tainly a most creditable exhibit of intelligent work, and will be a decided advance in our knowledge of this subject. It also shows what can be done with the microscope in the hands of one capable of using it to the best advantage.

THE CELESTIAL WORLD.

THE STAR OF BETHLEHEM.

"Where can the Star of Bethlehem be found?" is the oft-repeated question that comes from many quarters. The fact is, no such star is visible in any part of the heavens. An observer with a vivid imagination fancied he had discovered this long-looked-for star, and announced its return in some journal of the day. The paragraph was widely copied throughout the country. The idea pleased the popular fancy, was received with almost unquestioning faith, and the sky was eagerly scanned for a glimpse of the star that once shone over the humble dwelling that enshrined the Redeemer of mankind. Even the peerless Venus was impressed into service, and was firmly believed to be the sacred star once more shining upon the earth after wandering for ages in the star depths.

The history of the so-called Star of Bethlehem is briefly this: Tycho Brahe, a Danish astronomer, discovered, in the year 1572, an apparently new star near Caph in Cassiopea. When first seen, in November, it had attained the first magnitude. It increased rapidly in brilliancy, until it rivaled Venus, and was visible at noonday. It began to diminish in brightness in December, and continued to fade away until the following May, when it disappeared from view.

Forty years later, when the telescope was invented, a small telescopic star was found close to the spot where the wonderful star was seen. It is still there, and is probably the same. It is now classed among variable stars, and is, therefore, liable to blaze forth at any time in the same extraordinary manner. After classifying the star as a variable, the next thing to be done was to find out its period of variability. Astronomical records were searched, and it was ascertained that about the years 1263 and 956 bright stars suddenly appeared near the same quarter of the heavens. It was, therefore, classified as a variable, with a period of about 309 years. Counting back three periods from 956, the exact period being uncertain, the star may have appeared near the time of the Christian era. Some imaginative observer, for this reason, christened it the Star of Bethlehem, and with scarce the shadow of a foundation the name has adhered to it ever since. It is also known as the Pilgrim Star, and among astronomers as the star of 1572.

If the star be a variable, with a period approximating to 309 years, it is now due, and liable to burst forth into sudden brilliancy at any time. No celestial event would be more welcome to astronomers. The scientific world would be wild with excitement over the substantiation of an ingenious theory and the confirmation of its hopes. Its first appearance, its exact position in the heavens, its changes from day to day, would be telegraphed all over the country, and minutely described in the journals of the day. The advent of a comet, spanning the sky from the zenith to the horizon, would be of no account in comparison with the blazing star! Meantime the telescopic star near Caph in Cassiopea shows no signs of any coming disturbance, and observers must wait patiently for developments, remembering that the outburst will be sudden, if it come.

It is generally considered that the extraordinary changes of light in stars like that of 1572 are caused by sudden outbursts of glowing hydrogen gas, which by its own light and by heating up the whole surface of the star causes the immense increase in brilliancy. The spots, faculæ, and rosy protuberances on the sun give some idea, on a small scale, of what may be going on in other suns on a much larger scale. Fortunately, the new or temporary stars observed by terrestrial astronomers number only about twenty-four, an infinitesimal number when compared with the boundless millions of stars that shine with nearly unchanging brightness. The probability is, therefore, small that our sun will be added to the list of blazing stars. He will probably shine for millions of years to come, as he has shone for millions of years in the past, and if observed from other suns and systems will be classed as a variable, with a period of about eleven years, corresponding to the cycle of sun spots.

THE GREAT SUN SPOT OF LAST JUNE.

The solar surface should, according to the sun spot theory, be approaching its most quiescent condition, for it is passing through the stage known as the minimum of sun spots. The condition of the fiery orb, however, does not always conform to the laws laid down. The sun has a way of his own that sets all theories at defiance. An immense spot appeared on his surface on the 7th of June. It was carefully observed by European astronomers during its whole passage across the solar disk. When first seen it was situated a little south of the equator, and its greatest diameter measured 50". It was observed with the naked eye and the telescope, and continued to be visible until the 17th, when it disappeared on the sun's border. The appearance of this enormous sun spot, denoting great activity of the solar force, is specially remarkable as occurring at a time when the sun is passing through the minimum of the eleven-year cycle of sun spots.

Alvan Clark.

One of the great masters of the mechanical arts has passed away. Alvan Clark, the most eminent manufacturer of telescopic lenses in the world, died a little after 3 o'clock on the morning of August 19, 1887. His advanced age had so weakened him that he succumbed to an indisposition that had only affected him for a few days. At the present period, when the subject of manual training is exciting so much attention in educational circles, the lesson of Mr. Clark's life is peculiarly interesting. By his extraordinary technical skill, industry, and patience, he won for himself a fame that was world-wide. In spite of the peculiar field of his work, his fame was not confined to astronomical circles. His name had become a household word.

He was born in Ashfield, Mass., on March 8, 1804. He came of the old Mayflower or Puritan stock. His father was a farmer, and young Alvan received only a public school education. He showed artistic tastes early in life, and possessed a great aptitude for sketching. In 1826 he obtained a position in Lowell, Mass., as designer and engraver for the calico printers in one of the mills. For nine years he kept to this occupation. In 1835 he removed to Boston, and opened a studio on Tremont Street for painting miniatures. His home was in Prospect Street, Cambridge. For twenty years he pursued the profession of artist. He had married on March 26, 1826, his wife being Miss Maria Pease, of Conway, Mass. Their son, Alvan G. Clark, about the year 1844 was a student at Andover, following the course in engineering. The father became interested in the son's scientific studies, and it was at this period that Mr. Clark began the work of his life. According to his own recital, he was thus led to study technical optics:

"My son, Alvan G. Clark, was at Andover, studying to be an engineer. His young mind seemed to be absorbed in telescopes. I was a portrait painter then, and I began to study mechanics and astronomy so as to instruct my boy. We experimented together, and succeeded in making a reflecting telescope. One of the Cambridge professors was much pleased with some instruments we made, and when we suggested to him that we would like to manufacture improved instruments, he gave us great encouragement, and we went ahead."

After succeeding with a speculum, lenses were the next object on which they were to try their ability. The result of their work was so good that, giving up all other pursuits, the father and son devoted themselves to making telescopes. Their reputation grew, and gradually reached England. The Rev. W. R. Dawes, a prominent astronomer of that country, heard of them, and ordered a glass. It reached him in the fall of 1853. This telescope did such fine work that it made their reputation abroad, and many foreign orders were at once received. They began by making six-inch objectives, and their telescopes furnished with these were of wonderfully fine quality. But they gradually increased the size of their work, and in 1860 received an order for a lens of 18 inches diameter. It was in this year also that their present factory was built. Up to that period 15 inches was the diameter of the largest lens in the world. The new order came from the University of Michigan. The civil war prevented its acceptance by the university, and it was sold to the Astronomical Society of Chicago, Ill. By its use, on the night of January 31, 1862, he and his son, Mr. Alvan G. Clark, discovered the companion of Sirius. In consequence of this discovery, the Lalande medal was awarded by the French Academy of Sciences. When in its final position, in which it was placed in 1862, this great glass showed twenty stars hitherto unseen in the nebula of Orion.

During the war the firm were kept busy making binocular field glasses for the use of the Federal officers. In 1870 a contract with them was authorized by the United States Congress for a telescope for the Naval Observatory at Washington. Work was begun upon it in January, 1871. In 1872 the glass was tested with most remarkable results, yet more work was put upon it, and it was only in 1873 that it was mounted. It is considered almost perfect. A duplicate of this glass was ordered by and made for Mr. J. S. McCormick, of Chicago, to be presented to the Washington and Lee University of Virginia. About the same period they began to make a yet larger lens for the Russian observatory at Pulkowa. This instrument cost the Russian government $33,000. It has a clear aperture of 30 inches, a focal distance of 45 feet, and a magnifying power of 2,000 diameters. The general increase in diameter of the firm's lenses may now be thus summarized in inches: 6, 8¼, 9⅛, 12. 15½ (Astronomical Society of Chicago), 18½, 23 (Princeton College), 26 (Naval Observatory and J. S. McCormick), and 30 (Pulkowa Observatory). For the last instrument the Imperial Academy of Science gave a vote of thanks, and the Czar of Russia a gold medal.

The great telescope of 36 inches diameter, for the Lick Observatory of the University of California, is greatest triumph. The price was placed at $50,000. The main portions of the lens were completed about a year ago. The photographic lens is still unmade. It was nearly completed with the others, when, during an experiment, it was destroyed. Mr. Alvan G. Clark is now in Europe to secure a new disk for another attempt.

It is said that Alvan Clark had never seen a lens ground. All his skill he acquired in his own workshop. He was extremely modest, preferring to talk of his artist life rather than of his optical triumphs. To those who visited his shop he used to exhibit with pride his miniatures. These were very fine, and had he continued as an artist, there is little doubt that renown would have been acquired by his brush. Later in life he returned to portrait painting as a recreation. Up to a recent period he was in daily attendance at his shop.

Amherst College in 1854, Princeton in 1865, and Harvard in 1874 gave him the degree of A.M. His wife and two sons, Alvan G. and George B. Clark, survive him. Last year the sixtieth anniversary of his wedding was celebrated.

He made several scientific discoveries of importance, inventing a double eye piece and devising a very valuable and accurate method of measuring small celestial arcs. It is a matter of congratulation that his sons have so long been associated with him, as the extinguishment of the Clark establishment would be a misfortune to science.

Metallic Thermometers for Hot Drying Chambers.

The object of this instrument, says the *Bulletin de la Societe Industrielle de Mulhouse*, devised by Mr. H. Grosheintz, is to indicate the average temperature of a hot flue or drying chamber, in which it is necessary for success in the drying of delicate fabrics that the process of drying should take place very regularly and at an exact temperature.

The thermometer consists of a brass wire, the expansion and contraction of which supply the indications of temperature, and a system of levers outside the drying chamber, by means of which the range of action is multiplied. Thus the variations in temperature may be read more plainly. The apparatus is at work in the establishment of Messrs. Scheurer, Rott & Co., in a drying chamber 74 feet long, between walls. The wire is one twenty-fifth inch or one millimeter in thickness, and is 79 feet in length, stretched from outside to outside of the walls, passing through openings in them. One end is fastened to the outside of one wall, and the other end is connected to a system of levers outside the other wall, by means of which the variations in the length of the wire are multiplied sixteen times.

Taking the expansion of brass wire at 0·18 per cent of the length, between the temperatures 32° and 212° F., the extension on 79 feet of length is $79 \times 100 \div 0{\cdot}18 = 1{\cdot}685$ inches, and $1{\cdot}685 \times 16 = 27$ inches is the range of the pointer between the given extremes. The scale is graduated in accordance with a mercurial thermometer, placed within the chamber at about the middle of the wire. The metallic thermometer is very sensitive. For instance, when the two thermometers, metallic and mercurial, read 60° C., or 140° F., at the beginning of an operation, before the pieces to be dried can be passed in, the metallic thermometer falls 9° or 10°, while the mercurial remains stationary. The metallic thermometer has been at work for three years continuously, and gives great satisfaction.

Manufacture of Glucose with Nitric Acid.

The originators of this process, A. Seyberlich and A. Trampedach, use nitric acid for the saccharification of starchy or amylaceous matter. To eliminate, then, the nitric acid from the solution of glucose thus obtained, water saturated with sulphurous acid is added in such quantity that the sirup smells of this gas. The mixture, heated rapidly, brings about the decomposition of the nitric acid. At the expense of the oxygen contained in this acid the sulphurous acid is rapidly converted into sulphuric acid, and nitric oxide is evolved. The reaction is so perfect that no trace of nitric acid can be found with Schönbein's reagent. On heating to boiling, the excess of sulphurous acid is expelled from the saccharine solution. This last operation must be conducted rapidly, and with an abundant supply of steam, so that the saccharine solution shall not remain long in contact with the sulphuric acid formed, as otherwise the sugar would be liable to decomposition. The solution of glucose obtained is neutralized with carbonate of lime, and made alkaline with alkaline carbonates evaporated and crystallized. The crystalline mass contains only a small quantity of sulphate of sodium, and can be at once washed.—*Zeitschrift fur die Chem. Indust.*

FOUR kittens, born at Narragansett Hotel, in New London, were bound together like the Siamese twins by a ligature at the abdomen. The cords were in the form of two triangles joined at the apex, the four ends connecting the kittens, with a space of 1½ inches between.