THE BEN NEVIS METEOROLOGICAL OBSERVATORY 1883-1904

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Figure 1. Ben Nevis Observatory in Winter

On 1 October 1904 the meteorological observatory at the summit of Ben Nevis (1344 metres), the highest mountain in Britain and its companion low-level observatory at sea-level in neighbouring Fort William were closed, since the British Government was unwilling to provide sufficient funding to maintain their continued operation. Observations had started at the summit observatory on 28 November 1883, with low-level observations initially being made five times a day by the schoolmaster in Fort William. The building of the low-level observatory was mainly financed by a grant from surplus funds from the Edinburgh Exhibition of 1886 and observations there commenced in July 1890. The 20 years of observations at the summit observatory still provide the most complete set of mountain weather data for the British Isles, since it has not proved possible for modern automatic instruments to maintain uninterrupted operation in the severe weather conditions which are typical of Scottish mountain-tops during the winter half of the year.

In 1877 David Milne Home, chairman of the Council of the Scottish Meteorological Society (SMS), proposed that a meteorological observatory should be established at the summit of the Ben Nevis, and in 1878, having climbed the mountain (at the age of 73), he reported that this was feasible. This was during a period when high-level observatories were being established in many parts of the world, in order to obtain routine observations at higher levels in the atmosphere and hence improve the understanding of the vertical structure of weather systems. Since Ben Nevis lay near to the west coast of Scotland,

directly in the path of Atlantic storms, it was considered a particularly useful site for an observatory. The SMS applied for government funding, without success, being referred from one government department to another.

Meanwhile a remarkable character, Clement Wragge, who had been running 3 meteorological stations at varying altitudes near his home in Cheshire, offered in 1881 to make daily ascents of Ben Nevis during the summer of that year, with the SMS providing instruments. This offer was accepted and Wragge, occasionally relieved by an assistant, climbed the mountain daily from 1 June to mid-October, starting out at 5 a.m. Weather conditions on the mountain were often appalling and his subsequent bedraggled appearance led to his local nickname of "Inclement Wragge". His wife made comparison observations in Fort William. During the summer of 1882, he carried out a more ambitious programme with the help of two assistants, one of whom was Angus Rankin who later worked at the permanent observatory. In 1883 the daily climbs were continued by the assistants.

The observations of Wragge and his assistants showed that the weather conditions at the top of the mountain, even in summer, were much more severe than had been realised previously and that it would be impossible to use standard automatic recording instruments, with a single observer to maintain their operation. Manual recording would be essential. The greatest problem was the severe icing which could occur at any time of the year, although it was naturally greatest in winter. The louvres of the thermometer screen could become rapidly blocked with ice. Wind speeds were much greater than had been encountered at low ground sites, so a very strong building was required.

Wragge's exploits received wide publicity and when a public appeal was launched by the SMS in 1883, there was a very rapid response from throughout the UK. Funds came in so quickly that a start could be made that summer on building the access pony track (with a gradient of not more than 1 in 5) and the first stage of the summit observatory. The building was declared open on 17 October 1883, by the proprietor of the estate which included Ben Nevis, Mrs Cameron Campbell of Monzie, who ascended the mountain on a pony. A showery, northwesterly airstream covered Scotland that morning and the snowline was crossed at about 700 metres, giving those in the party a taste of what life might be like at the new observatory. There had been 19 applicants for the position of Superintendent, including one from Clement Wragge, but the directors decided to appoint Robert Traill Omond and a disappointed Wragge left for Australia. Omond, who had worked with Professor Tait at Edinburgh University, proved to be an excellent choice.

The first winter was a very stormy one and there were gaps in the observations, when it proved impossible for the observers to dig themselves out of the building, or it was too dangerous for them to attempt to reach the instruments. The following summer the building was enlarged, with a prefabricated wooden tower being added to provide an exit in deep snow conditions and to support the Robinson anemometer.

Observations were made hourly of pressure, dry and wet bulb temperature, precipitation (with snow being melted to give the equivalent rainfall), wind speed and direction and

visibility. Since for a large part of the year the anemometer was too iced up to be used, the wind force was estimated by the angle at which the observers could lean into the wind. These estimates were calibrated against the anemometer when it was working and it was found that the actual wind speed for a given force was much greater than the wind speed for the same force on the Beaufort scale. This difference needs to be taken into account when using the Ben Nevis wind data.

During the summer, standard Stevenson screens were used for temperature measurements, but in winter the screens were mounted on ladder-like stands so that they could be moved up or down as the snow level varied. Duplicate screens were kept, so that if a screen became badly iced up it could be taken indoors to thaw out and replaced with a new screen. Raingauges were exchanged each hour, with the actual measurements being made inside the observatory. The observers were only too aware of the problems involved in measuring precipitation when much of it fell as snow.

The low-level observatory was equipped by the Meteorological Office in London, with standard photographic recording instruments for pressure and temperature and with a Beckley self-recording raingauge for precipitation.

A notable feature of Ben Nevis weather was the very high frequency of hill fog at the summit. For the months of November, December and January this was observed for almost 80% of the time and only in May and June did the frequency fall to about 55%. Because of the maritime climate, mean winter temperatures were about -5˚C, giving ideal conditions for a rapid build up of rime on all exposed surfaces.

The winds at the summit were very strongly affected by the topography of the mountain, with its narrow plateau area and 600 metre cliffs immediately to the north of the observatory. It appears that westerly or northwesterly “free air” winds were deflected around the western flanks of the mountain and were observed as relatively light but very gusty northerlies. It was not appreciated at the time that this was a local effect and not a general feature of the variation of wind direction with height.

The observatory provided an excellent location for a field laboratory, with hygrometric experiments being carried out by Dickson (1886) and Herbertson (1905). The Aitken dust counter was used in a series of experiments between 1891 and 1894 (Aitken, 1902). C T R Wilson, when a student, acted as a relief observer for two weeks during the summer of 1894 and was so impressed by the glories and corona that he saw, that he began laboratory experiments on clouds formed by the expansion of moist air. From these experiments he eventually developed the cloud chamber, one of the most important tools used in atomic physics research and for which he received the Nobel Prize for physics in 1927. Among those who worked for longer periods at the observatory were R C Mossman, who was the meteorologist on the Scottish Antarctic expedition of 1902-1904 and W S Bruce, the leader of that expedition.

The hourly observations were published in full in the Transactions of the Royal Society of Edinburgh (1890, 1902, 1905, 1910a, 1910b), together with summary tables and the

observatory log-book. There were many papers published at the time in the Journals of the Scottish Meteorological Society, chiefly by Alexander Buchan, Secretary of the SMS, R T Omond, R C Mossman and Angus Rankin. Although the daily observation sheets were sent to the Meteorological Office in London, it appears that no attempt was made to use them to improve forecasting.

The annual cost of running the observatories was £1000, but government grants were only £350. Several times closure was threatened, but generous donations from private individuals temporarily alleviated the problem. Then in 1902 the SMS was told that the grants would be withdrawn at the end of that year. There was a public outcry in Scotland and a Treasury Committee of Enquiry was set up to look into the administration of the annual grant of £15,300 to the Meteorological Council. Sufficient funds were obtained to keep the observatories going until the Committee was due to report in 1904, but they only recommended that the annual grant of £350 should continue, ignoring the evidence from the SMS that the sum required was about £950 per annum. The Directors issued a Memorandum which said "It is to the Directors a matter of profound disappointment that in this wealthy country it should have been found impossible to obtain the comparatively small sum required to carry on a work of great scientific value and interest, and that they are now obliged to dispose of the Observatory buildings and dismiss the staff".

The principal aim of the SMS in setting up the Ben Nevis Observatory was to improve weather forecasting, but little progress in this was achieved at the time, although in retrospect the hourly observations provide many clues to frontal theory, later developed in Scandinavia. In contrast to the present, there was then little interest in mountain weather *per se*, but the old data are still of great value (Roy, 2004).

References

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Biographical sketch

Joined the UK Met Office in 1961 and in 1981 was appointed as Superintendent of the Edinburgh Meteorological Office, the climatological office for Scotland, which holds the Scottish weather archives, including the Ben Nevis observations. Retired in 1990 and completed an M Phil in meteorology at Edinburgh University in 1995. Became the honorary secretary of the Scottish Centre of the Royal Meteorological Society in 1997.