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THE CASTLEHILL OBSERVATORY, ABERDEEN

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The Beginning

The Scottish Universities of the late eighteenth century were justly proud that they tried to spread education beyond the social élite, to artisans (through extra-mural work) and to the gifted sons of the poorer classes. In the revelation of the era, that science—particularly natural philosophy—was good for everyone, it would have occurred to many to wish for an observatory equipped with the highest quality instruments of the day. Edinburgh, the capital city, tried and failed to raise an adequate public subscription for such a cause. What Aberdeen possessed that other universities and towns apparently did not was the right man in the right place. Long since forgotten, the driving force behind the erection of the Castlehill Observatory at Aberdeen was Patrick Copland (Figure 1), in title Professor of Mathematics at Marischal College but in fact the man responsible for teaching natural philosophy.

In September 1780, in the name of the College, Copland initiated a subscription fund for "proper Apparatus of Instruments in the University for Explaining to young men the Principles of Natural Philosophy from which those of the greater number of the Useful Arts in life derived",[1] adding that owing to their low state, the College funds "so far from being able to Afford the Capital Instruments they wanted were little more than barely sufficient for the Annual Repairs". He detailed that they wanted an orrery, a quadrant and an astronomical clock for explaining the principles of "Navigation and other useful Branches of Science". The Town Council were asked for their approval first. After due deliberation, "being perfectly satisfied of the Public Utility of the Plan proposed by the Memorialists and that the Execution of it will tend to promote the Interests of Science and the Education of Youth", they unanimously agreed to contribute twenty guineas.

Further generous contributions quickly followed from local bodies as well as many of "the Gentlemen in Aberdeen and the Neighbouring Country".[2] It soon became clear that the subscription was to exceed all initial hopes. All told, a total of almost £400 was raised. Early in November 1780 Copland wrote to the Astronomer Royal in London, Nevil Maskelyne, for advice on fitting out a complete observatory. Copland was fortunate to have made his friendship some seven years earlier in another connection. Maskelyne replied that he was "very ready to render you any service either in pointing out proper instruments to you or assisting you in getting them executed here".[3] On both counts he was as good as his word, and has thereby left us an insight into how a leading British astronomer of the period considered a prosperous provincial observatory should be equipped.

Fortified by Maskelyne's support, Copland returned to the Town Council in February 1781 with a plan and elevation sketch of a proposed Observatory Building.[4] He had examined all the high ground around the town for a site with a commanding view of the horizon, particularly in the north–south direction.

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FIG. 1. Prof. Patrick Copland, founder of the Observatory. (Photograph of a portrait by courtesy of his great-great-great-grandson, Patrick Copland.)

The best site was at the south-east projection of the old Ramparts on the Castle Hill. Unfortunately the Town owned the land and had earmarked the site for a substantial flagstaff. Perhaps fearing that such an important symbol might have more emotional appeal to the Council than mere passing ideas on the "Education of Youth", Copland lowered the tone of his argument by asserting that the observatory would make the flagstaff more conspicuous and indeed the twin round buildings of his plan "would be Ornamental to the Town being placed in so elevated a Situation". Also, probably realizing that development of the Castle Hill area was very much a topic of the times, Marischal College offered "to remove the Materials of the Observatory whenever it shall appear proper to the Council that the ground should be applied to any other purpose".

Thus it was under these conditions that the Observatory was started, on gifted money and borrowed ground.

The exact position of the building, with a thumbnail sketch, is shown on Alexander Milne's town plan of 1789.[5] The view must have been excellent and 'seeing' at night incomparably better than from the same site today. Coal fires had not become widespread and the oil-lamp street lighting was dismal, serving little more than to emphasize how dark it really was. The observatory itself consisted of three rooms, two of these forming circular wings about 12 ft in diameter with opening conical roofs.[6] The seaward roof could rotate and had opening slits through which McCulloch's quadrant or Dollond's telescope was sited. The western roof was fixed, with opening slits for Ramsden's transit telescope. The middle room provided a little accommodation for the observer.

The *Aberdeen journal and North British magazine* reported on 15 October 1781 that "last week was completed the Observatory belonging to Marischal College, situated on the Castlehill, to the East of this city. And we are happy in being able to inform all Lovers of Science, that it will probably in a few weeks be furnished with an excellent set of Astronomical Instruments . . . ".[7] In fact, the installation of all the equipment took some time but it was indeed "an excellent set". Before detailing the principal items in the next section it is worth relating some interesting background revealed in correspondence about their acquisition.

In early October of 1781 Maskelyne had just paid a visit to Kenneth McCulloch in London who was constructing for the observatory a large quadrant that was to be accurately divided by Troughton.[8] This work may have been a new venture for McCulloch since Maskelyne comments: "I called on Mr McCulloch to inspect your quadrant and found most of the parts prepared and allmost [*sic*] ready for putting together; it was framed strong and with good judgement. I was glad to find that he seems to understand what he is about, and by what I saw he had done and what he told me he proposed to do, he seemed very intelligent and not a mere copyist. I shall call on him again, when the work is more advanced."[9] Maskelyne advised on clocks and confirmed the excellence of the telescope by Dollond of 46 inches focal length that he had recommended Copland to buy. Although we are not sure when, Copland himself spent some seven months in London[10] visiting the various instrument-makers concerned and generally making himself known in philosophical circles.

His enthusiasm was obviously infectious and his contacts were in the most influential circles. In July 1782 a letter[11] reporting news of Copland in London says: "Ramsden had not touched the great Equatorial which [had] been with

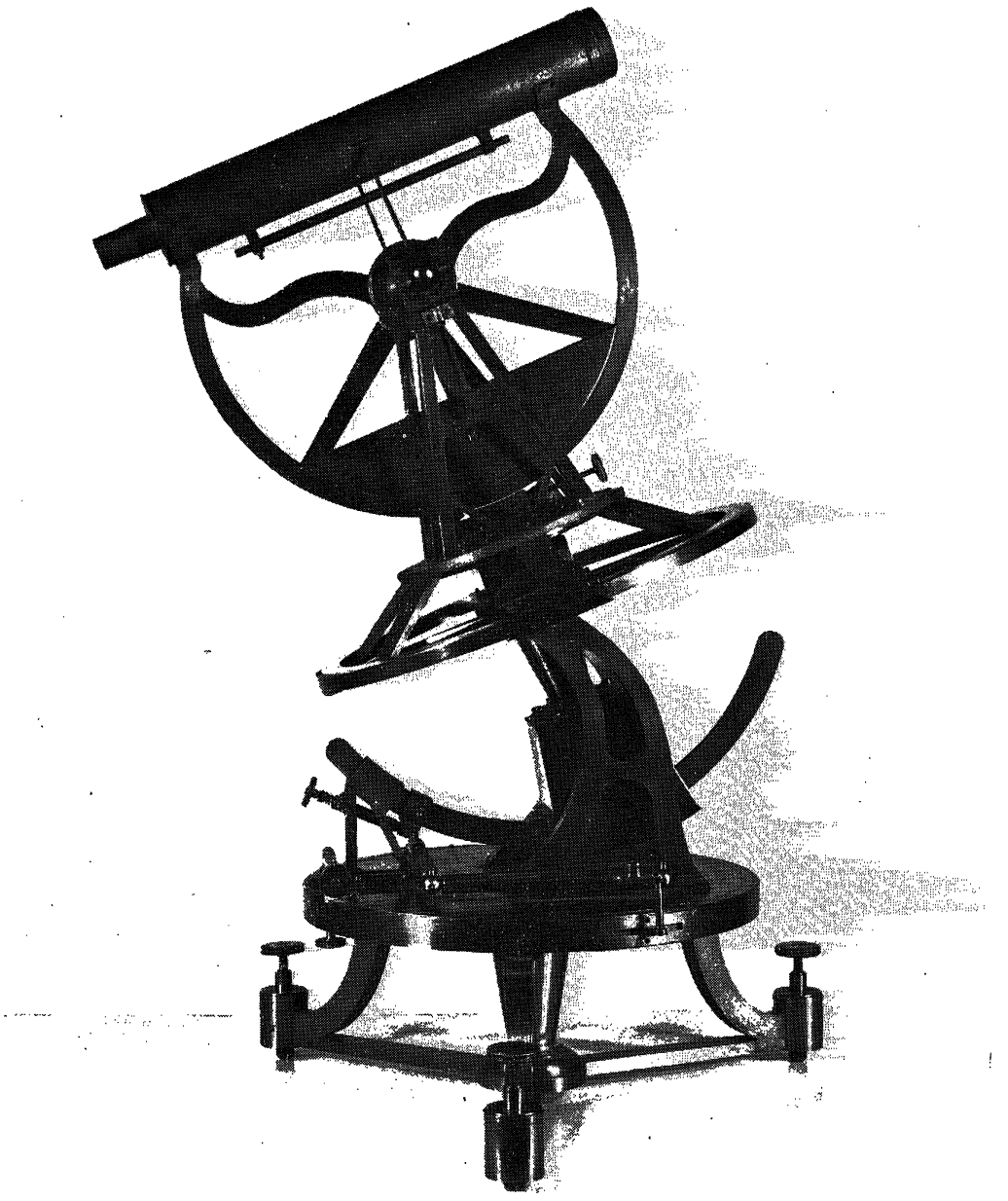

FIG. 2. The equatorial surveying telescope by Sisson and Ramsden. The azimuth circle scale is 16 inches diameter, divided into 10′ arc with a vernier to 5″ arc; the equatorial circle scale is 17 inches diameter, divided into 1′ time with a vernier to 1″ time; the declination circle is 17 inches diameter, divided into 10′ arc with a vernier now of indistinct markings, apparently to 10″ arc. The instrument is larger and more finely divided than Ramsden's own equatorial. The optics of the 17 inch telescope are missing.

him many Months but the Prof'r has acquired so great influence over him that he has prevailed with him to lay aside Instruments for his Favourite the Duke of Marleborough and the Apparatus for the Operations that interest Philosophers so much at present for connecting the Observatories of London and Paris by

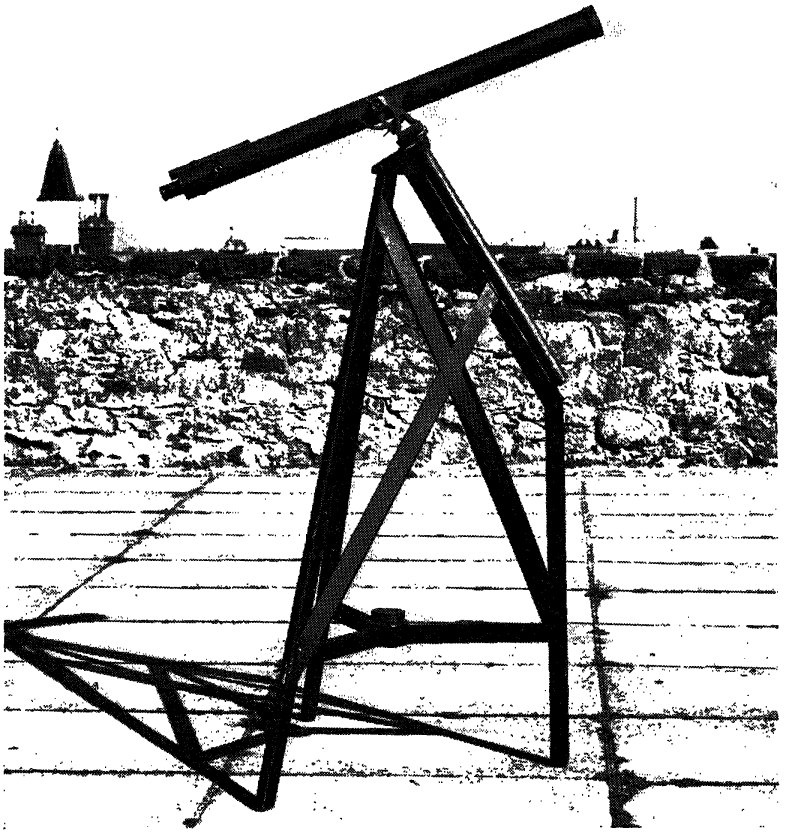

FIG. 3. The 46-inch focal length telescope by Dollond which was extensively used by Andrew Mackay: photographed at the site of the Observatory. The angular adjusting rods and the steadying arms have not survived.

actual Mensuration and set a dozen of his best Men at work on his Equatorial and Transit Instruments. . . ." The Aberdeen observatory was receiving very privileged treatment.

Copland's most important contacts were Maskelyne himself and John Stuart, the third Earl of Bute (1713–92). Lord Bute was an amateur astronomer of enthusiasm and wealth. At this period he was acquiring telescopes at an impressive rate, particularly from Dollond and Ramsden.[12] He was also Chancellor of Marischal College. However, although he had been one of the most powerful figures in Britain, he had by this time become somewhat ostracized for political reasons and had withdrawn from much of his previous social life. Copland was therefore surprised to find that he was not only most favourably received but that he was offered the equatorial and transit as a gift for the observatory. The two instruments were said to have cost the Earl of Bute 500 gns[13] and Copland was of course most pleased to accept instruments that the College itself could never have afforded.

The Instruments

A reliable inventory of equipment seems to be that contained in the account of Marischal College by John Stuart [no relative of Lord Bute] which forms

part of an appendix to the Statistical Account of Scotland.[14] The items mentioned by Stuart are confirmed in various parts of the Knight manuscript[15] which was most likely written in the 1820s. Knight also adds prices, which cannot generally be checked though it has been established that he was a fairly meticulous chronicler of Marischal College history. The Royal Society of Edinburgh's summary, the only other account contemporary with Stuart's, contains a few errors and Kennedy's list in the *Annals of Aberdeen*[16] adds one or two extra points of detail but omits others. The following list is compiled from these references, with additional comments. Items not shown in the accompanying figures no longer belong to the University and have not been traced.

(1) A transit telescope by Ramsden of 4ft focus and 3 inches aperture. In the field of view were five vertical wires covering a width slightly greater than the Sun's disk. A magnification of ×90 was available.[17] Made in 1781 for the observatory, this instrument was one of the two donated by the Earl of Bute.

(2) An equatorial instrument by Sisson and Ramsden, shown in Figure 2. Knight records that it was made by Sisson about 1770–73 but in 1781 it was divided anew by Ramsden who added an achromatic telescope and refraction apparatus, presumably similar to that described in the account of his own equatorial.[18] This was the second of the Earl of Bute's donations.

(3) A double achromatic telescope by Dollond of 4ft focus and $2\frac{3}{4}$ inch aperture, on a polar axis set on a mahogany stand and having a divided object glass micrometer. The instrument still in the University's possession shown in Figure 3 exactly fits this description except that it is without the object glass micrometer. It is signed "Dollond, London" but unnumbered. There were originally three eyepieces and Mackay records[19] that for observations of Jupiter's satellites he used powers of "about 80 and 115 according to the state of the atmosphere". In the observatory notebook he records powers of about 70 and 126 and always refers to the telescope as the "46 inch achromatic of Dollond". Maskelyne suggested in his letter to Copland of 7 December 1780 that Sisson should make the mount but there is no record of whether he did or not. The cost was £73. 10.

(4) A moveable astronomical quadrant of 2ft radius, made by McCulloch and divided with great accuracy by Troughton. Mackay records[20] that "this quadrant has two separate sets of divisions: the quadrantal arc of the inner set is divided into ninety degrees as usual; and the exterior arc is divided into ninety six primary divisions; each of which is subdivided into eight equal parts; and the vernier gives one thirty-second part of a subdivision, or 13·18 seconds. A micrometer screw is attached to the vernier, which serves to regulate the motion of the index, and by which, the excess in seconds above the next less division of the vernier is shown". The instrument is said to have had two telescopes and cost £126.

(5) A Newtonian reflecting telescope of 5ft focus by Hearne. Little is known about this instrument except that in 1819 Copland paid "Cary"[21] 16 gns for reworking the large mirror and providing a new smaller one and three eyepieces.

FIG. 4. The small Gregorian by James Short.

(6) A 12-inch Gregorian of 3 inch aperture by James Short of London. Figure 4 shows this, the oldest instrument in the observatory. Labelled $1740 \cdot \frac{5}{258} = 12$, it was made in 1740 and was only the fifth of this size by Short. The mirror was also reworked by Cary in 1819. Purchased about 1769, prior to the observatory's construction, for 8 gns.

(7) The principal time keeper—a Marriott clock with gridiron pendulum made in 1781, costing £50. The original ruby pallets were replaced by agate ones in 1840. With the decline of astronomical observations in the second half of the nineteenth century it was allowed to deteriorate but was restored to good working order in 1979. Figure 5 shows the clock as it now is. Mackay records in the surviving observatory notebook (AUL MS 504) that the amplitude of the pendulum was typically 1° 40′ (there is now no scale) and that it lasted over a month between windings.

(8) A journeyman clock, counting the minutes and seconds by the stroke of a hammer upon bells, by John Gartly, a well-known Aberdeen clockmaker. Cost £8.

(9) An astronomical clock. This clock was made by Copland himself and his assistant John King (later a clockmaker in Aberdeen) some time in the 1780s. It shows the apparent motion of the Sun, Moon and stars as seen from the Earth, as well as telling solar and lunar time.[22] The clock, shown in Figure 6, was restored in 1981.

(10) An orrery, constructed by an ingenious artist in Perth, at a cost of £20, exhibiting the motion of the planets.

(11) A barometer and thermometer by Miller of Edinburgh.

There was also an alarm clock. Marischal College's run of *The nautical almanac and astronomical ephemeris* was begun in 1781, and was certainly intended for the observatory, and other books were purchased from the Liddel fund for mathematical sciences. It is likely that the observatory had a small library associated with it.

The Observatory's Use

It is very clear that the main motivation for constructing and equipping the observatory was educational, and there is every indication that this was its main function. Almost all Copland's energies over a period of forty-seven years when he was professor at Marischal College went into teaching, demonstrating and promulgating the usefulness of natural philosophy. Unfortunately he published nothing and left no notes or written accounts of his activities. The Statistical Account cited above relates that "In the observatory, the construction and adjustments of the different instruments, the method of making observations, with the calculations and results deduced from them, were explained to the students". Apart from a comment[23] by Copland's eldest son that his father spent "many years in telescopic observation of the heavens", we know little of Copland's own use of the observatory. He added the Ferguson astronomical clock for educational reasons, and Knight records[24] expenditure on maintaining the observatory.

We do know that Copland made his mark on the popular imagination when he used the observatory to release balloons for unspecified scientific purposes. After one of the first flights, the *Aberdeen journal* for 15 March 1784 reported:

> The Balloon [3½ ft in diameter by 5 ft high] mentioned in our last, which was sent off from the Observatory of Marischal College, under the direction of Professor Copland, (being the first experiment of this kind made in Scotland,) descended again at the house of Strichen [some 50 km distant]

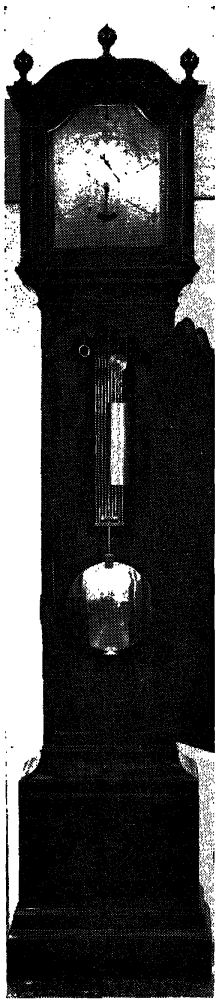

FIG. 5. The Observatory's master clock by Marriott, with the case door open showing the compensated pendulum.

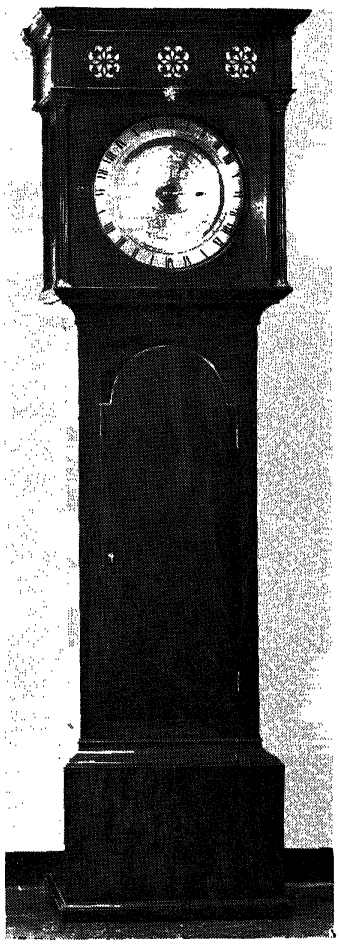

FIG. 6. The astronomical clock designed by James Ferguson and made by Copland and his assistant John King. The clock stands 7ft tall.

> a few minutes after 1 o'clock of the same day. . . . The country people who observed it first descending from the clouds, were greatly alarmed; some taking it for an evil spirit, and others for the angel coming to sound the last trumpet.

A letter of 1783 remarking on the persistent unusual weather[25] continues: "The thunder and lightning are in general attributed to the Hocus Pocus tricks, which Professor Copland has lately been playing at the Observatory and elsewhere—It is affirmed that he has drawn all this mischief out of the Clouds by means of the Black Art, and that he has loaded his Electrical Batteries for purposes best known to himself. The mob are greatly incensed against him, the very women would surely attack him in the Streets, were it not for a small vial of Electrical matter, which he is said to carry about in his Breeches Pocket for present use, and which he can discharge upon a minutes warning."

The observatory was certainly used by a freelance teacher of mathematics and navigation, "a little, bustling, bandy-legged man, with eyes of jet and a countenance of much intelligence and animation"—Andrew Mackay.[26] He published several books during his lifetime, the most notable of which was written during the period in which he was "Assistant Keeper of the Observatory in Aberdeen".[27] This treatise on *The theory and practice of finding longitude at sea or land*[28] contains examples of most of the techniques he advocates based on actual observations made at the observatory. As an aside to one discussion (p. 203) he described the observatory's meridian mark "on the Grampian Hills, about 13900 feet distant from the Observatory. The mark is seen against the sky, and has a circular perforation in its top, of such a size, that the middle wire of the transit instrument covers about a third, and therefore a segment of light is seen on each side". He continues by mentioning that the observatory's clock is set from noon observations of the Sun in Ramsden's transit and gives an example of a boat determining its longitude with the chronometer set correct at the observatory. We may conjecture that this practice could well have taken place (Arnold's marine chronometers being accessibly priced at 60 gns around 1790) and, even more probably, that the manager of the town's public clocks availed himself of the nearby observatory standard of time.

Mackay's book is not a mere collection of recipes but the account of a practising observer. By making the first accurate observations at Aberdeen of the zenith distances of the Sun, some planets and some stars,[29] he accurately determined the latitude of the Observatory at 57° 8′ 59½″. This showed that the best general maps of the day (for example Ainsley's map or La Rochette's North Sea chart[30]) placed Aberdeen some six kilometres too far south. The modern value for the site is 57° 8′ 55″·3 (determined from the ordnance survey map) which differs by only 130 metres.

His observations of Jupiter's satellites, of eclipses of the Sun and Moon and of a stellar occultation enabled him to solve in several ways the more complicated problem of finding the longitude of Aberdeen.[31] His result of 2° 8′ for the longitude for the Observatory was less accurate (the modern value is 2° 5′ 15″), though it was also an improvement over existing estimates.

The only surviving observatory notebook, AUL MS 504, is a soft-covered jotter kept by Andrew Mackay containing sixty-eight pages, all used. The account opens on 17 December 1785 and closes on 27 December 1791. The majority of entries are meridian transit times, mainly of the Sun, but also of Jupiter, Saturn, Venus, the Moon and Mercury, and initially of a number of brighter stars (and one on 21 March 1790 of Uranus). These observations were chiefly concerned with regulating the Marriott clock. Most of the other entries are times of immersion or emersion of Jupiter's principal satellites as seen through Dollond's telescope; the remainder concern timings of eclipses and the occultation of a star by the Moon as data to determine the observatory's longitude. The notebook confirms that the examples that appeared to refer to the Castlehill observatory in Mackay's treatise[32] are indeed genuine. It also shows that Mackay used most of his worthwhile material. However, the notebook is certainly not a complete record of the observatory's use for there are no readings from McCulloch's quadrant or from the universal equatorial, though these instruments were used. Observations began more than two years prior

to the book's starting date. Consequently we are still left wondering what astronomy besides some careful positional work was actually done.

The Observatory's Demise

Barely ten years after the observatory had got going, the threat of invasion from the Continent caused the Town Council to offer the Castlehill site in 1792 as a suitable area for an infantry barracks.[33] In June 1794 the foundation stone was laid. One year later the Professors at Marischal complained[34] "That from the late erection of Barracks on the Castle Hill, the Observatory has been so much injured, as to be in a ruinous condition and the Apparatus in so great danger of being stolen or destroyed, that it was found necessary for its preservation, to remove the whole to the College". They asked the Town Council to make an application on their behalf to Government for some £500 to allow them to purchase land and rebuild the observatory. In November 1796 the Observatory was finally taken down, the site at the extremity of the Barracks' premises being subsequently used for a powder magazine.[35] With a sensitivity for the College's predicament[36] and a feeling for the value of learning which a government today would be hard pressed to match, the College was not only offered what it asked for but was given £800 in 1798 to purchase a new site and re-erect an observatory.[37]

In the event, no suitable independent site could be found and the new observatory with three cupolas was built on the top of the Marischal College buildings. The residue of some £130 from the compensation grant was set aside as a fund for running and maintaining the new facility. And thus, after a life of barely fifteen years, the Castlehill Observatory was obliterated. Its existence has tended to be overlooked[38] but it was certainly a pioneering venture which predated the eminent nineteenth-century observatories in Edinburgh and Glasgow and which could, with a kinder twist of fate, have become an excellent centre.

It may be wondered what happened to those splendid instruments in their new location. Unfortunately Andrew Mackay left Aberdeen a few years later and the town was deprived of the one experienced person who might have become an astronomer of note. Copland maintained the apparatus and indeed enlarged it. However, apart from nucleating local interest the only further serious observations recorded were more precise occultation measurements made by Professor John Cruickshank which established the location as one of the secondary standards of longitude in Western Europe.[39] In 1837 the relocated observatory was demolished along with the whole of the old building and, in spite of hopes to the contrary, Marischal College did not provide comparable new accommodation. It seems likely that it was around this period that some of the apparatus disappeared, for there is no mention of Ramsden's transit, McCulloch's quadrant, Hearne's telescope, the orrery and other items during a resurgence of astronomical interest at Aberdeen University in the 1860s.

Acknowledgements

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making available manuscript and other material. He is also very grateful to Alexander Patrick Copland, descendant of Professor Copland, for access to private family correspondence.

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27. Title quoted in ATCR, lxvi, 26 Sept. 1791.
28. *Op. cit.*, ref. 19.
29. Mackay, *op. cit.* (ref. 20), 135–9.
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