LIGHTHOUSE ILLUMINATION.

IN the present day, the majority of lighthouses in the United States or practically all depend upon kerosene oil as their illuminant. In old times, the first representatives of warning lights on shore may be supposed to have been bonfires, succeeded in their turn by braziers. It is believed that the Colossus of Rhodes held in his upstretched hand a brazier in which a fire was maintained to guide vessels into the harbor. His modern successor, the Goddess of Liberty, in the harbor of New York, carries an electric torch, in virtually the same position that her prototype is supposed to have held his brazier. Candles also played their part in the illumination of lighthouses, but in modern days everything has given way to the oil lamp, with very few and isolated exceptions.

A representative of the early oil lamp is shown in the cut. This was adapted to burn lard oil, and in order to prevent the oil from chilling, a curved copper rod extended from a point well above the chimney down into the oil, and terminated above the chimney in a small ball. The waste heat of the flame thus maintained the oil in a heated state. Eight to twenty-four of these lamps were mounted on a single armature. In Montauk Point light, twenty-four of them were used, and were removed in 1853. They originally burned sperm oil, which was afterward changed to lard oil. This lamp was fitted with a reflector illustrating the reflecting or catoptric system of lighthouse illumination.

Its successor was a French mechanical lamp for colza, sperm or lard oil, which was used in lenticular burners. In this machinery pumped the oil up to the wick, whence it continually overflowed. The machinery was objectionable and the lamp was superseded in time by Funck's hydraulic float lamp, in which the oil was carried in a reservoir surrounding the upper part of the prolongation of the chimney, thus being kept warm and fluid by the waste heat. In its course to the wick the oil passed through a chamber containing a float. The float was adjusted so as to rise and close by a valve the oil inlet as soon as the oil reached the proper height in the wick reservoir, thus maintaining the oil always at the same level. Lard oil was the fuel of this lamp. Professor Joseph Henry, who took the most active interest in the lighthouse establishment of the United States, and who was constantly experimenting in the laboratory and field upon the subjects of night and fog signals, introduced lard oil, thereby saving $100,000 per annum. The year 1864 is the date of this change. He was greatly interested in the development of the Funck lamp just described. As kerosene has improved in quality the time came, about 1873, when it naturally superseded the more expensive lard oil. For its combustion in the smaller lighthouses the lamp known as the Funck-Heap lamp was devised. This is the product of the ingenuity of Mr. Joseph Funck and Major D. P. Heap.

It is a standard Argand lamp with single wick. The feed of the wick is effected by a screw thread on the wick-carrying tube, as in the student's type of lamp. The chimney is carried in a gallery, which furnishes a support for it, and in which it can stand erect when removed from the lamp. A brass deflecting cap surrounds the wick, and around its base this cap is perforated with a number of holes. The holes admit cold air, which, forming a mantle around the flame, protects the chimney from intense heat, which would whiten or might even melt it. A deflecting button is carried by a spindle in the center of the flame. This button gets nearly red hot, and the air rising and impinging upon it becomes undoubtedly materially heated, so that a certain amount of regenerative effect ensues. This lamp is rated at fifty candle power. Its wick is 1⅛ inches internal and 1¼ inches external diameter. Its flame is so white and intense that it is almost painful to look at. It burns 1½ gills of oil per hour, 202 gallons being allowed for its annual consumption.

For the larger lights larger lamps are used. In the drawings we show the first order five-wick burner, rated at 500 candles, which is used in the first order lighthouses. Next to it is shown the first order kerosene lamp, on which such burner is mounted. This lamp is a float lamp embodying the float valve already described. To force the oil up from the reservoir below, a weighted piston is used. This piston, with leather packing, tightly fits the cylindrical oil chamber below the burner. It is weighted, and contains a valve opening downward. Its weight forces the oil up to the chamber and thence into the wick chamber. As required, the piston is drawn up by turning the handle, the downward opening valve permitting this to be done, and is then again released when its weight again comes into play, and the oil is forced upward.

In practice, the piston is raised once a night and feeds ½ gallon per hour. Its total feeding capacity is 8½ gallons. The annual supply of oil to such a burner is 2,156 gallons. In the float lamps the oil is maintained constantly at a level of 1½ inches below the top of the wick.

To trim the wick the valve is shut in the supply pipe, and the lamp is allowed to burn out, which it does very soon. After cooling, the wicks are then brushed off, no attempt being made to cut them. In the Funck-Heap lamp the trimming is effected also by rubbing off the wick after the oil has been burned out.

The lenticular apparatus in which these lamps are burned is universally of the Fresnel order of construction. Where the entire horizon is to be lighted, it is obvious that the lamp might be surrounded by a species of cylinder whose longitudinal section as regards each side would be lenticular. This construction would exact an immense thickness of glass for the center part. To avoid this the lens is broken up into a series of prisms, with the exception of a small portion of the center. These prisms are bent around to the shape of the lens chamber, and are so cut as to represent sections of a lens as it would be at each position of a prism. Thus immense structures are built up, the first order lenticular apparatus, which we show in one of the cuts, being large enough to contain a number of men, while the second order and fourth order lenses, which we also show in the cut, are, of course, of considerably smaller size. The smallest regular lighthouse lens used is the fifth order, and below this, for special purposes, come special lanterns; some with true Fresnel lenses, others with as near an approach to them as can be got in pressed glass.

The lenses may be disposed in annular segments, in which case their concentration of the rays of light is altogether in the vertical direction, the light, as it were, being converted from a sphere of dissemination to what is almost a disk. Sometimes flash lights are required. These are produced by having the prisms and glass of the lenses so ground and mounted as to represent a number of true lenses, which send the light out, not in discoid distribution, but in a definite number of radiating beams. If such a lenticular apparatus is rotated, it will carry with it around the circle of the horizon these beams, producing for the onlooker the effect of a corresponding number of flashes per revolution of the lens. For color effects colored glass chimneys were at one time used, but proved expensive on account of their fragility. They have been replaced by colored glass shades.

An application of the circular lens to lamps is shown in the range light, one of the largest in the world, and which is to be one of the exhibits at the Columbian fair. As regards its refracting apparatus the drawing speaks for itself. The back of the light is the characteristic part of the apparatus. This consists of a set of totally reflecting prisms cut at such an angle and so set as to reflect back all the light which falls upon them. Thus this range light utilizes a great part of the light which would otherwise be totally wasted. It is open at the sides so as to give the most convenient access possible to the lamp.

In the cuts showing the first order light, the section of plate glass lantern in which the light and great lenticular apparatus is maintained are also exhibited.

To show the type of building in which these lights are placed, a view is given of Execution Rock lighthouse. This is situated on Long Island Sound, a little north of a line connecting Glen Island with Sands Point, about twenty miles from the Battery. It is one of the older structures, and in former days the keeper used to live in the lighthouse itself. Since those times a very substantial stone house has been built for his accommodation and a powerful fog signal is established to warn approaching vessels while still far from it. The light, formerly a stationary one, is now a flashing light, while the Sands Point light a mile distant is fixed.

The oil used by the Lighthouse Department must conform to the following test: It must be of 140° flash test, 154° fire test, about 0·800 sp. gr., and free from acid, and, burnt in an Argand burner of the Funck-Heap style, light must show 18 candles illuminating power on a consumption of $\frac{1}{8}$ of a gill per hour. In 1878 the use of kerosene was commenced on a small scale; its use is now universal in the United States.

The electric arc lamp, apparently very powerful, is found to be very unsatisfactory in fogs, owing to its slight penetrative power. The Board do not regard its use with much favor on this account. The incandescent electric lamp, however, does meet with some applications, and probably will meet with more on lightships and similar places. Recently a number of electric-lighted buoys have been established to mark Gedney's Channel, in the lower bay of New York. Each of these carries a small Fresnel lenticular apparatus, with a 50 candle power incandescent lamp inside it. The whole are maintained by current supplied by cable from the shore. The installation, while on its face of the most perfect type, has really given a great deal of trouble, and its behavior has not been such as to entitle the system to be very favorably regarded.

Our thanks are specially due to Major D. P. Heap, U. S. A., engineer in charge of the third district, for courtesies received in connection with this article.

Photography in Colors.

Mr. Frederick Ives, of Philadelphia, recently delivered his second and concluding lecture on "Photography in the Colors of Nature," before the members of the Royal Institution, London, and showed some remarkable views of Yellowstone Park produced in colors by means of his composite process. Mr. Ives first explained in detail the principles upon which the three colored screens which he uses in producing his triplicate negative are selected, illustrating the theory by means of magic lantern views of the spectrum, but the greater part of his lecture was devoted to the mechanical aspects of his invention—in particular, the means by which the three images are superimposed. With the subject of the production of permanent color prints by his process Mr. Ives dealt very briefly; indeed, he frankly admitted that such prints could only be produced by a complicated process which required a considerable scientific knowledge of the laws of color sensation on the part of the operator, and at a cost which precluded the possibility of profitable manufacture. He claimed, however, that by the application of his invention to the helio-chromoscope he had actually solved the problem of photography in the colors of nature, since the illusion thus produced was more perfect than could possibly be obtained by means of a photographic print. He promised that his camera, in which the triple negative is produced on a single sensitized plate by means of a single lens with a single exposure, would shortly be obtainable everywhere by amateurs, who would thus be enabled by a process as simple as that of the production of an ordinary photograph to make a transparency which, on being placed in position in the helio-chromoscope or behind the triple objective of a specially fitted magic lantern, would perfectly reproduce the colors of nature.

In conclusion, Mr. Ives showed by means of the magic lantern some half a dozen views in Yellowstone Park, and one or two portraits, the colors of which were wonderfully natural, though the lecturer explained that tints could only be reproduced in their full brilliancy by a lantern illuminated by sunlight or the electric light. A photograph of flowers of most brilliant hues was shown in the helio-chromoscope.

Professor Hofmann.

We regret to have to record the death of the illustrious chemist August Wilhelm Hofmann. He died on May 5. Prof. Hofmann, says *Nature*, was well known in England, where he spent many of his best years. On Liebig's recommendation he was appointed in 1848 Superintendent of the Royal College of Chemistry, in London. This institution, which made great progress under his care, was in 1853 merged in the Royal School of Mines as the Chemical Section. He became a Warden of the Royal Mint in 1855. In 1864 he accepted the chair of chemistry at Bonn, and in the following year he was called to Berlin, where he spent the rest of his life as professor of chemistry. He made many contributions to the *Annalen der Chemie*, to the Transactions of the Chemical Society, and to the Philosophical Transactions of the Royal Society, of which latter institution he was made a fellow in 1851, in recognition of his services to science. In 1854 he was awarded a royal medal for his "Memoirs on the Molecular Constitution of the Organic Bases." Some of his discoveries led to industrial results of the highest importance. The high respect in which Prof. Hofmann was held in Germany was shown at his funeral, which took place recently. It was very largely attended, and, according to the Berlin correspondent of the *Standard*, "was in all respects worthy of a prince of science." The correspondent says: "The Empress Frederick, immediately on receiving the news of the professor's death, telegraphed to his widow, 'My deepest sympathy in your great, your irreparable loss. I am deeply shocked by the quite unexpected news of your dear husband's death.' Her imperial majesty sent a splendid laurel wreath bearing her initials, to be placed on the coffin, and a court chamberlain represented her majesty at the funeral. The minister of education and numerous officials of his department, all the members of the Berlin Academy, and almost all the professors and students of the university, accompanied the funeral procession to the cemetery."

Workmen Killed by an Electric Shock.

An accident recently occurred at the Edgar Thomson Steel Works at Braddock, Pa., by which two men were killed and several others rendered unconscious. A number of men were working on a traveling crane in the blacksmith shop. The boom came in contact with the electric light wire and cut through the insulation. In an instant the full force of the current was conducted along the iron framework of the crane, and all the men in contact were knocked insensible. A panic ensued among the other employes, but as soon as the cause was ascertained the current was shut off, and a rush was then made to assist the prostrate men. All except three of the men soon recovered. The others were carried outside the shop and restoratives promptly administered. Two died in a few minutes.