CAROLINE HERSCHEL; 1750 - 1848

Early years in Germany

Caroline Herschel, born 16th March 1750 (German calendar), 1751 (British calendar) in Hanover. One of 10 children (only 6 survived to adulthood), 4th daughter; father was a military musician.

Older brothers William, Jacob, Alexander. Younger brother Dietrich.

Mother was a typical German *hausfrau*; religious, only domestic interests, mystified by her husband's intellectual interests, did not see the need to stretch her children intellectually. She could neither read nor write.

Caroline had a deep-seated desire for self-improvement, and was mentally well-equipped.

Her brothers were trained as musicians. She was refused an education because she was a girl; her father advised her that she was unlikely to marry as she was neither handsome nor rich. Her role in life was to be housekeeper to one of her brothers.

After her father's death brother Jacob would not allow her to have French lessons, but she was allowed to go to sewing classes provided she confined her efforts to making clothes for him. He believed that a sister's job in life was to contribute to ones comfort. It is hard to see in this young woman the one who was to share in her brother's triumphs, and to secure international recognition as an astronomer in her own right.

It was her elder brother William who rescued her, at age 22, and brought her to England. (But Jacob required him to provide the cost of a servant who would take Caroline's place in the Hanover house.)

William brought her to Bath in 1772, to train as a singer. She also learnt English, arithmetic and book-keeping. She had a good voice (soprano) and considerable ability. She sang solo parts in The Messiah and Judas Maccabeus; she was doing up to 5 performances a week in Bath and Bristol - with William conducting. She refused to perform except under his direction.

She was serious-minded and found the Bath social life and etiquette trying and irrelevant. She was frail and physically slight, but made of tough stuff.

As William's housekeeper she had to supervise the servants; she probably brought the worst out in them, by always suspecting them to be lazy and dishonest.

William

William was at that time choirmaster, gave private music lessons, and was organist at the Octagon Chapel in Bath. He played the violin, the oboe and the harpsicord and composed. His true bent, however, was scientific rather than musical.

His interest in optics and astronomy grew and starting roughly at the time Caroline arrived, music ceased to be his first interest, and in summer 1773 he began making his own telescopes. By the end of 1773 he was casting his own mirrors. He pursued astronomy with ferocious energy and tenacity, undertaking large projects. Caroline regretted that almost every room in the house had been turned into a workshop, and that lace ruffles were getting spattered with molten

pitch. While making a 7' mirror he worked 16 hours continuously on it - Caroline fed him mouthfuls of food so that he would not have to take his hands off the work.

He greatly improved telescope optics. By 1795 he had made at least 200 mirrors of 7' focal length, 150 of 10' and 80 of 20'. He always made seveeral for the current telescope, and selected the best. He made telescopes of greater magnification and greater grasp. His most famous telescope was 40' long, and 4' in diameter; however it was less successful than the 20' telescope with which he and Caroline did much of their important work.

Astronomy

William discovered Uranus in 1781 (probably becaue he had the best telescope in the world) and was appointed court astronomer by William III. At this point he gave up music altogether. It was he who demonstrated the existence of infrared radiation in the solar spectrum (with a thermometer mounted beyond the red end of the spectrum), and with Caroline as his assistant he made catalogues of stars, of nebulae and clusters of star, of double stars, and began to consider the 'structure of the heavens'. They founded stellar (as opposed to planetary) astronomy.

They were living at Windsor at this stage and had frequent distinguished visitors; whenever the Royal family were feeling bored or had visitors they didn't know what to do with, they bundled into a coach and went round to the Herschels' place to see the telescopes. The Herschels' visitors book reads like something out of Debretts! But during these visits it became clear to these visitors that Caroline knew what was what every bit as well as William.

Caroline helped with the design and building of the telescopes, (she pounded horse manure to make the mould for a new mirror), but it was in the use of the telescopes to map and catalogue the heavens that she played an essential role. They had a very efficient observing system: William worked at the telescope, calling out the transits while Caroline, his collaborator, sat within earshot at a small table equipped with a clock and pointer showing the telescope azimuth, noting the time of each. This way he was able to remain dark-adapted, and did not have to lose his night-sight by coming to write down his observations at a lamp-lit desk. They discovered variable stars, the ice caps on Mars, the heights of the mountains on the moon, the rotations of the moons of other planets. Together the catalogued 2500 new nebulae and clusters of stars and 1000 double stars (these gave the first evidence of gravity working outside the solar syatem).

They worked whenever weather permitted; there is a note about Thames flood water lapping at the bottom of the garden, and one night when the temperature dropped to 11°F the ink froze and William's feet became fastened to the ground by ice! Caroline also made the cups of coffee, and thawed frosted clothing.
In 1787 the King gave Caroline an annual salary - the first time a woman had been made assistant to the court astronomer.

Caroline also trained as an observer, and William gave her a telescope of her own to use when he was away; it was described as a comet sweeper. With this she found 8 comets and computed their orbits; she also found several star clusters and a number of new nebulae. On August 1st 1786 she became the first woman to be recognised for discovering a comet. She knew the skies so well that the appearance of anything unusual was apparent to her. She became known throughout Europe as a astronomer in her own right.

$-12^{\circ}C$

$\frac{(1-32)}{2} = \frac{9}{5}$

$C = \frac{5 \times (-21)}{9} = \frac{-105}{9} = -12$

When they started making observations she needed to learn more maths; through asking William pertinent questions at the breakfast table she taught herself spherical trig and logarithms.

During the day she wrote up the previous night's observations, calculated the stellar positions, prepared catalogues for publication, ran the house, supervised the workmen if William was away, and perhaps got some sleep.

When William married in 1788 Caroline no longer had to housekeep for him, and this led to a productive period for her. She also was able to forge her own friendships. Through an acquaintance from Hannover days, now working at the Palace, she became known to the Royal Princesses who were interested in astronomy and sought out the company of the famous woman scientist.

After William

William died at age 84 in 1822. Caroline felt lost without him, and immediately after the funeral returned to Hanover.

Her brother William had been her lifeline, so small wonder that she completely identified with all his interests, sublimating her own. She was extremely self-effacing, reflecting all the praise she received back to him. She appears to have been without personal ambition, and underestimated her own abilities. After William's death she published a catalogue of the 2500 nebulae they had observed 'Reduction and arrangement in the form of a catalogue in zones of all the star clusters and nebulae observed by Sir William Herschel'. Caroline's name only appears in pencil underneath the title - added by her nephew John. In her public utterances she underrates her own contributions; did she really feel so inferior? Or was it the only way to be a lady and do science? One cannot tell; that tactic would have been socially very acceptable - and she wouldn't be the only able woman scientist to have to play it that way. She was caught between her achievements and the prevailing social attitudes that defined women's role in science as that of uncredited assistant. Her self-deprecation is understandable given the limitations of her background, her education; these made her scientific successes unprecedented.

During her retirement in Hanover eminent astronomers and Royalty came to call on her. She was pointed at in the street, honoured by the Palace and saluted with the profoundest respect at theatre or concert. In 1828 the Royal Astronomical Society awarded her a Gold Medal; she was the first woman to win one of their gold medals; she is the only woman to have won one of their gold medals, and 160 years were to elapse before any other woman won any award from the RAS (me in 1989). She stands tall. She received another gold medal, on her 96th birthday, from the King of Prussia...'in recognition of the valuable services rendered to astronomy by you as the fellow worker of your immortal brother, Sir William Herschel'. She was made an Honorary Member of the RAS in 1835 and in 1838 the Royal Irish Academy made her a member.

She died in 1848 at age 97. Her end was said to be tranquil and free from suffering - a simple cessation of life. By order of the Princess Royal palm brances were strewn on her coffin.

Obituary

She was the greatest woman astronomer of her day, and unsurpassed for decades to follow. Her memory lives, for her own work and as collaborator with her brother for their seminal work.

The RAS obituary notice concludes:

> Her memory will live, with that of her brother, as long as astronomical records of the last and present century are preserved: and it will live on its own merits, even though, as may reasonably be hoped, the time should come when the astronomical celebrity of a woman will not, by the mere circumstance of sex, be sufficient to excite the slightest remark.

This was written in 1848 by an august, distinguished, professional body that had not yet admitted women to membership; and it talks of the time coming when the gender of an eminent female astronomer will not cause comment! Caroline Herschel must have had an enormous impact!

I am active, adventurous, aggressive, assertive, curious, energetic, enterprising frank, independent and inventive

Needless to say, this hasn't won me many friends.

Why are women leaving or falling behind?

- Domestic/caring responsibilities
- Mobility problems
- Educational/cultural conditioning
- Playing field not level
- Wrong game

International Astronomical Union Membership

Countries with > 50 members

Country	Number of members	% female
Argentine	65	31
France	561	26
Mexico	55	20
Russia	264	19
Ukraine	84	18
Italy	373	17
Spain	161	14
Brazil	87	14
Poland	94	13
Belgium	81	12
Greece	89	11
China PR	292	9.3
USA	2069	8.6
Czechoslovakia	94	8.5
Denmark	50	8
NL	162	7.4
UK	481	6.6
Canada	206	6.3
Australia	173	5.2
Sweden	84	4.8
Germany	429	3.7
Switzerland	55	1.8
Japan	350	1.4