

SIR WILLIAM HERSCHEL

SELECTED STUDIES AND REMINISCENCES

HERSCHEL'S DISCOVERY OF URANUS

Herschel began in 1780 his second review of the heavens, using a seven-foot Newtonian, of $6\frac{1}{4}$ inches aperture, with a magnifying power of 227. "For distinctness of vision," he said "this instrument is, perhaps, equal to any that was ever made." His praise was amply justified. As he worked his way with it through the constellation Gemini, on the night of March 13th, 1781 [in Herschel's forty-third year] an unprecedented event occurred. "A new planet swam into his ken." He did not recognize it as such. He could only be certain that it was not a fixed star. His keen eye, armed with a perfect telescope, discerned at once that the object had a disc; and the application of higher powers showed the disc to be a substantial reality. The stellar "patines of bright gold" will not stand this test. Being of purely optical production, they gain nothing by magnification.

At that epoch new planets had not begun to be found by the dozen. Five, besides the earth [and the moon—a secondary planet—seven in all] had been known from the remotest antiquity. Five, and no more, seemed to

have a prescriptive right to exist. The boundaries of the solar system were of immemorial establishment. It was scarcely conceivable that they should need to be enlarged. The notion did not occur to Herschel. His discovery was modestly imparted to the Royal Society as "An Account of a Comet." He had, indeed, noticed that the supposed comet moved in planetary fashion from west to east, and very near the ecliptic; and, after a few months, its true nature was virtually proved by Lexell of St. Petersburg. On November 28th, Herschel measured, with his freshly-invented "lamp-micrometer," the diameter of this "singular star;" and it was not until a year later, November 7th, 1782, that he felt sufficiently sure of its planetary status to exercise his right of giving it a name. Yet this, in the long run, he failed to accomplish. The appellation "Georgium Sidus," bestowed in honor of his patron, George III., never crossed the Channel, and has long since gone out of fashion amongst ourselves. Lalande tried to get the new planet called "Herschel;" but the title "Uranus," proposed by Bode, of Berlin, was the "fittest," and survived.—AGNES M. CLERKE, in "*The Herschels and Modern Astronomy*," in "*The Century Science Series*."

HERSCHEL'S FAME AFTER HIS DISCOVERY OF URANUS

This discovery [of Uranus] made the turning-point of Herschel's career. It transformed him from a music master into an astronomer. Without it his vast abilities would probably have been in great measure wasted. No man could long have borne the strain of so arduous a double life as he was then leading. Relief from it came just in time. It is true that fame, being often more of a hin-

scholar to another, or giving one the slip, he called at home to see how the men went on with the furnace, which was built in a room below, even with the garden."

At last, the concert season being over, and everything in readiness for the operation of casting, "the metal," we hear from the same deeply-interested eye-witness, "was in the furnace; but, unfortunately, it began to leak at the moment when ready for pouring, and both my brothers, and the caster with his men, were obliged to run out at opposite doors, for the stone flooring, which ought to have been taken up, flew about in all directions, as high as the ceiling. My poor brother William fell, exhausted with heat and exertion, on a heap of brickbats. Before the second casting was attempted, everything which could ensure success had been attended to, and a very perfect metal was found in the mould, which, however, had cracked in the cooling."—AGNES M. CLERKE.

HERSCHEL'S FAME AS DESCRIBED BY ARAGO

A telescope, a simple telescope, only two English feet in length, falls into the hands of Herschel during his residence at Bath. This instrument, however imperfect, shows him a multitude of stars in the sky that the naked eye cannot discern; shows him also some of the known objects, but now under their true dimensions; reveals forms to him that the richest imaginations of antiquity had never suspected. Herschel is transported with enthusiasm. He will, without delay, have a similar instrument but of larger dimensions. The answer from London is delayed for some days: these few days appear as many centuries to him. When the answer arrives, the

price that the optician demands proves to be much beyond the pecuniary resources of a mere organist. To any other man this would have been a clap of thunder. This unexpected difficulty, on the contrary, inspired Herschel with fresh energy: he cannot buy a telescope, then he will construct one with his own hands. The musician of the Octagon Chapel rushes immediately into a multitude of experiments, on metallic alloys that reflect light with the greatest intensity, on the means of giving the parabolic figure to the mirrors, on the causes that in the operation of polishing affect the regularity of the figure, etc. So rare a degree of perseverance at last receives its reward. In 1774 Herschel has the happiness of being able to examine the heavens with a Newtonian telescope of five English feet focus, entirely made by himself. This success tempts him to undertake still more difficult enterprises. Other telescopes, of seven, of eight, of ten, and even of twelve feet focal distance, crown his efforts. As if to answer in advance those critics who would have accused him of a superfluity of apparatus, of unnecessary luxury, in the large size of the new instruments, and his extreme minutiae in their execution, Nature granted to the astronomical musician, on the 13th of March, 1781, the unheard-of honour of commencing his career of observation with the discovery of a new planet, situated on the confines of our solar system. Dating from that moment, Herschel's reputation, no longer in his character of musician, but as a constructor of telescopes and as an astronomer, spread throughout the world. The king, George III., a great lover of science, and much inclined besides to protect and patronize both men and things of Hanoverian origin, had Herschel presented to him; he was

charmed with the simple, yet lucid and modest account that he gave of his repeated endeavors; he caught a glimpse of the glory that so penetrating an observer might reflect on his reign, ensured to him a pension of 300 guineas a year, and moreover a residence near Windsor Castle, first at Clay Hall, and then at Slough. The visions of George III. were completely realized. We may confidently assert, relative to the little house and garden of Slough, that it is the spot of all the world where the greatest number of discoveries have been made. The name of that village will never perish; science will transmit it religiously to our latest posterity.—FRANCOIS ARAGO, in "*Biographies of Distinguished Scientific Men.*"

HERSCHEL'S WONDERFUL ENERGY IN "REVIEWING THE HEAVENS"

"The man at the eye-end" is the truly essential part of a telescope. No one knew this better than Herschel. Every serene dark night was to him a precious opportunity availed of to the last minute. The thermometer might descend below zero, ink might freeze, mirrors might crack; but provided the stars shone, he and his sister worked on from dusk to dawn. In this way, his "third review," begun at Bath, was finished [at Datchet, near Windsor] in the spring of 1783. The swiftness with which it was conducted implied no want of thoroughness. "Many a night," he states, "in the course of eleven or twelve hours of observation, I have carefully and singly examined not less than 400 celestial objects, besides taking measures, and sometimes viewing a particular star for half an hour together, with all the various powers."

The assiduity appears well-nigh incredible with which he gathered in an abundant harvest of nebulae and double stars; his elaborate papers, brimful of invention and experience, being written by day, or during nights unpropitious for star-gazing. On one occasion he is said to have worked without intermission at the telescope and the desk for seventy-two hours, and then slept unbrokenly for twenty-six hours. His instruments were never allowed to remain disabled. They were kept, like himself, on the alert. Relays of specula were provided, and one was in no case removed from the tube for repolishing, unless another was ready to take its place. Even the meetings of the Royal Society were attended only when moonlight effaced the delicate objects of his particular search.—AGNES M. CLERKE.

HERSCHEL'S GREAT "FORTY-FOOT"

Herschel trusted nothing to chance. "There is not one screw-bolt," his sister asserted [respecting the construction of the great forty-foot telescope], "about the whole apparatus but what was fixed under the immediate eye of my brother. I have seen him lie stretched many an hour in a burning sun, across the top beam, whilst the ironwork for the various motions was being fixed. At one time no less than twenty-four men (twelve and twelve relieving each other) kept polishing day and night; my brother, of course, never leaving them all the while, taking his food without allowing himself time to sit down to table."

At this stage of the undertaking it became the fashion with visitors to use the empty tube as a promenade. Dr.

and Miss Burney called, in July, 1786, "to see, and *take a walk* through the immense new telescope." "It held me quite upright," the authoress of "Evelina" related, "and without the least inconvenience; so would it have done had I been dressed in feathers and a bell-hoop."

George III. and the Archbishop of Canterbury followed the general example; and the prelate being incommoded by the darkness and the uncertain footing, the King, who was in front, turned back to help him, saying: "Come, my lord bishop, I will show *you* the way to heaven." On another occasion "God save the King" was sung and played within the tube by a large number of musicians; and the rumor went abroad that it had been turned into a ball-room!

The great telescope took rank, before and after its completion, as the chief scientific wonder of the age. Slough was crowded with sightseers. All the ruck of Grand Dukes and Serene Highnesses from abroad, besides royal, noble, and gentlefolk at home, flocked to gaze at it and interrogate its maker with ignorant or intelligent wonder.—AGNES M. CLERKE.

HERSCHEL'S CHARACTER

William Herschel was endowed by nature with an almost faultless character. He had the fervor without the irritability of genius; he was generous, genial, sincere; tolerant of ignorance; patient under the acute distress, to which his situation rendered him peculiarly liable, of unseasonable interruptions at critical moments: he was warm-hearted and open-handed. His change of country

and condition, his absorption in science, the homage paid to him, never led him to forget the claims of kindred. Time and money were alike lavished in the relief of family necessities.

On religious topics he was usually reticent; but a hint of the reverent spirit in which his researches were conducted, may be gathered from a sentence in a letter he once wrote. "It is certainly," he said, "a very laudable thing to receive instruction from the great work-master of nature, and for that reason all experimental philosophy is instituted."

To investigate was then, in his view, to "receive instruction;" and one of the secrets of his wonderful success lay in the docility with which he came to be taught.—AGNES M. CLERKE.

HERSCHEL'S WORK AND ITS INFLUENCE

Herschel was, in the highest and widest sense, the founder of sidereal astronomy. He organized the science and set it going; he laid down the principles of its future action; he accumulated materials for its generalizations, and gave examples of how best to employ them. His work was at once so stimulating and so practical that its abandonment might be called impossible. Others were sure to resume where he had left off. His son [John Frederick William Herschel—known to fame as Sir John Herschel] was his first and fittest successor; he was the only one who undertook in its entirety the inherited task. Yet there are to be found in every quarter of the world men imbued with William Herschel's sublime ambitions. Success swells the ranks of an invading army; and the

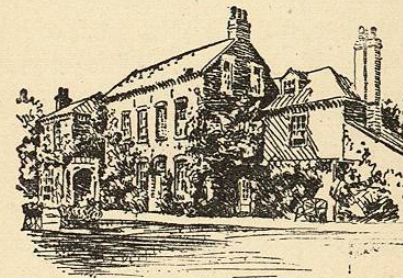
drance than a help, brought embarrassment in its train. In November, 1781, Herschel was compelled to break the complex web of his engagements at Bath by a journey to London for the purpose of receiving in person the Copley Medal awarded to him by the Royal Society, of which body he was, some days later, elected a Fellow. At home, he was persecuted by admirers; and they were invariably received with an easy suavity of manner that gave no hint of preoccupation. Every one of scientific pretension who visited Bath sought an interview with the extraordinary man who, by way of interlude to pressing duties, had built telescopes of unheard-of power, and performed the startling feat of adding a primary member to the solar system. Among the few of these callers whose names have been preserved was Dr. Maskelyne, then, and for thirty years afterwards, Astronomer-Royal. "With the latter," Miss Herschel relates, "he (William) was engaged in a long conversation which to me sounded like quarrelling, and the first words my brother said after he was gone were, 'That is a devil of a fellow!'" The phrase was doubtless meant as a sign of regard, for the acquaintance thus begun ripened into cordial intimacy. And William Herschel never lost or forgot a friend.—AGNES M. CLERKE.

HERSCHEL'S WONDERFUL ENERGY IN TELESCOPE-MAKING

The first of Herschel's *effective* twenty-foot telescopes was erected at 19 New King Street [Bath], in the summer of 1781. Enclosing a mirror twelve inches in diameter, it far surpassed any seeing-machine that had ever existed in the world. Yet its maker regarded it as only marking a step in his upward progress. A speculum of thirty-feet

focus was the next object of his ambition. For its achievement no amount of exertion was counted too great. Its composition was regulated by fresh experiments on various alloys of copper and tin. Its weight and shape were again and again calculated, and the methods appropriate to its production earnestly discussed. "I saw nothing else," Caroline Herschel tells us, "and heard nothing else talked of, but these things when my brothers were together."

"The mirror," she continues, "was to be cast in a mould of loam prepared from horse-dung, of which an



GARDEN VIEW, HERSCHEL HOUSE, SLOUGH.

immense quantity was to be pounded in a mortar and sifted through a fine sieve. It was an endless piece of work, and served me for many an hour's exercise; and Alex frequently took his turn at it, for we were all eager to do something towards the great undertaking. Even Sir William Watson [a neighbor—a gentleman interested in science who became a great friend of the Herschels] would sometimes take the pestle from me when he found me in the work-room."

The matter was never out of the master's thoughts. "If a minute could but be spared in going from one