

march of astronomy has, within the last decade [1885-1895] assumed a triumphal character. The victory can never be completely won; the march can never reach its final goal; but spoils are meanwhile gathered up by the wayside which eager recruits are crowding in to share. The heavens are, year by year, giving up secrets long and patiently watched for, while holding in reserve many others still more mysterious. There is no fear of interest being exhausted by disclosure.—AGNES M. CLERKE.

CAROLINE HERSCHEL'S DEVOTION TO HER BROTHER.

Miss Herschel was business-like and matter-of-fact. But her devotion [when William Herschel was in the first fervor of telescope making] triumphed over her common-sense. Keeping her misgivings to herself, she met unlooked-for demands with the utmost zeal, intelligence, and discretion. She was always at hand when wanted, yet never in the way. Through her care, some degree of domestic comfort was maintained amid the unwonted confusion of optical manufacture. During the tedious process of mirror-polishing, she sustained her brother physically and mentally, putting food into his mouth, and reading aloud "Don Quixote," and the "Arabian Nights." She was ready with direct aid, too, and "became in time as useful a member of the workshop as a boy might be to his master in the first year of his apprenticeship." "Alex," she continued, "was always very alert, assisting when anything new was going forward; but he wanted perseverance, and never liked to confine himself at home for many hours together. And so it happened that my brother William was obliged to make trial of my

abilities in copying for him catalogues, tables, and sometimes whole papers which were lent him for his perusal." —AGNES M. CLERKE.

CAROLINE HERSCHEL AS ASSISTANT KING'S ASTRONOMER

Miss Herschel [when officially appointed assistant to her brother who had been made the "King's Astrono-



CAROLINE HERSCHEL.

mer"] set to work with a will to learn all that was needful for her untried office. Not out of books. "My dear brother William," she wrote in 1831, "was my only teacher, and we began generally where we should have ended; he supposing I knew all that went before." The lessons were of the most desultory kind. They consisted of answers to questions put by her as occasions arose,

tumn of 1783, two nebulae of first rate importance. She was by this time more than reconciled to her astronomical lot; Von Magellan, indeed, reported in 1785, that brother and sister were equally captivated with the stars.

On August 1st, 1786, her brother's absence leaving her free to observe on her own account, she discerned a round, hazy object, suspiciously resembling a comet. Its motion within the next twenty-four hours certified it as such, and she immediately announced the apparition to her learned friends, Dr. Blagden and Mr. Aubert. The latter declared in reply, "You have immortalized your name," and saw in imagination "your wonderfully clever and wonderfully amiable brother shedding," upon receipt of the intelligence, "tears of joy." This was the first of a series of eight similar discoveries, in five of which her priority was unquestioned. They were comprised within eleven years, and were made, after 1790, with an excellent five-foot reflector mounted on the roof of the house at Slough. Considering that she swept the heavens only as an interlude to her regular duties, never for an hour forsaking her place beside the great telescopes in the garden, her aptitude for that fascinating pursuit must be rated very high.—AGNES M. CLERKE.

READERS' AND STUDENTS' NOTES

1. For ordinary readers the standard life of Herschel is that by Dr. Edward S. Holden, director of the Lick Observatory, entitled "*Life and Works of Sir William Herschel*" (New York: Scribners, \$1.50). It is a brief and eminently readable work and has the merit of containing an excellent bibliography of Herschel.

2. An excellent biographical sketch of Herschel, together with an account of his astronomical achievements, will be found in Arago's "*Biographies of Distinguished Scientific Men*" (London: Longmans). This work also contains biographical sketches and accounts of the achievements of Laplace, Joseph Fourier, Fresnel, Thomas Young, James Watt, and several other great men of science. These sketches and accounts are peculiarly valuable from the fact that the author was himself a distinguished man of science.

3. The latest biographical account of Herschel is that contained in a volume of "*The Century Science Series*," entitled "*The Herschels and Modern Astronomy*," by Agnes M. Clerke (New York: The Macmillan Co., \$1.25). This excellent series of scientific biographies, edited by Sir Henry Roscoe, cannot be too highly commended. Each biography is the work of a specialist in the department of science to which the subject of the biography belonged. The work we are at present concerned with contains an account not only of Sir William Herschel, but also of his sister, Caroline Herschel, and of his son, Sir John Herschel. The authoress is well known for her "*Popular History of Astronomy During the Nineteenth Century*." "*The Herschels and Modern Astronomy*" is an excellent work in every respect.

4. Morton's "*Heroes of Science—Astronomers*" (New York: E. & J. B. Young & Co.) already mentioned, devotes a chapter to Herschel. Herschel is also the theme of numerous paragraphs in Miss Buckley's "*Short History of Natural Science*" (New York: D. Appleton & Co.). For young people a capital account of both Sir William Herschel and Caroline Herschel is given in Sarah K. Bolton's "*Famous Men of Science*."

5. Herschel is of course the subject of an important chapter in Sir Robert Ball's "*Great Astronomers*," previously noticed.

during breakfast, or at odd moments. The scraps of information thus snatched were carefully recorded in her commonplace book, where they constituted a miscellaneous jumble of elementary formulæ, solutions of problems in trigonometry, rules for the use of tables of logarithms, for converting sidereal into solar time, and the like. Nothing was entrusted to a memory compared by her instructor to "sand, in which everything could be inscribed with ease, but as easily effaced." So that even the multiplication table was carried about in her pocket. She appears never to have spent a single hour in the systematic study of astronomy. Her method was that in vogue at Dotheboy's Hall, to "go and know it," by practicing, as it were, blindfold, what she had been taught. Yet a computational error has never, we believe, been imputed to her; and the volume of her work was very great.

Her aid was indispensable, and from December, 1783, she "became entirely attached to the writing-desk." She was no mere mechanical assistant. A wound-up automaton would have ill served William Herschel's turn. He wanted "a being to execute his commands with the quickness of lightning;" and his commands were various. For he was making, not following, precedents, and fresh exigencies continually arose. Under these novel circumstances, his sister displayed incredible zeal, promptitude, and versatility. She would throw down her pen to run to the clock, to fetch and carry instruments, to measure the ground between the lamp-micrometer and the observer's eye; discharging these and many other successive tasks with a rapidity that kept pace with his swift proceedings. Fatigue, want of sleep, cold, were disregarded; and although nature often exacted next day penalties of

weariness and depression for those nights of intense activity, the faithful amanuensis never complained. "I had the comfort," she remarked simply, "to see that my brother was satisfied with my endeavors to assist him." The service was not unaccompanied by danger. One night poor Caroline, running in the dark over ground a foot deep in melting snow, in order to make some alteration in the movement of the telescope, fell over a great hook, which entered her leg so deeply that a couple of ounces of her flesh remained behind when she was lifted off it. The wound was formidable enough, in Dr. Lind's opinion, to entitle a soldier to six weeks' hospital nursing, but it was treated cursorily at Datchet; the patient consoling herself for a few nights' disablement, with the reflection that her brother, owing to cloudy weather, "was no loser through the accident."

Busy days succeeded watchful nights. From the materials collected at the telescope she formed properly arranged catalogues, calculating, in all, the places of 2,500 nebulae. She brought the whole of Flamsteed's "British Catalogue"—then the *vade mecum* of astronomers—into zones of one degree wide, for the purpose of William's methodical examination; copied out his papers for the Royal Society; kept the observing books straight, and documents in order. Then in the long summer months, when "there was nothing but grinding and polishing to be seen," she took her share of that too.—AGNES M. CLERKE.

CAROLINE HERSCHEL'S ORIGINAL WORK AS AN ASTRONOMER

Miss Herschel began, in 1782, to "sweep for comets," and discovered with a 27-inch reflector, in the au-