A COMET-FINDER.

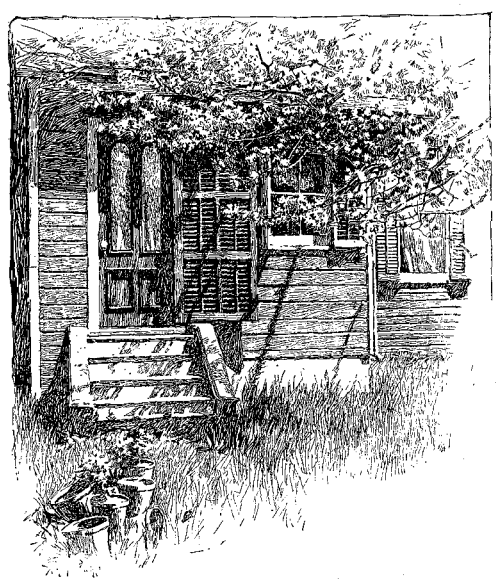
ENGRAVED BY R. G. TIETZE.

WILLIAM R. BROOKS.

ALMOST within the shadows of an apple-orchard, raised two feet above the sod, in one corner of a farm-lot fence, near the village of Phelps, New York, is a rude platform of boards less than twelve feet square. Firmly anchored in the ground, and rising four feet above the surface of the platform at its center, stands a heavy post fashioned to particular uses. At a little distance, a low-roofed and red-painted cottage is snuggled among the apple-trees. The slanting roof of a shed creeps close under the eaves at the rear of the little house, and from its door a narrow board path leads beneath the apple-trees, over a mumbling brook, to the rough platform of planks at the corner of the orchard lot. The red house is the home of Astronomer William R. Brooks, and the huddle of slabs in the corner is the Red House Observatory. From this humble outlook, since 1881, Mr. Brooks has discovered eleven comets—more than have been found by any one of his scientific colleagues during the same time.

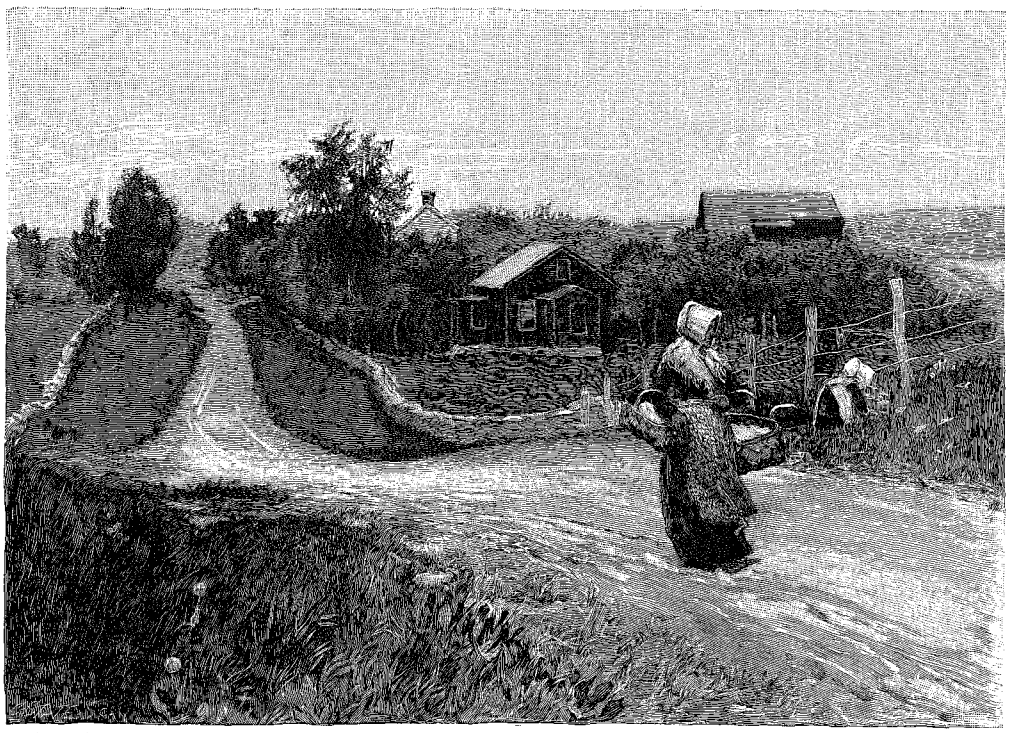
On a September evening in 1883, with a telescope of his own making, Mr. Brooks caught the first glimmer of Pons's great comet of 1812, once more sweeping into vision after a journey around the sun of more than seventy years' duration. Scanty observations in 1812 by Pons and others had resulted in imperfect calculations of the time required for its revolution around the sun. Its reappearance was somewhat anticipated in 1880. Nightly, since then, astronomers had watched for it with perfected instruments. Three years had passed when, on an autumn night, Mr. Brooks first caught its returning glow upon the glasses of his home-made telescope. Again, on an August night four years later, he recorded the return of Olbers's great comet of 1815, also overdue.

Phelps village is in that region of western New York where clear-watered lakes with Indian names are clustered so thickly—Seneca, Canandaigua, Cayuga, Keuka, and Onondaga. The hamlet is more than one hundred years old, has 1500 dwellers, and lies upon the Auburn branch of the New York Central Railroad, sixty miles from Syracuse, and forty-two from Rochester. One summer day the writer went to talk with Mr. Brooks about his work. The way led beyond the outskirts of the village, down an easy slope, over a rustic bridge, and finally through a ravine, out upon a yellow ribbon of country road. As the writer did most of his growing-up in the village of Phelps, and had recollections of Mr. Brooks as the photographer of the village, before whom he had once stood to be photographed, he knew that the



DRAWN BY GUY ROSE.

THE RED HOUSE, FROM THE FRONT GATE.



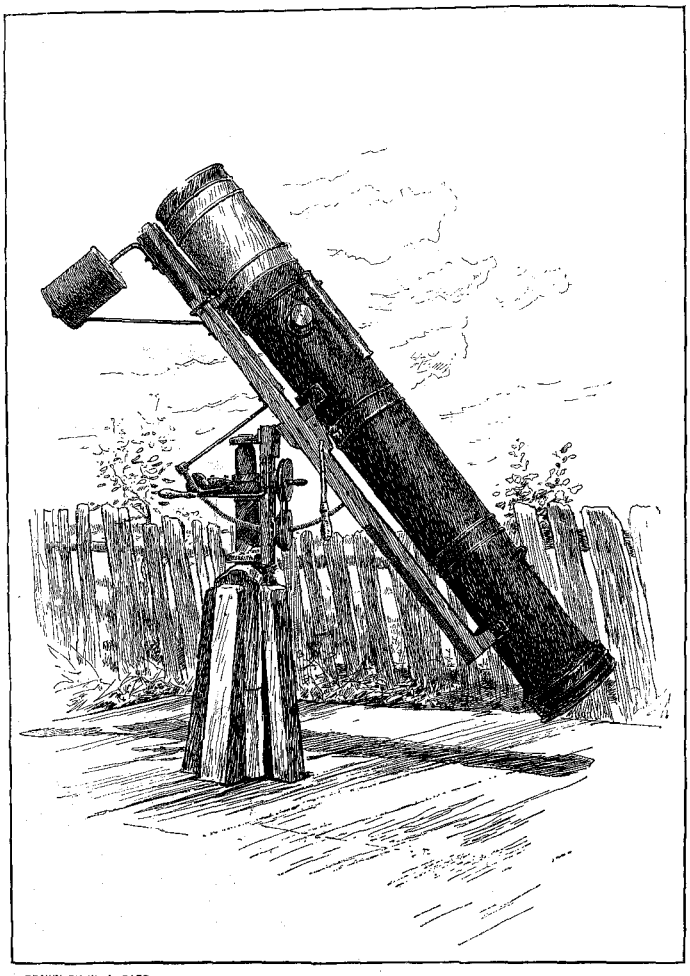
DRAWN BY GUY ROSE. ENGRAVED BY CHARLES STATE.

THE RED HOUSE, FROM THE SOUTH.

man of medium, well-proportioned stature who welcomed him at the threshold was the Red House astronomer.

A huge regulator clock marked "Red House Observatory" in gilt letters stood in the entry. Seated at a casement in a little room with plain appointments, Mr. Brooks chatted of his work, his wife aiding him now and then with her recollection; and when his little nine-year-old daughter came in from a romp, and dropped upon a hassock at her father's feet, the astronomer's family were all present. This little girl, Anna Caroline Brooks, is an assistant to her father in his astronomical work. Independently she observed with a smaller telescope the occultation of Jupiter by the moon on March 23, 1889.

Mr. Brooks was born in Maidstone, England, in 1844. His father was a Baptist minister who came to America when his son was thirteen years old, and settled near Darien, New York. Before coming to America, and while on a voyage to Australia, the lad, in watching the captain of the vessel take observations, had his first impulse toward the study of astronomy. By studies in his American home he became familiar with the theory and construction of telescopes and with scientific works. He made his first telescope when he was fourteen years of age, and with his own hands has constructed the instruments he has since used. Lacking suitable tools, the boy made many journeys to the shop of a friendly cabinet-maker four miles from his home, where he was allowed the use of tools and material. The tube of his first instrument was of wood, and square, as was the sliding eyepiece. It was finished just in time to afford him observations of Donati's great comet of 1858. At seventeen he delivered his first astronomical lecture, illustrated by charts, in his father's church. During this early period he made many experiments in natural philosophy and mechanics. Invention also occupied his attention. He had not then seen a sewing-machine, but he made one which aroused wonder among the housewives of the neighborhood. He made detailed drawings also for an ocean steamer, with double, revolving hull on the screw principle, which was expected to cross the Atlantic Ocean in three days. Those were the early days of photography. The boy saved a little money with which he bought chemicals for experiment. His first camera was a darkened chamber in the parsonage, with a spectacle glass for a lens, fitted in a board in the window. This gave a view of the church shaded by great elms. The plate was held by hand against a standard during exposure. Early in his astronomical work Mr. Brooks employed photography in his researches, and he became



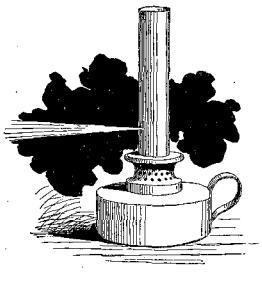
DRAWN BY W. J. BAER.

LARGE TELESCOPE OF THE RED HOUSE OBSERVATORY, WITH WHICH ELEVEN COMETS WERE DISCOVERED BY MR. BROOKS.

convinced that it would serve an important purpose by disclosing many objects invisible with the largest telescopes, and also in charting the heavens. While yet a youth, Mr. Brooks spent three years in the Shepherd Iron Works at Buffalo, where he assisted in constructing steam-engines and other heavy machinery. There he acquired much of the mechanical skill which has aided him in the construction of his astronomical instruments. Meanwhile he was perfecting himself in mechanical drawing.

In 1870 Mr. Brooks, who had married at the age of twenty-four, settled in Phelps, where he became the village photographer. During leisure hours, with tools and appliances of his own construction, he made in his studio his second telescope, an achromatic instrument of 2-inch aperture. With this he secured observations of the transit of Mercury in 1878. He next constructed a 5-inch diameter reflecting telescope, with which he discovered his first comet on October 4, 1881. It was discovered independently by Denning, in England, on the same morning. Finally he constructed a silver-on-glass reflecting telescope of 9-inch aperture, grinding and polishing the glasses with his own tools and hands. With this instrument, optically of surpassing excellence, as its record proves, Mr. Brooks up to 1888 did all his subsequent work. He spent one year perfecting the large glass of this instrument. It is of unusually short focus, and has great light-grasping power, revealing exceedingly faint objects. It thus serves the prime purpose of its constructor—the discovery of comets and nebulæ. Meantime Mr. Brooks forsook photography, and moved to the red house outside the village. The large telescope was finished there, and nothing was then lacking but an observatory. With his own hands he erected in one corner of the farm-lot a platform as described. This rude staging he named the Red House Observatory, which is now known wherever tidings reach by wire or cable.

In a corner of the summer kitchen Mr. Brooks showed me a locker-like box of boards reaching from floor to roof. It was fastened with strong staples and a lock. The door was opened, and then, standing upright, was disclosed an object that had the appearance of a very large stovepipe, fitted together and ribbed with strengthening bands at the joints. This was the home-made telescope, a Newtonian reflector. Its large speculum, or mirror, is of glass accurately ground and polished to a parabolic curve. It is silvered on its front surface, and the silver film is polished in the most perfect manner. The large speculum rests in a



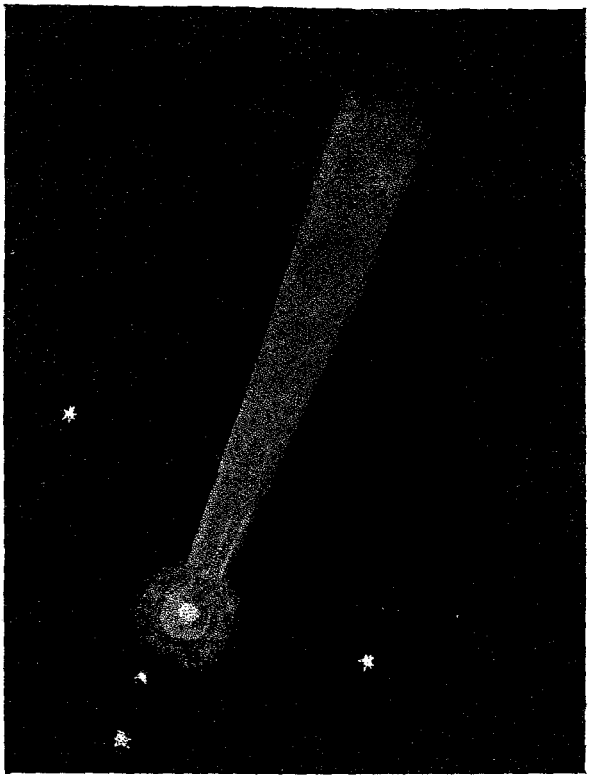
THE ARTIFICIAL STAR.

cell at the lower end of an iron tube. The upper end of the tube is open. Rays of light from an object, the moon for instance, pass down the open-mouthed tube in parallel rays, and are then reflected back in converging rays. Just before they come to a focus they strike a small flat speculum set at an angle of forty-five degrees, and are reflected out to an eyepiece through an opening in the side of the tube.

While replacing the telescope in the wooden closet, Mr. Brooks invited me to remain during the evening to see the instrument mounted and to test its power. Then we went into the shop, the other compartment beneath the woodshed roof. A machinist's bench, with a polished steel vise, was there, each the handiwork of the owner. Gauges and calipers of various forms, iron clamp-screws of graded sizes, and strange appliances of wood and steel, lay about, all wrought by the same hands. There was a compact little engine to supply power to pulleys and shafting above. Close at hand was an object like the flat wheel upon which potters fix and whirl the clay. Dropping upon a stool, Mr. Brooks patted the wheel, which, when the engine was started, began to whirl. "This," said Mr. Brooks, "is the machine upon which the specula are ground. The making of optical surfaces," he continued, "requires high skill, close judgment, and patience. It stands at the head and front of technical art. As in the case of the telescope you have just seen, the beginning of the speculum was a rough disk of glass, and a year was spent perfecting it. Having determined the focal length, gauges of proper curve were made, and round disks of iron called 'tools' were carefully turned in the lathe, to fit the curvature of the gauges. The rough glass was then placed upon the iron revolving table of this optical machine, which is of my own invention, and differs considerably from those of Lord Rosse or Lassell. It introduces a great variety of beautiful motions for producing perfect curves. The coarse grinding is done with sand and water placed between the glass and the iron tool. The latter is driven backward and forward over the glass by attachment to this long arm and adjustable crank. As the grinding tool oscillates, it also revolves. The glass also rotates with a differential motion. When the glass is brought roughly to the curve of the tool, emery of different grades of fineness is used, until an exceedingly smooth surface is obtained. The polishing follows. The iron tool is heated, and a layer of melted pitch is poured over it. The glass is then covered with rouge and water, and the pitch while yet warm is pressed down upon the glass conforming to its curve. The tool is again set in motion, and the polishing proceeds, rouge and water being added until a perfect polish is obtained.

"Now the most difficult part of the work begins — the 'figuring' or correcting of the curve of the glass. To be of any use in a reflecting telescope the mirror must have a perfect parabolic curve — the only curve that will reflect parallel rays of light to a focus. The glass is taken to a darkened room — the cellar of my cottage has served in my work — where by means of an artificial star and very refined methods the curve of the glass is ascertained. For an artificial star," he explained, "I use a lamp with a metal chimney having in it a hole about $\frac{1}{200}$ of an inch in diameter. The hole is my artificial star." "Why should the perfecting of the speculum in your large instrument have occupied you a year?" said I to Mr. Brooks.

"I believe," said he, "that I found it first to have a hyperbolic curve: that was of no use. I may have found it next to be an oblate spheroid: that is of no use. It may have been spher-

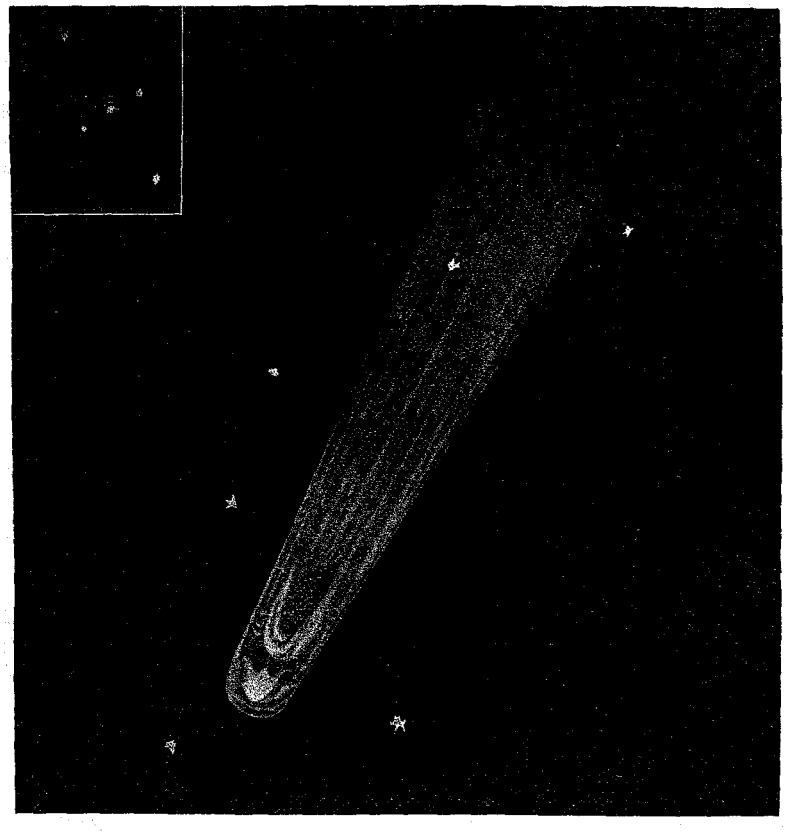


BROOKS'S COMET NO. 1 OF 1883.[1]

[1] The comet pictures in this article are by D. B. Keeler, after drawings by Mr. Brooks.

ical: that is of no use. I may have found it elliptical: but that would not do; it must be a parabola. And yet the difference between the parabola and any of these other curves is so slight that it cannot be measured mechanically — only optically; and the changes are all made in the polishing stage of the work. After each test the speculum, if not of the required curve, must be returned to this wheel until of perfect 'figure.'"

The moon had been at full the evening before and between dusk and moonrise there was only half an hour for searching. A long interval of cloudy weather had preceded, and Mr. Brooks was eager to resume his work. Snow lay two feet deep between the house and the observatory. A path was made, and the telescope, carried from the house in the arms of its maker, was at length put in position. In the second sweep of the heavens there came to the



THE PONS-BROOKS COMET.

(The small figure in the left-hand upper corner gives the telescopic field when this comet was first detected by Mr. Brooks on the evening of September 1, 1883.)

Upon a stand near by was an instrument of burnished brass and glistening steel which had been constructed in the woodshed shop. It was an equatorial refractor.

Of the comets which Mr. Brooks has discovered, the first was of short period, circling the sun every eight years and four months, and was found in October of 1881, with the third telescope of his construction. One year afterward came the second discovery, with the fourth and last instrument. This comet of October, 1882, was a fragmentary body, a companion to the great comet of that year.

On the night of February 23, 1883, the mercury at the Red House had shrunk below zero. watcher's anxious eye the vision of a beautifully bright telescopic comet, bordering on naked-eye visibility. It had a short, delicate, straight tail, pointing from the sun. Each of his previous comets had been so hazy as to be easily mistaken for nebulæ, but of this discovery there could be no doubt. "He came bounding up the steps two at a time out of the heavy snow," said Mrs. Brooks.

During the month of August, 1883, the astronomer had devoted eighty hours to fruitless work. On the night of September 1, the celebrated Pons discovery, the great comet of 1812, again broke within the range of earthly vision, and the patient man in the fence corner

TELESCOPIC VIEW OF BROOKS'S COMET NO. 2 OF 1886. DISCOVERED MAY 1, 1886.

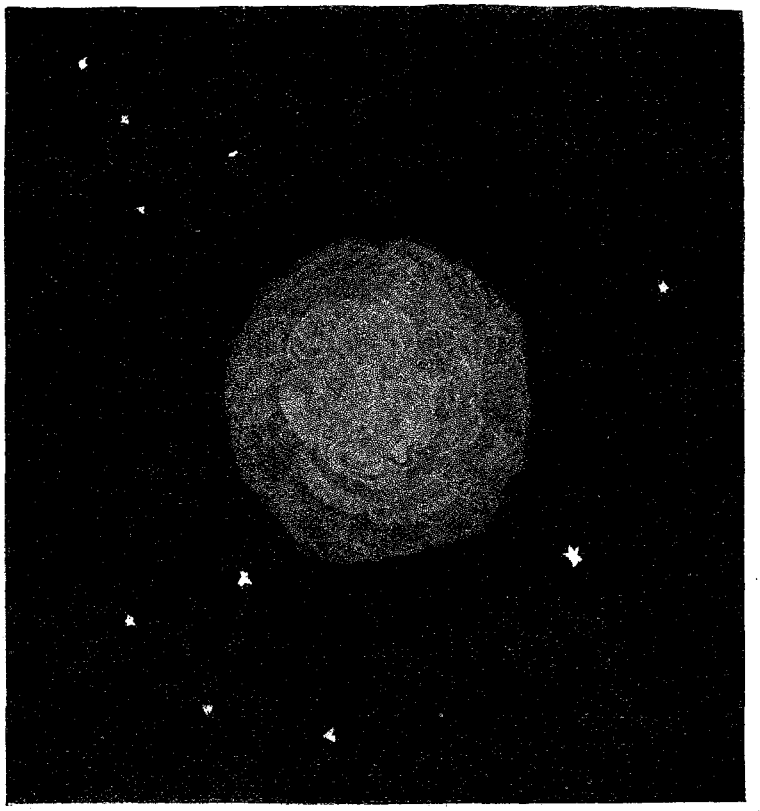
was the first to greet the wanderer. "This comet," said his child, "was credited to papa as the faintest one ever discovered."

"At discovery this comet was coming directly toward us," explained Mr. Brooks, "and at perihelion it appeared as a naked-eye comet. Its head had an approximate diameter of 500,000 miles, with a tail 20 million miles in length. At discovery it was not less than 350 millions of miles distant. Greatest interest attaches to its periodic character, being the second on the list of known comets of long period. Of this class Halley's was the first. The period of revolution around the sun of what is now known as the Pons-Brooks comet is seventy-one years, four months, ten days. Its next return to visibility will be in the year 1955."

This comet — the most notable he had then found — was discovered by Mr. Brooks on a Saturday evening. The same is true of five others discovered from the Red House Observatory, so that Saturday has grown into the family calendar as a lucky day. Mr. Brooks took particular care that his child should become familiar with the appearance of the Pons-Brooks comet and the circumstances of its discovery. He indulges the hope that she may live to see it return.

Fruitless searching followed, until on August 31, 1885, in the constellation Hunting Dogs, the next and fifth comet appeared to Mr. Brooks. Then four months went by without results. On the evening after Christmas of 1885, while his telescope was trained on the constellation Aquila, his sixth discovery appeared. It was low down in the western heavens, somewhat bright, moving slowly eastward, and fast settling behind the orchard. Of its cometary nature there was no doubt, and its position was secured, but the direction of its motion had not been accurately determined when it sank behind the trees. The probability that some other watcher would find the comet before another evening incited action. The telescope was removed from its permanent stand, and Mr. Brooks carried it over the brook and around the house. Wife and father were called to assist. A table, books, and door-mats were hurried out from the cottage, and, while the astronomer lifted the instrument upon the fence and guided its direction, the wife adjusted the table, books, and mats to support it. Thus the direction of the comet's motion was ascertained, and at eight o'clock the discovery was announced by telegraph. The news was cabled abroad the same night. A prize of $200 was awarded for the discovery of this comet. "For a few hours after each discovery," said Mrs. Brooks, "there is a natural anxiety lest the telegraph should inform us that the comet had been seen elsewhere; but this has happened only once."

The seventh discovery at the Red House was made four months later, April 27, 1886, in the constellation Cassiopeia, and only four days after, May 1, 2:45 A. M., came the eighth Red House comet, this time in Pegasus. With its fan-shaped tail, it greatly resembled in miniature the Donati comet of 1858, and Mr. Brooks was reminded of his dreams when viewing Donati's comet with the square, wooden-tubed telescope made at the friendly cabinet-maker's shop.



BROOKS'S COMET NO. 3 OF 1886. DISCOVERED MAY 22, 1886.
(Telescopic view. This illustrates the type of tailless comet, usually, as in this instance, of short period.)

On the evening of May 22, 1886, the ninth comet was found in the constellation Virgo. It was globular in form and without tail. Here was established an unprecedented record of discovery — five comets in less than nine months, four in succession, two within four days, three in less than one month and visible from earth at the same time.

Within a few degrees of the spot where the Pons-Brooks comet reappeared, the next and tenth discovery was made by Mr. Brooks. It was in the constellation Draco, and was found on the evening of January 22, 1887. Finally came the eleventh and last. On the morning of August 26, 1887, the press of the United States and of the Old World announced the discovery on the night before, at the Red House Observatory, of a comet equaling in importance that of 1812. While sweeping the eastern skies early on the morning of August 25, Mr. Brooks detected a faint nebulous object in the constellation Cancer. It was at once suspected to be a comet, and the detection of motion soon confirmed the suspicion. Two days later it had moved into the same telescopic field with the star ι Cancri. Continued observations soon proved this new foundling to be the Olbers comet of 1815, thus adding a third to the list of known long-period comets. Like the Pons-Brooks comet, it was overdue at rediscovery. It was brightish upon its reappearance, had a short, brush-like tail, and was moving slowly eastward toward the sun. Increasing in brightness until October, it then passed perihelion. Although it did not become visible to the naked eye, it presented a fine appearance in large telescopes, and, like the Pons-Brooks comet, ranks as one of the most valuable additions to cometary astronomy. Thus it had fallen to the lot of the same man to detect on their first return two of the three known comets of long period.

When we moved from the evening meal only a rim of the setting sun shone through the apple-trees, and the host, proceeding to the kitchen locker, removed his telescope. He feared, he said, there was "too much atmospheric disturbance for good telescopic definition." Tilting the top of the telescope toward him, he lifted it with tenderness, and led the way toward the observatory, the child Anna accompanying us. In the center of a rude staging of rough sawn planks, held up from the earth a couple of feet by four posts at the corners, is the standard upon which the telescope is mounted when in use. A hickory post about six inches square was set firmly in the ground, and was braced by four hemlock scantlings. Post and braces do not touch the platform; hence no tremors or vibrations of the structure are communicated to the telescope. The upper part of the post was turned true in a lathe, and on this the movable part of the apparatus turns in azimuth, or parallel with the horizon. The telescope is placed in a "cradle," and this is hinged to the perpendicular part so as to give the motion in altitude — from horizon to zenith. The motion in altitude is governed by a large quadrant screw. The lower portion of the screw passes through a large nut operated by a pulley in the hand of the observer. An iron weight at the front of the cradle balances the telescope

so that it moves easily and smoothly, and by means of these two motions in azimuth and altitude, the telescope may be directed to any part of the heavens.

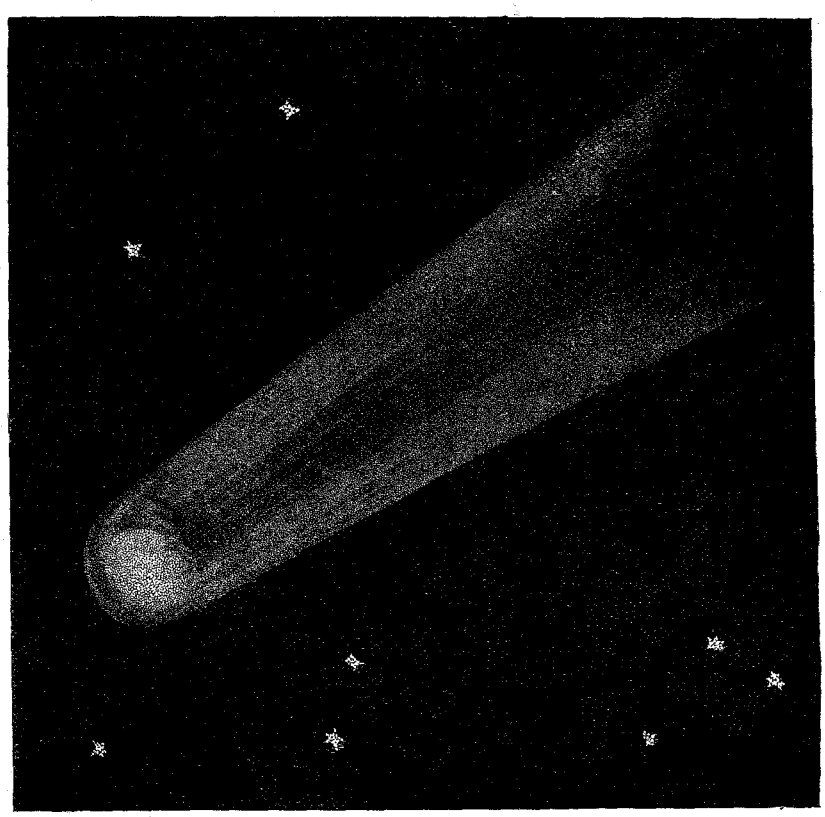
While Mr. Brooks was mounting the telescope, the sun, then below the horizon, was yet reaching over its edge with shafts of light. The tin cover of the speculum, like the cap of a photographic camera, was removed from the mouth of the telescope, and the dew-cap, extending the length of the tube, was adjusted, so that dew might not deposit upon the glasses. Should currents of heated air from the observer's body drift past the open end of the tube, the clear definition of objects would cease; this the dew-cap prevents.

The mellow afterglow had changed before all was adjusted. Mr. Brooks seated himself beside me on the edge of the platform. Tree-toads chirped in the apple-trees; pioneer crickets were filing their little saws in the near stubble-fields; occasionally a wheel rumbled somewhere over a roadway bridge; on the trees, where chickens had gone to roost, the leaves were motionless; from some place, away off, came the barking of a dog; an apple, letting go before its time, fell with a thud into the matted grass: and so we sat upon the edge of the Red House Observatory, each prodding the moist earth with careless heel. And so, while cigar smoke curled in the quiet air, I asked Mr. Brooks if he went sweeping about with his telescope at random in the heavens nightly.

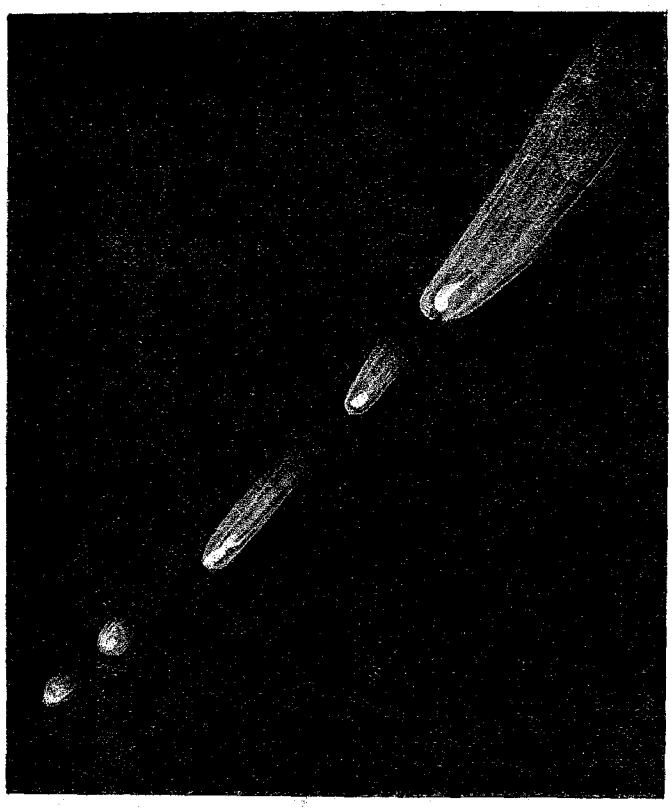
He answered that only strict and systematic methods were effective in cometary research. His sweeping is usually done near the sun, low down in the western sky at evening, and in the eastern sky of a morning. This, because all comets are brightest when nearest the sun, and therefore are more easily seen. They are found, however, in all parts of the sky, and sometimes in opposition to the sun. Blocking out his nightly work, he takes a certain number of degrees of the heavens, say ninety degrees, beginning at the horizon, and working upward. Where he leaves off on one night he begins on the next, keeping careful records of the regions searched.

Then followed the relation of experiences of lonely vigils with the telescope through long winter nights, when snow bent the apple-limbs, covered the platform of slabs, and muffled the mumblings of the brook; of nights when the patient watcher had forgotten his suffering from cold in the joy of discovery; of nights when frost particles glittered in the air, and the rigors of his unprotected position had been fruitless; of summer nights when physical comfort made even barren search a delight to the watcher; of nights when the tube had been trained to the indicated location of some wanderer first discovered by another, and of days when observations of discovery were being worked out to scientific exactitude of time and location.

Meanwhile twilight had deepened to dusk.



TELESCOPIC VIEW OF THE OLBERS-BROOKS COMET, 1815–1887.



BROOKS'S MULTIPLE COMET.

The telescope was leveled upon Jupiter, visible just above the apple-trees westward, and I was called to look. Those who are acquainted with telescopic work may estimate the relative power of this instrument when the appearance of celestial objects viewed with its aid is described in lay terms. Jupiter, 490 millions of miles away, was a glowing disk as large as the moon to the unaided eye. Its belts glowed brightly, and its four moons, three on one side and one on the other, were like burnished bucklers hung against the dark sky. So near the horizon was the planet that, seen through earth's atmosphere horizontally, its definition was a trifle unsteady. An object at the zenith is more sharply defined, because only the thickness of the earth's atmosphere interferes to blur the vision. While I gazed, the glowing light of Jupiter was lost, the telescope not having been moved. Earth had so far moved in her axial revolution that the object had been carried off the field of view in the eyepiece, which has a diameter of about half an inch, corresponding to about one quarter of a degree of the heavens. The Red House Observatory had moved with the earth in its axial revolution a dozen miles while the planet was being carried across the telescopic field.

"Look at the Milky Way," said Mr. Brooks, as he tilted the tube so that its dark mouth swallowed mellow light from the zenith. There was a feeling like that one might have wandering in strange antipodal scenes, with the occasional sound of a human voice close to the ear. The visual sense and the aural function were far separated, and yet coöperative, in the same body. The result was somehow jarring. A rapt listener to symphony would in like manner be disturbed by the measured utterance of criticism at his side. Then Mr. Brooks became silent, and I listened to the stillness of what I saw, if such seeming contradiction may be understood — a stillness undisturbed save by occasional fluttering of a querulous chicken disturbed by jostling neighbors on a near apple-limb or by cattle lifting their wet blue noses over the fence to see what it was all about.

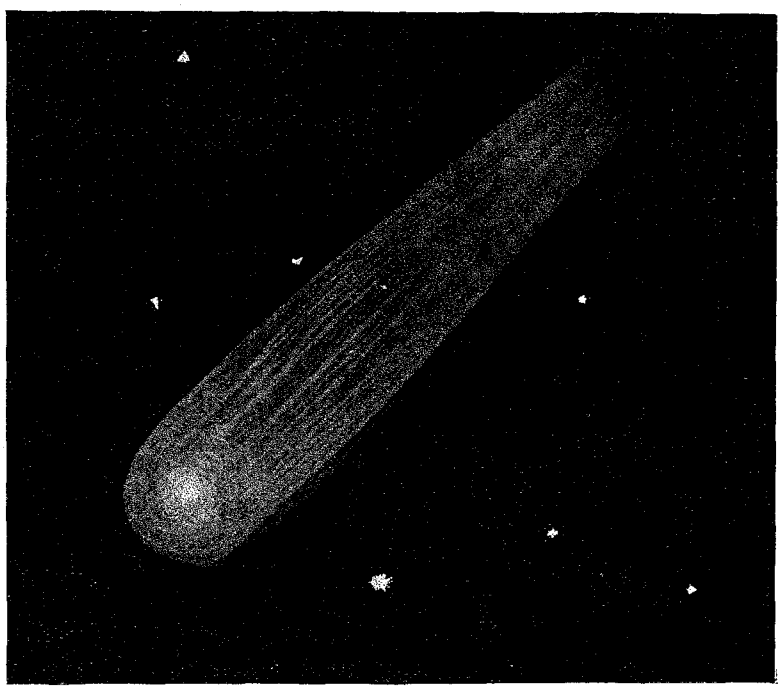
The Milky Way was a mighty yellow belt pierced by knobs of light — permanent stars jutting through a spangled confusion of lesser ones. A diaphragm was removed from the opening of the telescope, which, with thus increased aperture and power, resolved the dusty spangle of background into other stars with the same relative confusion of dusty spangle beyond and beyond. Next, the tube was trained so that its black throat drew in the cold, steady light from Polaris — the apparent center of diurnal revolution of all the stars. To have resting in one's brain the earth end of a light-ray that shot away 234 trillions of miles to a mysterious source, brought somehow a fearsome sensation. It is outside of human comprehension to compass the physical fact. It is difficult to believe that, should that hard, glittering point be blotted out, a watcher on earth would be forty years older before the last glint of its light, hurrying to earth 186,000 miles a second, would die upon the eye.

The night had grown cooler, the air had cleared, though scarfs of mist lay close upon the fields. The child had several times shouted the discovery of plunging meteors, and the instrument was surrendered to the astronomer. "There," he spoke, with a turn of the wheel, "I have now my starting-point for the night —

just above Arcturus, and before the dawn, or before the harvest moon has come, I shall have swept upward to the zenith."

"This must be lonesome work," I said to Mrs. Brooks. For fear of disturbing him, she responded in undertones. With something of amusement, she explained that beside her husband's sleeping-place a little window had been made in the side of the house. Through this he observed the atmospheric and other conditions whenever he woke in the night. Sometimes the evenings may be cloudy or the moon may set late; but if, upon waking, he finds the skies clear and moonless, it has been for years his habit to rise and go out to the fence corner to pursue his researches.

The night had neared its meridian, and the child Anna, grown oblivious of meteors, was asleep in her mother's lap. The cows, gone to bed in dew-wet grass just over the fence, softly crunched the mysterious cud. The querulous chicken was quiet, and stillness was upon the farms and forests. The occasional bark of some dog, and the nameless sounds of the night, emphasized its hush. The astronomer had become silent in his far wanderings. His night work had begun. He scarcely knew of any person near, and turned, as though surprised, to respond good-night to wife, child, and visitor. When I reached the village, the steeple clock was sounding midnight.



THE BROOKS COMET OF AUGUST 28, 1892. TELESCOPIC VIEW.

On April 17, 1888, Mr. Brooks left the Red House, and removed to the beautiful village of Geneva, on Seneca Lake, New York, six miles away, to take charge of the Smith Observatory, established and maintained by William Smith, Esq., of that place. Here Mr. Brooks superintended the erection of the new observatory, the contracts for the construction and erection of the new instruments, all of which are of the best workmanship, combining all the modern improvements and many refinements of detail suggested by himself. The equatorial telescope has an objective ten inches and one-eighth in aperture, with a photographic lens of the same size. The instrumental equipment embraces a meridian circle, an astronomical clock, and a spectroscope. During his residence in Geneva Mr. Brooks has already discovered eight new comets, four of them within a period of less than one year. The total number of his discoveries is now nineteen.

The first comet discovered by him at Geneva was on the evening of August 7, 1888, in the northwestern heavens. It was situated in the constellation Ursa Major, close to one of the fore-paws. The comet was moving away from the sun in a southeasterly course. It had a short, faint tail, which presented the curious anomaly of pointing almost directly toward the sun, instead of away from it, as well-regulated comets do. Mr. Brooks's next comet was discovered independently, in less than a month after the first, viz., on September 3; Barnard, at the Lick Observatory, it was subsequently learned, having found it the morning previous. It remained visible with good telescopes over a year. Mr. Brooks's next discovery was made on the morning of January 14, thus opening the year 1889. The next discovery came on the morning of July 6, 1889. This comet was in the constellation Cetus, and moved so slowly that it remained nearly six days in the same telescopic field as when discovered. It proved to be a most valuable and

interesting discovery, a comet of short period, thus adding another member to our solar system. As a telescopic comet, this one stands unique in the annals of astronomy. It was found to be attended by several companions. Two of these were visible in moderate-size telescopes, and in the large instruments of California and Vienna four were seen. It is known as Brooks's Multiple comet.

Mr. Brooks's next comet was discovered on the morning of March 19, 1890. It grew brighter until June, when it had a bright stellar nucleus and a fine tail. For this discovery he was awarded a medal by the Astronomical Society of the Pacific,—the first medal awarded by that society. On August 28, 1892, the sixth comet from the Geneva Observatory was discovered by Mr. Brooks; on November 19, in Constellation Virgo, he found another comet; and again another on the morning of October 16, 1893. This discovery was also in Virgo, being the third found by him in that nebulous region, all within short distances from one another, and the nineteenth comet found by this astronomer. It had a tail some three degrees in length, the normal appearance being straight, but, passing daily through a series of changes, now slightly curved, then abruptly bent near the head and split into numerous branches and a multiplicity of forms. Much of this was detected visually, but the photographic revelations of this comet were still more marvelous. Upon the photographic plates secured in the clear atmosphere of the Lick Observatory, the tail was shown increased to ten degrees in length, and in form unlike that of any comet yet observed. In one instance the tail was so broken up and distorted as to appear like a torch flaring in the wind.

Mr. Brooks's work, however, in his new and well-equipped observatory is by no means confined to cometary research; indeed, this forms only a small part of his work. Planetary and solar phenomena, transit work for the determination of time, double-star and spectroscopic observations now engage his attention. He is now devoting much time to photography of the heavens. An important part of his work is the reception of visitors to the observatory, which is open to the public every clear evening. Lecture courses upon astronomy also occupy Mr. Brooks's spare time. He has won a large number of the Warner Gold Prizes for cometary discoveries. His English colleagues, in 1887, honored him by electing him a Fellow of the Royal Astronomical Society, and also a member of the Liverpool Astronomical Society. He is a Fellow of the American Association for the Advancement of Science. In 1890 he was elected a member of the British Astronomical Association, and in 1891 Hobart College conferred upon him the honorary degree of Master of Arts. Mr. Brooks has relations with The Associated Press, and tidings of his discoveries are at once transmitted to all parts of the world, and the news of discoveries by other astronomers is speedily transmitted to him.

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WILD FLOWERS OF ENGLISH SPEECH IN AMERICA.[1]

ENGLISH in the year 1600, though enriched by the glorious group of writers of Elizabeth's reign, was still the speech of a people fond of the chimney-corner, and living shut in by their four seas. In the hundred years that followed, expanding commerce, and the planting of numerous English colonies on the mainland of America and in subtropical West India islands, subjected to a serious strain a language that had hardly ever before encountered the great world. A multitude of things had to be named that hitherto had been unknown and undreamed of even by the seers of the golden age of English imagination, and expressions were to be found for modes of life and action beyond the experience of Saxon or Norman. This exigency was met by taxing old phrases to their utmost through new applications, by giving new meanings and wider currency to provincial words, by borrowing from other European languages, and by plundering the dialects of the barbarians. Every new animal, new plant, new custom, demanded a new word, or, perhaps, a whole set of them. The settlers in different regions supplied identical deficiencies by different devices, and hence came many of the local variations in our American English. If we had the means of tracing the effect of similar crises at the period of Anglo-Saxon migration from the Continent, we might

[1] Since this article was written a few of the words treated as beyond the pale of lexicography may have been brought within it by the issue of new editions of the standard dictionaries, and in particular by the publication of "The Century Dictionary," a work that has opened its columns to a much fuller recognition of American usage than any of its predecessors.