

ART. XI. – *Sir Daniel Fleming's Meteorological Observations at Rydal, 1689-1693.*

By GORDON MANLEY, M.A., D.Sc.

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**A**MONG the Fleming papers there is a small notebook of 32 leaves, approximately 6"×4" (15×10 cm.), made up of a number of sheets roughly stitched together in the centre. In the 1890 report on the Fleming MSS. (Hist. MSS. Commission, 12th Report, Appendix Part VII) it is listed as "Barometer Observations" without further comment. Inspection reveals a sequence of daily meteorological observations from 26 November 1689 to 27 April 1693 (Gregorian or "New Style" dates will be quoted here unless otherwise stated) entitled in Sir Daniel's characteristic hand "The second part of some observations of my Baroscope, etc." On the first page, headed "Notarum Explicatio" he gives a list of his abbreviations, for example, "As, the ascending of ye quicksilver", "cl, cloudy without rain", "F, fair without clouds", "Th, Thaw". "The Quicksilver", he says, "is set down as it is every morning" and he generally reads it at 8h., in units that appear to be tenths of an inch. I am greatly indebted to Miss MacPherson of the Record Office, Kendal, for drawing my attention to this MS. and for providing me with a working copy.

Sir Daniel Fleming of Rydal Hall is known to us as one of a very characteristic breed of North-countrymen who combine energy and precision of mind with determination, a sense of duty, and a care for his possessions. These are displayed here in a regard for accuracy of observation and recording of natural phenomena and of such measurements as his instrument afforded. Bearing in mind his careful accounting of such things as his sons' expenditure at Oxford and his daughters' music lessons, we might see in him the kind of man who would set about the keeping of a daily record, especially if he could see some use in it. It was a period when time-keeping and the recording of events in time had become a widespread fashion; the social diarists flourished, together with the clockmakers. Moreover, the sciences of today were emerging. In meteorology, observation led to counting and measurement, and the barometer and thermometer had been invented earlier in the century.

With regard to the keeping of meteorological observations, it was quite soon after the foundation of the Royal Society that Dr Wilkins in 1663 read a paper in which he advocated the maintenance of "a history of the weather"; and in the following year Hooke devised his scheme for the recording of daily instrumental and eye observations. In the north of England we know that Richard Towneley "the mathematician" had his barometer at Towneley Hall, near Burnley, as early as 1665. At some time towards 1670 he acquired a thermometer and was keeping daily observations. This we know from his letters to the Royal Society, of which he later became a Fellow; he also corresponded with one of its founders, Sir Robert Boyle (cf. Boyle's *Works*, edition of 1744, vol. 5). Towneley is chiefly known to posterity for his very early rainfall record (1677-1704) and his ingenious method of measurement.

I have however found no evidence that Towneley and Fleming exchanged correspondence or were otherwise directly acquainted, although Towneley as a Lancashire landowner is mentioned in a letter from Lancaster to Roger Fleming in 1688 (H.M.C. Report cited above, 224). Sir Daniel acquired his “baroscope” in 1686 – one has the impression that for a couple of decades or so the terms barometer and baroscope were not always distinguished – it was sent to him by his frequent correspondent and friend Sir John Lowther of Sockbridge, together with a letter dated 24 April 1686 (O.S.) that reads: “I send a barometer which cost 30s. The Philosophical Transactions are in six volumes”. In the otherwise meticulous Fleming accounts I find no mention of a payment for either. Perhaps we might conjecture that, during or after his fortnight’s stay in London in November 1685, he had asked Lowther to obtain and despatch a barometer from London.

From Nicholas Goodison’s work on *English Barometers, 1660-1860* (1969) it appears that barometers could be obtained in London soon after 1670, and by 1694 “it was easy to be furnished with a quicksilver weather glass”. Goodison quotes from a letter by Richard Leigh to his wife at Lyme Hall, near Stockport, in 1675, that “the carrier will bring a long deal box with a bottle that hath quicksilver in it”.

I am indebted to Mr B. C. Jones, Cumbria County Archivist, for providing me with a copy of a relevant document, D/Lons/L/Fleming ms.K, from the Lonsdale MSS. This is a manuscript, in an elegant hand, of “Directions for Setting up the Baroscope or Quicksilver Weatherglass”. Careful instructions are given for filling the tube in such a way as to avoid “bubbles of Aire”. It is noted that a little spare mercury is provided to allow for accidental spillage; and the scale for the height of the mercury column is provided with graduations, in tenths, from 28 to 31 inches. Sir Daniel has added on this MS. a note in his own hand, “Set up in Rydal-Parlor ye 12th of May A.D. 1686”. This is 18 days after the date (above) of the despatch, so it could well have come from London by the Kendal carrier. In these “Directions”, which we may presume to have been supplied by Sir John Lowther himself and returned to him from Rydal, we read “Lastly, you are not so strictly to take notice of the words engraved (though for the most part it will agree with them) as for its rising and falling, whether little or much, experience will soon explain it.” This would refer to the customary marks Fair, Change, Rain, Stormy, and concludes a section on “Uses”, which begins “This glass foreshows fair or foul weather, not heat and cold.” This probably explains the frequent entry in the Rydal journal “quicksilver ascending” or “descending”.

The MS. notebook that we have is entitled “the second part”; hence it seems likely that Sir Daniel had begun his daily observations in 1686 in a similar manner. The entries in this “second part” begin in the middle of a month and end abruptly at the foot of a page, which leads one to think that he continued his daily observations beyond April 1693. But any further part has apparently not been found. It would be helpful to know more of the course of the weather in northern England through the very inclement year 1695.

The interest of this three-and-a-half-year sequence of daily observations is two-fold. It provides evidence of the rapid spread of the beginnings of organised science. Sir John Lowther (of Sockbridge), who was then resident for much of the year in London, wrote in a letter to Sir Daniel in May 1683 that “there has lately come over a barometer of the French fashion” and from the letter of 24 April 1686, already mentioned, it would

appear that Sir Daniel was interested in the Royal Society's *Philosophical Transactions*, the first volume of which came out in 1665. In common with many country gentlemen at that time he would wish to know more about this instrument whose behaviour appeared to foretell the weather; outside London, Richard Towneley in Lancashire, Sir Philip Skippon in Suffolk, Dr Robert Plot at Oxford, as well as Richard Leigh in Cheshire and perhaps Dr. Wroe, at Garstang in Lancashire can be named. Moreover Sir Daniel had purchased as early as December 1667, very soon after it was published, *Sprot's History of the Royal Society*, in which he could peruse an illustration of Robert Hooke's "scheme for daily observations". The scheme and abbreviations devised by Sir Daniel are however different; but there was everywhere a broad basis of agreement that the character of the day's weather should be noted as fine or fair, cloudy, showery or rainy and so on, together with the wind direction. Quite a number of contemporary journals have been preserved and can be compared, for example Locke in 1666-1667, Hooke 1672, Skippon 1673-1674, Ashmole 1677-1685, Downes 1681-1694; all of whom were known at the Royal Society. These with others contain enough instrumental observations to be capable of reduction to a common standard (G. Manley, "Central England Temperatures 1659-1973". *Quart. J. Roy. Met. Soc.*, 100, 1974, 389-405. A considerable list of references giving the location of the above-mentioned and other journals is there provided).

It would therefore appear that Sir Daniel's interest stemmed partly from his own reading and was further aroused through Sir John Lowther. The barometer became known elsewhere in Cumberland; the Reverend Thomas Robinson, the active-minded and observant rector of Ousby (1672-1719) who in 1709 published his well-known *Natural History* of these counties (after having commented on the helm wind in his "New Observations . . ." in 1696) seems to have been familiar with the barometer and thermometer before 1700. He may indeed have kept notes on the daily weather, but we have no further evidence. That he observed the clouds appears from his comment on the nearly equal altitudes of Crossfell, Blencathra and Helvellyn from "the falling of the vapours", which we might take to imply the base of level cloud-sheets. There may still be manuscripts as yet undiscovered that will give us further details of Cumbrian weather before 1700.

Not far away, one of the most interesting journals of the weather of those times was kept by Christopher Sanderson at Eggleston in Teesdale, six miles above Barnard Castle. (MS. Gateshead Central Library). He had no instruments, but on a majority of days from 1682-89 he noted the wind direction, with a brief comment on the weather. He does not quite overlap the Rydal record. The latter however can be compared with the entries in the journal of Captain Thomas Bellingham (ed. Hewitson, published at Preston, 1908) while stationed with his regiment at Preston, from August 1688 to June 1689. For example, snow fell on the night of 22 January (N.S.) at Rydal; and on the 23 Bellingham records the weather at Preston as "great frost and snow" with a northerly wind. This suggests a characteristic sharp snowfall providing a cover, followed by a clear sky and the rapid fall of temperature that a radiation night will give when the ground is freshly covered. Both at Preston and Rydal thaw is noted on February 1-2; and there are numerous other correspondences to be found, as one would expect.

In general it is enough to say that the characteristics of the weather at Rydal were very much the same as today. Anyone with a reasonably wide experience of the weather around Ambleside can readily interpret the kind of days that Fleming observed with

particular wind directions, and the associated meteorological situation. It would however not be easy to make much of the pressure readings. These are in single figures representing tenths of an inch. It is extremely unlikely that at the level of Rydal Hall the range of pressure over three years would be restricted to the interval 29 to 30 inches; and further, the need to apply temperature corrections was not then understood. Wind directions are helpful, but again it must be remembered that the Rydal valley runs nearly north-south, and that surface wind is much influenced by the trend of hills and valleys. The fact however that all the eight customary points of the compass appear fairly frequently may mean that he paid attention to the movement of the clouds; it is not always easy to say. The characteristic tendency for lengthy spells of fair weather with wind from N to E, or SE, is well in evidence; for example, much of June and early July in 1690. And correspondingly, we can appreciate the lengthy spells of changeable, showery, rainy (sometimes "much rain") days, although there is not enough evidence to enable one to make an immediate estimate of the quantity of rain.

*Typical entries by Sir Daniel Fleming are:*

- 19 December 1689 (19, "New Style") at 8B. Q3. F. wi, n. we. cl. cold, Fr Ni. Des.  
[at 8 a.m. quicksilver 3, fair with clear sky, wind north, weather cloudy without rain, cold. Frost at night, barometer falling.]
- 12 December 1689 (22, N.S.) at 8B. Q7. R. wi. Sw. we. c. Ha. Ni. St. Snm. As.  
[at 8 a.m. quicksilver 7, rain, wind SW, weather changeable, hail showers, night stormy, snow on mountains, barometer rising.]
- 28 June 1691 (8 July N.S.) at 8B, Q4. c. wi. S. we. F. Hot B. R.3.A. Ni. As.  
[at 8 a.m. quicksilver 4, changeable, wind south, weather fair with clear sky, hot before noon, rain 3 p.m., at night barometer rising.]

Something can be made of the entries mentioning snow, sleet, or "snow on the mountains around Rydal". It is evident that "snow on the mountains" was entered on occasions when a fresh cover was to be seen at some higher level. Little of the ground visible from the Hall rises much above 1,500 feet unless at a considerable distance; and it is reasonable to expect that if fresh snow could be seen lying at that altitude, falling sleet, or melting snowflakes in cold rain would have been observable at Rydal. From the look of what he chose to enter, it does not appear that Sir Daniel paid attention to rainy sleet, or to light passing showers occurring at Rydal; and in this respect he would resemble the average climatological observer today, whose annual total of days with snow, including sleet, will commonly amount to about two-thirds of the total given by an active airfield observer in the same region at the same level. For example, over the 10 years 1961-70 Ambleside averaged 21, Carlisle (airport) 35; Preston at a similar level further south, averaged 22, Manchester (airport) 32. It may be noted that from 1830 to 1870 a good amateur record kept by Alderman Fisher at Kendal gave an average of 23. Observations at Newton Rigg suffer from interruptions; from 1931-50 the average was 22. Supposing then that we count up the Rydal entries, including "snow on the mountains", and tabulate them by the New Style calendar months for comparison with today, we have the table I below.

Table I

Number of days with snow or sleet likely to have fallen at Rydal,  
November 1689 to April 1693 (4 "Winters").

	J	F	M	A	M	J	J	A	S	O	N	D	"Winter"	
1689										(?)	(2)	3	29+	1689-90
1690	11	5	2	3	(2?)	1	—	—	—	1	5	4	29	1690-91
1691	4	(3)	(8)	2	2	—	—	—	—	—	6	4	43	1691-92
1692	10	11	4	5	2	1	—	—	5	(0)	4	3	32+	1692-93
1693	4	3	10	(2)	(?)	?								
Average over four winters													33+	
Probable average at Rydal by similar standards, 1931-70.														
	>5	5	4	2	<1	—	—	—	—	<1	<2	3	23	
Brackets indicate uncertainty, not likely to exceed 1-2 days.														

It is evident that during these four winters the frequency of days with snow or sleet falling at Rydal was appreciably greater than the average today: 33, against about 23 by the standards of "a reasonable amateur". We also know from contemporary London observations that these years were characterised by a greater frequency of snow, in about the same ratio.

What is particularly interesting is that "snow on the mountains", which as we have seen very probably meant sleet observable at Rydal, was twice reported in June (3 June, 1690 and 8 June, 1692) and there were as many as five days in September 1692; at night on the 12 and 13, when the morning wind was entered as west, and again on the 14 with wind SE. It was also noted at night on the 20, after wind W in the morning, and on the 21, wind NE. The 12, 13 and 14 were also particularly noted as cold.

By the standards of this century, for snow to be observed lying even on the highest Lake District summits before the middle of September would be very remarkable indeed. That it fell and lay as early as September 12 on the lower summits around Rydal, with a westerly wind, could support the likelihood that the sea-surface temperatures prevailing between Ireland and Iceland were appreciably lower than today.

In this century the earliest widespread snowfall, which lay briefly in North Yorkshire to below 500 feet, and down to about 1,000 feet on Pendle in Lancashire, was that on the morning of 20 September 1919. Sleet was observed at many stations. In later years it was reported on one day at Newton Rigg in September 1954. From Blencarn Mrs Christine Tudor has noted the frequency of snow-cover on Crossfell since 1949: in September the summit was covered on one day, in 1954, and probably, though not certainly, on one morning in 1974 and one in 1976.

With regard to his other observations, the occurrence of frost is frequently mentioned, but we have not enough comments on its effects to be able to judge its intensity, as whether for example Windermere became frozen over in February 1692, which on other grounds seems possible. The entry "hot" seems from the context to refer to days with clear sky and strong sunshine, rather than unusually warm air. The summer of 1692 was evidently a poor one, but about three weeks of fair cool weather from late in September onward into October was no doubt welcomed.

As far as we at present know, this is the earliest sequence of systematic daily meteorological observations to have been kept within the Lake District, and it testifies to further aspects of the character and accomplishment of that versatile seventeenth-century "Great Squire of Rydal". He was evidently pleased with his observations of his barometer, as in a letter of 15 June, 1688 (Old Style) he writes to Sir J. Lowther to say that "the barometer has gained great credit in the country. A friend asks for one with quicksilver". We can wonder who he was.

Little doubt that there were other men in these Northern counties who followed his example in keeping meteorological observations in an organised way; but it must remain for others to discover them, perhaps in some hitherto neglected manuscript collection. So far, in north-western counties beyond the Ribble, there do not appear to be any more series of daily weather records, in manuscript or in print, until 1756. George Smith, who was then living at Wigton began to send in, for each month, a table of his daily observations of pressure, temperature, wind and weather to the *Gentleman's Magazine*; these he continued to the end of 1759. George Smith was an interesting character with a decidedly active mind who clearly liked to see himself in print; there is a note on him by the present author in CW2 xlvi, 135-44.

Early meteorological observations have in recent years acquired an increased interest throughout Europe, and contributions from this Atlantic fringe would be welcome. That further discoveries may be made has recently been shown in Yorkshire; in a collection of papers recently deposited at the Sheffield Central Library, the remarkably interesting daily weather notes in the diary of William Elmsall of Thornhill near Dewsbury from 1708 to 1740 do much to add to our knowledge for Northern England. In "Palatine Note Book" (Manchester) vol. 2, pp.1-7, for 1882, there is an account of "Silver-tongued Wroe" (Rev Dr Wroe, 1641-1718) who was vicar of Garstang 1684-96; it is said that for several years he kept "an exact diary of the weather glass"; presumably this is now lost.

I have to thank the Officers of the Royal Society for the opportunity to study the correspondence by Towneley preserved in their archives, and the Shell Organisation for a personal research grant to work on old records.