THE CONTRIBUTION OF ALEXANDER BUCHAN TO THE DEVELOPMENT OF CLIMATOLOGY AND SYNOPTIC METEOROLOGY

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Alexander Buchan (1829-1907) was appointed as the paid Secretary of the Scottish Meteorological Society (SMS) in December 1860 and continued in that post until his death in 1907. His contribution to climatology is generally well known, but he also played an important role in the early development of synoptic meteorology. This role was emphasised by Hildebrandsson and Teisserenc de Bort (1898) in their historical revue of the basis of dynamical meteorology.

During the early 1860's there was no general agreement on the best method of constructing synoptic charts and a common practice was to plot the departure of pressure from the average for each observing station, rather than convert the pressure to sea-level. This was the method that had been used by Buys Ballot in the Netherlands, when he formulated the law which bears his name.

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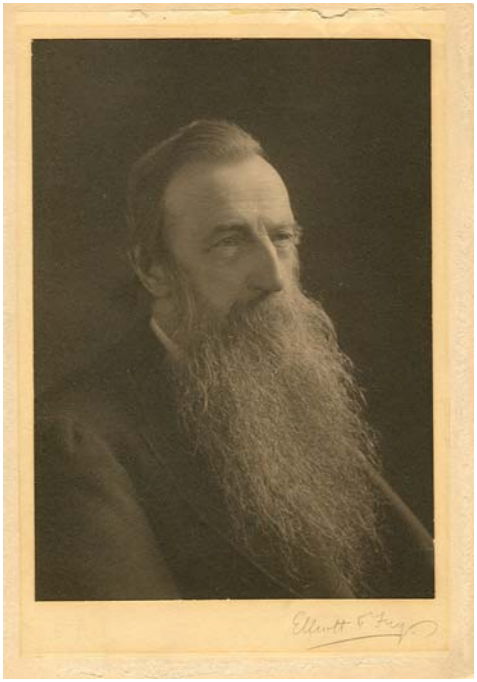

Alexander Buchan

From the autumn of 1863 the daily bulletin issued by the Observatoire de Paris, under Le Verrier, contained routine synoptic maps of surface pressure over part of Europe, using information obtained by telegraph from France and other countries of Europe. Buchan saw the merit of using surface pressure charts and, although he did not have access to real-time observations, he used his skill in handling large amounts of data to construct a series of 18 charts on which the movement and development of storms across Europe could be followed on a daily basis during certain periods in the months of October, November and December 1863 (Buchan, 1865). Much of the original data was in the form of station level pressure, which had to be converted to sea level, once the station height had been ascertained. The maps also included observations of wind speed and direction and Buchan was able to give a series of general rules describing the relationships between the pressure and winds fields. These rules provided an extension of Buys Ballots law and confirmed that (in the Northern Hemisphere) the air circulated in a counter- clockwise direction around a depression, with a component towards the centre of the depression. The wind speed was shown to be proportional to the closeness of the isobars – the barometric gradient, a nomenclature introduced by Thomas Stevenson of the SMS in 1868.

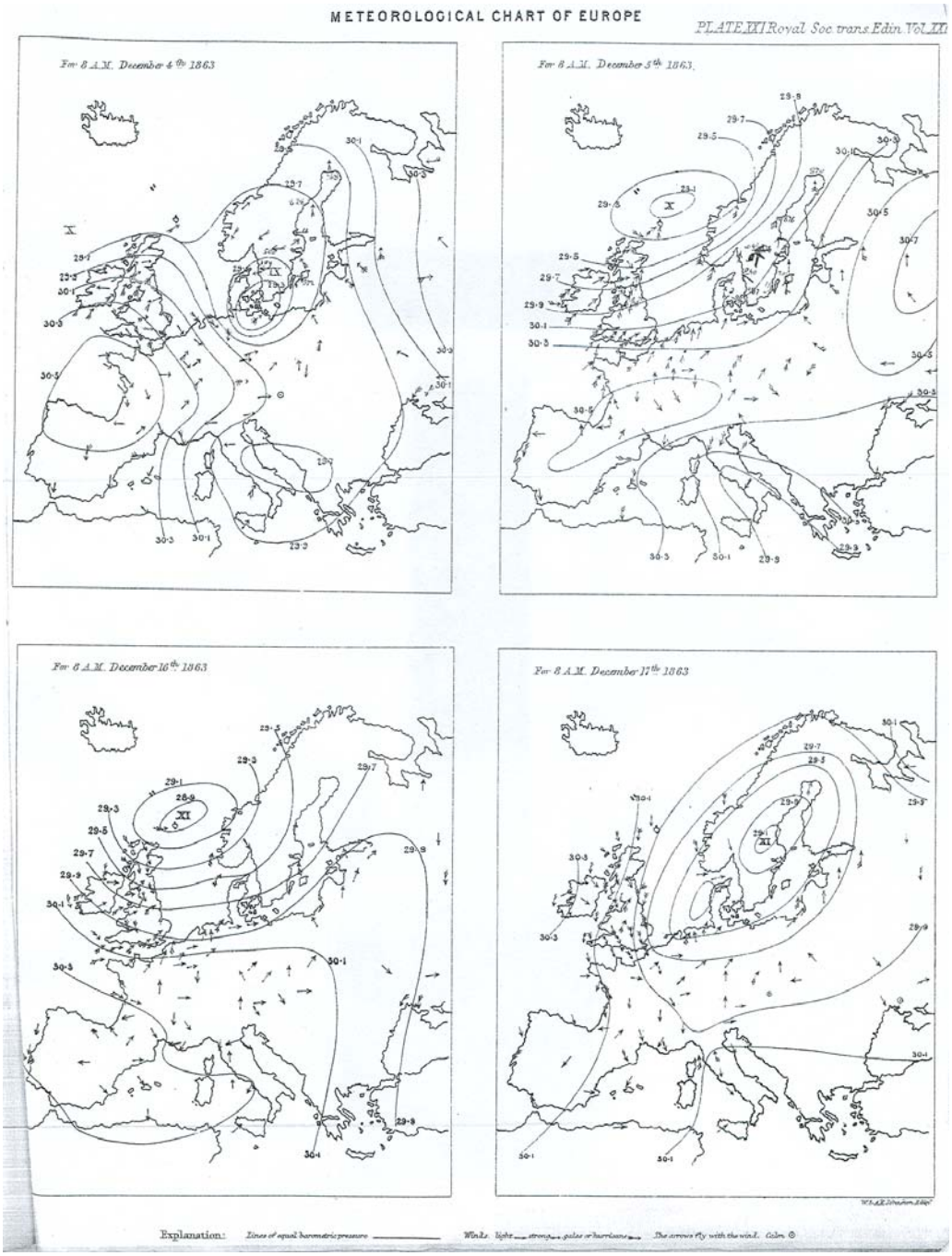

Figure 1. Isobar Charts for 4, 5, 16 and 17 December 1863 (from Buchan 1865)

Buchan also studied the trajectory and speed of movement of the centres of the depressions and the temperature pattern relative to the centre. The results of these investigations became widely known through their inclusion in the second edition of his "Handy Book of Meteorology" (1868a). He later (Buchan, 1868b) constructed isobar charts covering North America, the North Atlantic and Europe for the period 13 to 22 March 1863, using ships logs as well as land station observations and showed that the same relations applied.

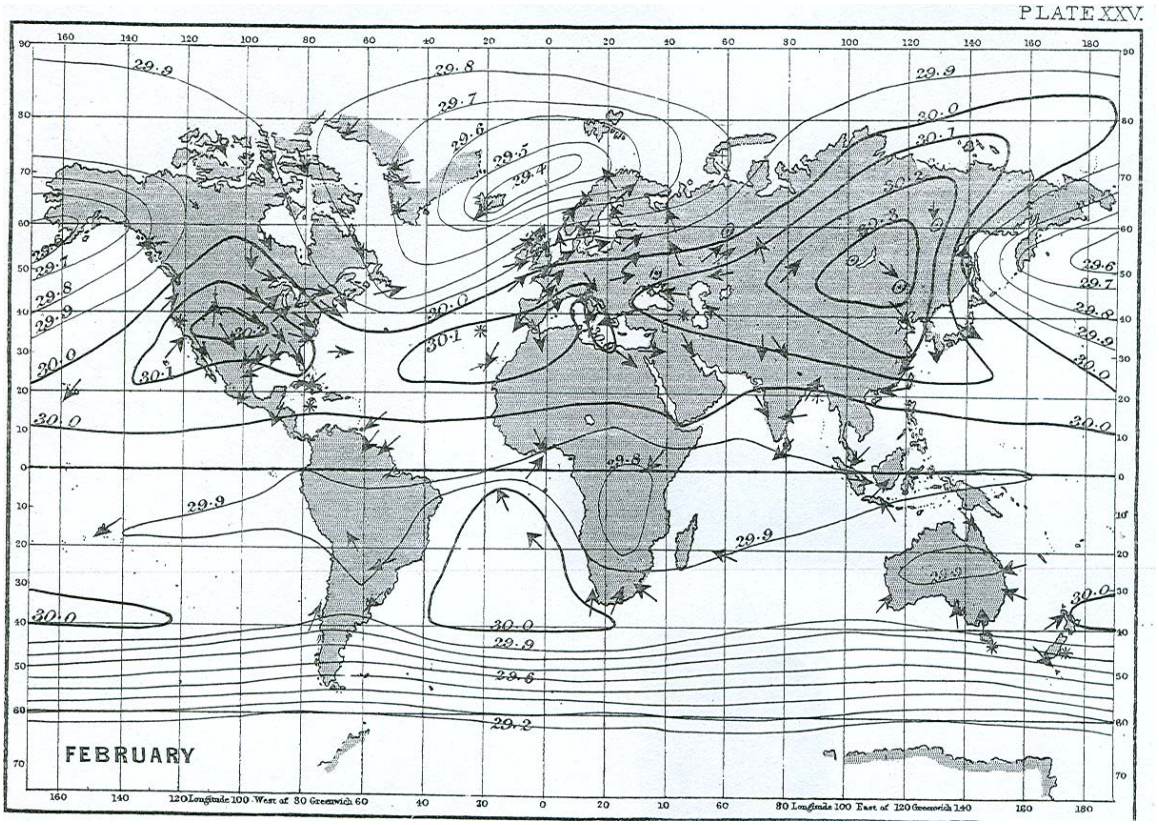

Figure 2. Mean Pressure and Winds for February (from Buchan 1869b)

He then extended the concept of combining pressure and wind data to a climatological and global scale, with the publication in 1869 of two papers on "The Mean Pressure of the Atmosphere and the Prevailing Winds over the Globe for the Months and for the Year". These papers were considered by Hann (1907) "to have exercised the greatest influence on the further development of the science". As more data became available, the global maps were improved and extended into the polar regions, with the publication in 1889 of the elegant series contained in the Atmospheric Circulation part of the Challenger Report.

His contribution to the understanding of the climate of the British Isles was immense and he published many papers on the subject, predominantly in the Journals of the SMS. Maps of average temperature, rainfall and pressure for Scotland and for the British Isles were produced and refined as more stations and longer observation periods became available. He devised methods for the correction of data and the extension of incomplete records.

He was a major supporter of the proposal by the SMS to set up a mountain observatory at the summit of Ben Nevis (1344 metres), the highest mountain in Scotland. This operated from 17 November 1883 to 1 October 1904. He specified how the hourly observations should be made, supervised their publication, and produced many valuable papers based on the data recorded. He made little progress, however, in his attempt to find a way of using the observations from Ben Nevis and its companion low-level observatory in Fort William to improve weather forecasting, partly because the depth of atmosphere sampled occupied only a small part of the troposphere

and partly because his approach to the problem was too climatological. He was still working hard on this study at the time of his death in 1907.

Buchan's name is still often quoted in references to "singularities", after he noted apparent interruptions in the smooth annual progression of temperature (so-called Buchan Spells) in Scotland. He attributed these to a tendency for changes in the pressure pattern to occur around specific dates, but pointed out that the actual dates could vary from year to year and that such changes were not observed every year.

Buchan's contribution to meteorology was widely acknowledged. He was one of the two British representatives to the international congresses in Leipzig (1872) and Vienna (1873), which standardised methods of making and reporting weather observations. From 1887 to 1904 he served on the Council which supervised the administration of the UK parliamentary grant for meteorology.

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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.