Luke Howard, Namer of Clouds

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Abstract

Luke Howard (1772–1864), who was born 250 years ago this November, was an amateur meteorologist, whose lifelong fascination with skies and weather led him to devise the classification and nomenclature of clouds that remains in international use today. He was also a pioneer in the study of urban climate, his 40-year instrumental record of London's weather forming the heart of his landmark publication, *The Climate of London* (2 vols, 1818–1820), for which he was elected a Fellow of the Royal Society in 1821. This article offers an overview of his meteorological life and achievements.

Luke Howard, who was born 250 years ago this November, was a pharmacist by profession, but a meteorologist by inclination, whose lifelong fascination with the weather led him to devise the classification and nomenclature of clouds that remains in international use today. He was also a pioneer in the study of urban climate, his forty-year instrumental record of London's weather forming the heart of his landmark publication, *The Climate of London* (2 vols, 1818-20), for which he was elected a Fellow of the Royal Society in 1821.

Born in the Old Street area of London to devout and commercially successful Quaker parents, Luke Howard was sent at the age of eight to a strict Quaker boarding school in Burford, Oxfordshire, where the rote-learning of Latin grammar dominated the curriculum to the exclusion of science and mathematics. 'My pretensions as a man of science are consequently but slender', he later wrote, though his lifetime habit of weather observation was established during his time at school, where the south-facing view from his dormitory window afforded a fine view of the Oxfordshire sky (Hamblyn, 2001). He was struck by the sky's constantly changing patterns, remembering 'one remarkable configuration of the Clouds in a full sky, because it was of rare occurence', and was also fascinated by the lurid sunsets of 1783 that resulted

from the sulphurous haze thrown up by the Laki fissures eruption in Iceland (Scott, 1976). Back home in London, Howard set up a small meteorological station in his parents' garden, consisting of a rain gauge, a thermometer and an inexpensive recording barometer, the gravel path to which was referred to by the family as 'Luke's Walk'.

Howard subsequently served a seven-year apprenticeship with a pharmacist in Lancashire, and it was during this period that he began to spend his evenings studying French, chemistry and the natural sciences. On his return to London in the early 1790s, Howard intensified his autodidactic regime, attending regular lectures and evening classes around the city, where he made the acquaintance of other young Dissenters, many of them fellow Quakers, who, debarred from attending English universities, as well as from joining the traditional guilds, looked elsewhere for education and employment. In 1796, a group of these young Dissenters established their own scientific debating club, which they named the Askesian Society (from the Greek for 'training'). At weekly evening meetings, held in the basement of the Plough Court pharmacy, off Lombard Street, members and visiting speakers gave lectures and demonstrations on a range of subjects including galvanism, gunpowder, chemical attraction, divining rods, laughing gas, ventriloquism, and the malleable properties of zinc. And it was there, in December 1802, that the 30-year-old Luke Howard presented the first draft of his influential paper on 'The Modifications of Clouds'.

By this time Howard was settled with a young family in Plaistow, to the east of London, having taken over the management of a chemical manufacturing laboratory. At Plaistow, Howard built a small meteorological observatory on the roof of his house, and began to write up his notes and observations in a systematic way, framing them in the light of recent atmospheric theories, such as those advanced by the Manchester Quaker John Dalton in his *Meteorological Observations* of 1793. Dalton's contention that condensed cloud droplets do not 'float', as previously thought, but fall continually under the influence of gravity, was instrumental in shaping Howard's conviction that clouds, far from being 'airy nothings', were subject to 'the same fixed Laws which

pervade every other department of Nature' (Howard, 1804). His simple but penetrating insight, based on years of direct observation, was that clouds might have many individual shapes, but they have few basic forms. It was in the Askesian lecture that he first proposed that every cloud belonged to one of only three principal families, to which he gave the descriptive Latin names: *Cirrus* (meaning 'fibre' or 'hair'), *Cumulus* ('heap' or 'pile'), and *Stratus* ('layer' or 'sheet'). A fourth term, *Nimbus* ('rain-cloud') was reserved for what Howard considered to be a rainy combination of the latter two.

Every kind of visible cloud, he argued, was either a modification of or a transition between one or more of the three major types, with intermediate or transitional forms named according to their relation to the principal clouds. So a high, wispy *Cirrus* cloud that descended and spread into a sheet (or *stratum*) was named *Cirrostratus*, while groups of fluffy *Cumulus* clouds that joined up and spread across the sky (again, into a *stratum* or sheet) were named *Cumulostratus*.

Howard had not been the first to attempt a classification of clouds — only the previous year Jean-Baptiste Lamarck had proposed a list of descriptive terms in French — but the success of Howard's system was due in part to his use of universal Latin (his school curriculum had finally come in useful), but mostly to his emphasis on the ceaseless mutability and inter-modifications of clouds. By applying Linnean principles of natural history classification to phenomena as short-lived and changeable as clouds – with their capacity to transfer allegiance from one type to another within the space of a few minutes – Howard had arrived at an elegant solution to the problem of naming transitional forms in nature.

The editor of London's *Philosophical Magazine* was in the audience that evening, and he encouraged Howard to write up his lecture for publication. The 'Essay on the Modifications of Clouds' appeared in the *Phil. Mag.* in 1803, then in booklet form in 1804, complete with engravings of the seven named clouds, based on Howard's own watercolours (he was an accomplished draughtsman). German and French translations soon followed, and an expanded edition appeared in 1832, by which time the cloud

terminology that Howard had bestowed was in circulation around the world (Day & Ludlam, 1972).

Following the publication of the essay, Howard continued his meteorological activities, contributing weather columns to a variety of journals, while continuing to keep twice-daily meteorological readings. It was from these instrumental records that Howard put together the first volume of *The Climate of London* (1818), a pioneering work of urban climatology (the second volume appeared in 1820), in which he made an early identification of what later became known as the urban heat island, 'an artificial warmth, induced by its structure, by a crowded population, and the consumption of great quantities of fuel in fires', as he presciently described it, referring to London's smoke-heavy atmosphere as 'city fog' (Howard, 1833). His instrumental records had indicated that the urban centre was warmer at night than the surrounding countryside; under a table showing a nine-year comparison between temperature readings in London and those in the country, he noted that 'night is 3.70° F warmer and day 0.34° F cooler in the city than in the country' (Howard, 1833).

In 1821 he was elected a Fellow of the Royal Society, and in 1823 he became a founder member of the Meteorological Society of London – a forerunner of today's Royal Meteorological Society –, but the following year he and his wife moved to Ackworth, Yorkshire, leaving the family pharmaceutical business in the hands of their sons. Howard's life in Yorkshire became largely devoted to charitable and educational work, though he continued with his meteorological researches. In 1842 he published an unconvincing treatise identifying an eighteen-year cycle in British weather, comprised of a seven-year rise followed by a ten-year fall in average temperature and rainfall; this was followed by his *Barometrographia: Twenty Years' Variation of the Barometer in the Climate of Britain* (1847), a visually impressive folio volume in which fluctuations of barometric pressure were plotted against the phases of the moon, in an attempt to determine the extent of lunar influence on climate. Howard had collected two decades'-worth of air-pressure data using a self-recording barograph clock (now in the collection of the Science Museum in London), the large circular print-outs from which were

reproduced in full colour, and copiously annotated; if *Barometrographia* has become a footnote in the history of meteorology, it can be considered a landmark in the history of data visualisation.

Meteorology, meanwhile, was beginning to be organized on an international footing, and over the following decades Howard's original cloud classification would be refined and enlarged in accordance with new observations and insights. The first of many changes to be made was the addition of *Stratocumulus*, a term suggested in 1840 by the German meteorologist Ludwig Kaemtz, who was keen to distinguish those rolling masses of greyish cloud from what Howard had termed '*Cumulo-stratus*: the *Cirro-stratus* blended with the *Cumulus'* (Kington, 1969). Kaemtz's inversion of the compound terms removed the cloud from the convective Cumulus family and placed it in the category of Stratus, assigning it a more suitable position within the family of low pressure clouds. Howard's original term ('*Cumulo-stratus'*) was soon dropped from the classification in favour of *Stratocumulus*, now defined as 'a layer of cloud, not flat enough to be called pure *Stratus*, but rising into lumps too irregular and not sufficiently rocky to be called true *Cumulus*' (Abercromby, 1887).

In the 1850s, Émilien Renou, director of the French meteorological observatories, proposed two further additions to the classification, in the form of *Altocumulus* and *Altostratus*, the term *alto* derived from the Latin for 'elevated'. Both these new cloud genera, as Renou pointed out, were medium-level clouds, with their altitude emphasized in the names he bestowed, since, as he argued, a cloud's altitude had a significant shaping influence on its form. Renou's suggestion gave strength to the case for adopting altitude as the principal criterion for grading the families of cloud. This idea would be taken up by observers all over the world, and in September 1896 — 'The International Year of Clouds' — the International Meteorological Congress (IMC), at their annual conference in Paris, formally adopted an expanded, ten-fold, version of Howard's original seven-part classification as the official global standard, with altitude promoted as the primary division of cloud identification. This new classification was published in the first, multi-lingual, *International Cloud Atlas* (IMC, 1896), a review of which, in the

Quarterly Journal of the Royal Meteorological Society (Jan. 1897), pointing out that 'no one can examine this Atlas or study the subject without seeing that the foundation was laid by Luke Howard' (Hamblyn, 2001).

The ten-genera classification in its current form is given in Table 1:

High Clouds:	0	Cirrus (Ci) *Howard, 1803*
base usually above 6km/>20,000 ft	1	Cirrocumulus (Cc) *Howard, 1803; Renou, 1855*
	2	Cirrostratus (Cs) *Howard, 1803; Renou, 1855*
Medium Clouds:	3	Altocumulus (Ac) *Renou, 1870*
base usually between 2 & 6km/ 6,500 & 20,000ft	4	Altostratus (As) *Renou, 1877*
	5	Nimbostratus (Ns) *International Commission for the Study of Clouds, 1930*
Low Clouds:	6	Stratocumulus (Sc) *Kaemtz, 1841*
base usually below 2km/<6,500ft	7	Stratus (St) *Howard, 1803; Hildebrandsson and Abercromby, 1887*
	8	Cumulus (Cu) *Howard, 1803*
	9	Cumulonimbus (Cb) *Weilbach, 1880*

Current WMO classification of the ten cloud genera (with dates of their formal adoption)

The intervening period has seen the names of numerous cloud species and varieties added to the ten genera (which in 1930 saw Howard's *Nimbus* replaced by *Nimbostratus*), along with the names of a range of accessory clouds, such as *velum* ('veil cloud'), or *pileus* ('cap cloud'), and of supplementary features, such as *incus* ('anvil'), or *virga* ('fallstreaks'), all of which appear in conjunction with the principal cloud types (Hamblyn, 2021). And the processes of naming and classification are ongoing: the most recent edition of the *International Cloud Atlas*, which was published, in digital form, on World Meteorological Day (23 March) 2017, featured twelve new cloud names, the first to be added since 1951, when *intortus* ('twisted') joined the list of cloud varieties.

Among the notable new additions in 2017 were the names of several special clouds, including *silvagenitus* (clouds formed by evapotranspiration from the tree canopy), *cataractagenitus* (clouds formed in the vicinity of large waterfalls), and *flammagenitus* (convection clouds formed above forest fires or volcanic eruptions) (WMO, 2017).

On reflection, it is remarkable that these natural atmospheric phenomena, which have been observed for millennia, have only just been named for science, along with several, more recent, anthropogenic cloud-forms such as *homogenitus* and *homomutatus* (spread-out aircraft contrails, now among the most common high-altitude clouds on Earth). It is heartening to know that, more than two centuries after he quietly proposed those four Latin names – *Cirrus*, *Cumulus*, *Stratus*, *Nimbus* – Luke Howard's mutable language of the skies continues to be refined and expanded, in global communion with our evolving understanding of the atmosphere. 'Never, probably, was Science wooed more entirely for her own sake', as his obituary in the *Friend* (1864) concluded; 'never was there a more thorough "labour of love" than that which he bestowed'.

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