIIrd collection, now in the Science Museum in London. It was started earlier than Copland's and contains a significant number of items made especially for the King, for his education and amusement. Some 45 items only are similar in title to Copland's. Undoubtedly the best comparison is Van Marum's collection in Haarlem. Of the inventory made in 1812 listing just over 500 items, 350 survive and are illustrated in Gerard Turner's catalogue of that collection now in Teyler's Museum. It is flattering Copland only a little to say that the best feel one can get for his collection is to examine Van Marum's collection, which was built up by a collector ordering the best equipment of his day from the best makers.

There are a good number of other partly surviving contemporary collections. One that merits comparison with Copland's teaching collection is the Danish Hauchs Physiske Cabinet at Soro Academy, not publicly catalogued. There are also those of the other ancient Scottish Universities, the Anderson Institution (which grew into Strathclyde University), the Belfast Institute and the Dublin Colleges (TCD and UCD), and collections abroad, notably in Utrecht, Leyden, in some of the ancient Italian Universities, in Harvard and a few of the pioneering American Colleges, the Royal Swedish Academy, and elsewhere. They were formed for a variety of reasons in individual circumstances. Nonetheless, Copland's collection can hold its

own with the best of them in range of items covered and, to use the modern idiom, *fitness for purpose*.

The motivation for the use of so much apparatus was its effectiveness in teaching: it aroused the student's curiosity; it riveted the facts in his mind; it clarified the principles by demonstrating their application; it emphasised the practical aspects of science and awakened the student's spirit of discovery. These were Copland's points. As a bonus, it was through the use of apparatus that great advances were being made in Physical Science in Copland's day and beyond, not through refinement of philosophy. In my judgement, Marischal College are right to be proud of their craftsman/professor who, by his own efforts, put them at the leading edge of public teaching in his subject. It was men such as Copland who helped establish a reputation for Scottish education that we are still, to some extent, the beneficiaries of today.

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