SUNLIGHT AND MOONLIGHT.

The following interesting report of a lecture by Prof. Morton, at the Academy of Music, Philadelphia, we copy from our esteemed cotemporary, the *Philadelphia Photographer*:

Assuming that his hearers were acquainted with the general laws governing the emission and reflection of light. Prof. Morton proceeded to explain the difference between regular and diffused reflection, illustrating this point by an original and singularly pleasing experiment. A large mirror was set midway in the stage, facing the audience, who could see themselves reflected on its ample surface. Over this mirror, an assistant, at a signal, let fall a delicate white veil, when at once there appeared, as if just within the surface of the glass, a phantom-like figure, which was then seemingly wrapped up in the veil, as that was rolled together, and appeared to fall with the falling tissue, as it was dropped to the floor. The appearance of this experiment was most beautiful and excited much attention. The lecturer then explained the method of its arrangement, in which a lantern, with a glass photographic picture placed at one side, and throwing an image obliquely on the mirror, played of course, an important part.

Various illustrations projected on the screen, from photographs of statues and mirrors, and landscapes with still water reflecting the adjacent objects, were then used.

To give such things due effect in such a building, is no easy task. The front of the stage is fifty feet in width, and the most distant of the audience more than one hundred feet from that point. An immense screen and powerful illumination are therefore necessary. The screen employed was of wet muslin, forty feet square, lowered into its place at the moment when required. To cover and illuminate brilliantly such a surface (sixteen hundred square feet), no ordinary lantern would suffice, and, accordingly, Professor Morton has had one constructed by Mr. Zentmayer, with condensers eight inches in diameter, and of three-inch focus, with which pictures of corresponding size are used. Thus, an objective of low power may be employed and loss of light avoided, as also a larger ignited surface of lime utilized without injury, on account of the corresponding increase of size in all parts. Most of the pictures used on this occasion were made by Mr. O. H. Willard, photographer, who also operated the lantern, and whose skill was equally well illustrated by the pictures produced and the style of their projection. Some of the transparencies were, however, made by Mr. O. G. Mason, of New York, from Mr. Rutherfurd's negatives, and others again, by Mr. J. C. Browne, of Philadelphia, all gentlemen whose skill is well known to our readers.

After the illustrations of reflection above mentioned, came a series of moon photographs, intermixed with copies of lunar maps, and a number of admirable imaginary views of lunar scenery, from drawings prepared by Mr. James Hamilton, our eminent artist, who is so widely known by his marine pieces, and who can produce more apparent motion and commotion on canvas than any one living, we believe. These views were of the most impressive description, especially one of the lunar volcano, Copernicus, and its vicinity.

The direct lunar photographs by Mr. Rutherfurd, were also most effective. Thus, we beheld, to our great delight, a moon, round and full-orbed, as bright as the original luminary, but rolling on to the screen as a globe of thirty-five feet in diameter, her mountains and volcanic cones, and extended plains distinctly visible. And this was not a mere picture skilfully painted, but a veritable reflection of that orb. The moon's own face *photographed* by powerful lenses, and magnified by Mr. Rutherfurd, whose skill in this department is unrivaled.

The lecturer described and named the various plains, and peaks, and hilly ranges, as though he had just returned from an exploring expedition to these Rocky Mountain regions. We had the Ocean of Tempests, and Seas of Showers, of Serenity, of Vapors, and of Clouds (still called seas, though now known to be arid land wastes), defined and designated, while the heights of the peaks, the depths of valleys and volcanic craters, were indicated as clearly as those of any earthly elevations or depressions accessible to the foot of the surveyor.

The planet Mars appeared, not as a brilliant speck or point of light, but as a vast round silver shield, with the marks of seas and continents distinctly traced. Another photograph, taken an hour later, and lo! the aspect of the planet had altered. A great snow-storm had been sweeping over it. Its majestic mountains and plains had been draped in a winding-sheet of frozen rain, and the dark wastes had become white, and the deep seas alone retained their original sombre hue. Think of a snow-storm in a distant planet, watched, and followed, and fixed on glass plates, and presented to an audience sitting comfortably in the opera-house of the city of Philadelphia.

The magnetic telegraph can tell us what is happening in distant parts of our globe, but here is a messenger who comes to us, and tells us what is happening in the planet Mars, more than thirty-five millions of miles away! The storm signal is hoisted on the coast of England, and mariners know that a tempest is up and at work on the broad Atlantic, and may soon be looked for, howling along the chalk cliffs of the island, and thundering into its bays; but the telescope, and the photographer with his baths and plates, here reveal how a tornado of sleet and snow is sweeping across the plains and oceans of the *planet Mars*.

Attention was next directed to the sun. His spots were, by means of photographic art, shown to be gigantic rents made in the robe of fiery cloud masses which compass the orb; just as wild cyclones or great rotary storms might tear and rift the rain clouds which cover our sky, twirling them round and making tempest circles, with radii of thousands of miles. The rotary motion of these sun-storms could be distinctly traced in the several photographs made at different periods of their progress, and the laws which regulated their motion investigated and determined.

To illustrate the effect of such a temperature as that shown to exist in the sun upon some familiar elements, and to explain why these should occur as *vapor* in his atmosphere, the lecturer placed himself with a powerful oxyhydrogen blowpipe upon a platform secured to one of the stage straps, and was raised to a considerable height, from which point, by burning a thick rope of steel wire in the jet, he caused to pour down a broad sheet of scintillating sparks and minute globules of boiling iron, which spread over the floor and rolled toward the footlights with an effect never to be forgotten by one witnessing it.

The fixed stars as suns of other systems were next noticed, and in connection with some of the peculiarities which they exhibit, the subject of persistence of vision was introduced and illustrated by several beautiful experiments, among which the most remarkable was a large wheel, five feet in diameter, carrying six Geissler tubes of great size, through which, while in motion, flashes of electric light were passed from an induction coil, made by Mr. Ritchie, of Boston, (probably the most powerful in the world, having produced sparks twenty inches in length), belonging to the University of Pennsylvania. This apparatus produced the appearance of a star with countless colored, vibrating and ever-changing rays.

The final and perhaps most impressive expe[redacted]nt of the lecture was, however, that illustrating the [redacted]te character of white light and the difference betw[redacted]effect as an illuminator and those of monochromatic light.

The drop curtain was lowered for a few moments, to allow of some scenic changes, and during this time the lecturer explained the subject in hand to the audience, and by aid of two large groups of chromatic burners, fed with spray of chemical solutions, produced lights of contrasting colors on opposite sides.

The curtain then rising displayed a brilliant palace scene, illuminated by several lime lights, judiciously placed. At a signal there then marched in a troup of brilliantly costumed masks (consisting of students of the University, who had volunteered for the occasion), bearing banners with appropriate colored devices.

The effect of this march was most striking, the tramp of the advancing columns, the rushing flutter of the banners crowding the stage, and the blaze of gaudy colors in the bright white light, formed a spectacle as pleasing as it was novel and unexpected. The masks having grouped themselves around the stage, at a signal the white light was turned off, and from six large sets of chromatic burners a flood of yellow light was emitted. Instantly the brilliant array became a troup of ghastly phantoms, clad in gray, and bearing banners with black and white devices.

The amount of yellow light was so great as to illuminate the entire house and reduce the audience to a concourse of sombre-clad spectres. The lights were then changed several times. This experiment was by far the most impressive thing we have ever seen, and by the precision with which everything was managed, reflects great credit on all concerned in its production

MANUFACTURE OF MALLEABLE IRON IN SCOTLAND.

In No. 1, of the current volume, we gave a condensed account, from the *Ironmonger*, of Cast Iron Working in Scotland. We herewith give, from the same source, a description of the manufacture of malleable iron, as conducted in that country.

The conversion of pig-iron into malleable by the "puddling" process was commenced in Scotland about forty years ago, when a number of workmen from England and Wales were brought into Lanarkshire for the purpose of instructing the Scotch ironworkers. The first attempts, however, to establish this branch of trade, were not successful, and it was not until 1836 that it was fairly started. There are now nearly 400 puddling furnaces and 50 rolling mills in operation, which, in 1867, produced 143,000 tuns of malleable iron, valued at £1,006,600.

THE PUDDLING PROCESS.

The places in which the process is carried on are nearly all constructed on the same plan. The mill consists of a vast roof supported on iron pillars, so that the sides are quite open. The puddling furnaces are built at intervals along one or two sides of the mill; and the floor, which is paved with iron plates, is crowded with machinery, a powerful steam engine occupying the centre. The work of the puddlers is probably the severest kind of labor voluntarily undertaken by men. The puddling furnace is a compact structure of fire-brick cased in iron. In consists of three parts—the fireplace, the hearth, and the flue. The fireplace is on the left hand side, and is separated from the hearth, which occupies the central place, by a low wall or ridge. To the right of the hearth is the flue, the entrance to which slopes downward from the hearth, so that when a fire is lighted in the fireplace, the flame is drawn close over the hearth in its passage to the flue. Each furnace requires two men to work it. One of these is the puddler, who has all the responsibility, and the other his assistant, who performs the portions of the work in which only slight skill is required. The quantity of pig-iron operated upon at a time is about four hundredweight, and is called a charge. One charge is got out of the furnace every two hours, and the work goes on night and day, from one week's end to the other, Sunday excepted—the men taking the night and day shifts by turns. After a charge is withdrawn, the furnace undergoes some slight preparation before another is put in. A coating of "bull dog"—a material prepared from the slag of the furnace—is laid upon the hearth, to fortify it against the intense heat. The pig iron, which has previously been broken into pieces of convenient size, is then thrown in, and the doors of the furnace are closed and sealed up with cinders. Intense heat is then generated. In about a quarter of an hour after the furnace has been sealed, the iron shows signs of melting, and an aperture in the hearth door about six inches square is opened. The puddler looks in at the opening, and determines whether it is time to disturb the iron. So soon as he sees the finer angles of the iron begin to melt, he thrusts in a stout rod of malleable iron, and moves the lumps of metal about, so that the entire mass may be equally heated. The puddler's assistant takes a turn at this part of the work; and during its progress the heat is occasionally moderated by means of the "damper," or by dashing small quantities of water upon the iron. At frequent intervals, the puddling bar is withdrawn and cooled by being dipped into water. The iron dissolves gradually on the hearth, and after a time begins to heave and bubble, innumerable jets of flame bursting forth all over its surface. The desired chemical change is now going on. The hot air from the furnace sweeps over the iron and carries off a great part of the carbon, sulphur, phosphorus, and silicon contained in the pig iron. Care must be taken to prevent the metal from becoming too fluid; and as soon as it attains a pasty consistency the heat is moderated. Meantime, the puddler uses his rod vigorously; and as the metal now begins to "dry," the labor of moving it about is increased. The metal at length seems to curdle and become granular. As it then ceases to give off carbonic oxide, the heat of the furnace is again raised, and the particles of metal begin to adhere together. From this point the chief puddler undertakes and completes the operation. As the metal agglutinates, it becomes very difficult to move. The puddler has to exert himself to the utmost; and he dare not relax his efforts for a single minute, else all the previous labor would be worse than lost. Though the perspiration trickles from his face and arms, and oozes through his scanty clothing, he must toil on. His eye is never removed from watching the contents of the furnace; and the expression of anxiety on his face indicates that the operation has reached a critical point. When the metal has attained a certain degree of consistency, the puddler divides it into five or six heaps. He then works each heap into a "ball" or "bloom." The door of the hearth is opened, and one after the other the balls are drawn out with a large pair of tongs and dragged over the floor to the "shingling" hammer. As the balls are drawn from the furnace they have a spongy appearence, and slag and other impurities trickle from them. The operation we have described occupies, on an average, about two hours, and the quantity of unrefined pig-iron required to make a tun of puddled iron may be stated at from 22 to 23 cwt

SHINGLING AND ROLLING.

It is the puddler's duty to convey the "balls" from the furnace, and to place them one by one on the anvil of the "shingling" hammer. Before the invention of the steam hammer, a somewhat clumsy contrivance was used for squeezing the slag out of the puddled iron, and beating it into shape. Now the steam hammer is everywhere employed for that purpose. When a puddler lays a "ball" on the anvil, he waits to see the result of the first blow, and from it he is enabled to judge of the quality of his work. The "shingler" then steps forward and takes charge of the "ball." His feet and legs are encased in iron armour, his body is covered by a stout leather apron, and he wears a mask of the same material. One stroke of the hammer makes apparent the use for this warlike attire, for it sends out in every direction jets of liquid fire, which patter against the legs of the workmen, and would inflict fearful injuries were they to come in contact with the skin. The manipulation of the ball under the hammer is severe work, and requires great expertness. The "shingler" uses a pair of tongs about four feet in length, and with these seizes the ball and turns it on the anvil every time the hammer ascends. He so manages that it assumes the shape of a brick, and the operation occupies only two or three minutes. The "shingler" passes the metal, yet at white heat, to the "rollers," who pass it through a series of grooves in a pair of solid iron cylinders. By this means it is drawn into bars of the required size.

The iron produced by the above process is called "puddled bar," and it has to go through another operation before it is suited for even the commoner purposes of the blacksmith. In order to produce what is known in the trade as "common iron, the puddled bars are cut up into short lengths, and a number of these are laid in a heap of sufficient size to make a bar of any stated dimensions. They are then placed in a "re-heating furnace," and exposed to a free circulation of heat. In about half an hour the iron becomes heated to what is known as the welding point, and is then removed and passed through the cylinders as before. When the rolling is completed, the bars are taken away by boys, and cut to the desired length by means of a circular saw, which passes through the metal with astonishing rapidity and with a hideous noise. The bars are then straightened on an iron plate, stamped with the maker's name, and allowed to cool. From the moment the iron is taken out of the re-heating furnace until the bars are ready for the market, the utmost expedition is required on the part of the workman; and their operations, especially when witnessed at night, form one of the most interesting sights connected with the manufacture of iron. When a finer quality of iron is required, another welding and rolling are given to it. These repeated heatings however, entail a considerable loss of material—equal, we believe, to eight or ten per cent for each heat. In making