Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

O. D. MUNN. A. E. BEACH.

TERMS FOR THE SCIENTIFIC AMERICAN.

One copy, one year, for the U. S., Canada or Mexico.................$3 00
One copy, six months, for the U. S., Canada or Mexico................ 1 50
One copy, one year, to any foreign country belonging to Postal Union. 4 00
Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, corner of Franklin Street, New York.

NEW YORK, SATURDAY, DECEMBER 16, 1893.

Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF

SCIENTIFIC AMERICAN SUPPLEMENT

No. 937.

For the Week Ending December 16, 1893.

Price 10 cents. For sale by all newsdealers

PROF. JOHN TYNDALL.

On the evening of December 4, Prof. John Tyndall died. The son of an Irish policeman, a man whom he himself described as "socially low, but mentally and morally high," he had before him the task of working his own way up in the world. He was born August 21, 1820, in Leighlin Bridge, near Carlow, Ireland. He left school at the age of nineteen, and joined the Irish Ordnance Survey. Here he may be said to have begun his scientific career. In 1841 an official asked him how he employed his leisure hours, and told him that with five hours a day at his disposal they "should be devoted to systematic study." He added, "Had I when at your age had a friend to advise me as I now advise you, instead of being in a subordinate position, I might have been at the head of the survey." Next morning it is said Tyndall was at his books at five o'clock, and for twelve years followed the advice given him.

He became dissatisfied with his slow progress, and in 1844 wished to emigrate to America. But a position as railroad engineer in England was obtained for him, and he remained. In 1847 he took the position of master of Queenwood College, Hants, Hampshire. He showed great talent for teaching and began to contribute scientific papers to scientific periodicals. In May, 1847, his father died. In 1848, with Frankland, since professor of chemistry in the Royal Institution, he went to Germany. There, under Bunsen, Knoblauch and Magnus, he studied science for two years, receiving his degree in 1850. In 1851, on his return to London, he met Faraday. He was at once taken up by the great master, and was associated with Faraday in his work at the Royal Institution of Great Britain. He was appointed to the chair of Natural Philosophy there in 1853, and after Faraday's death in 1867 succeeded him as superintendent.

He published many works and papers on scientific subjects. His books, written for the popular taste, are excellent examples of scientific exposition. In 1872, when at the height of his fame, he made a lecturing tour of the United States. His lectures, given in this city, were received by large audiences, no experimental lectures, probably, ever being greeted with such *eclat.* The daily papers reported them with illustrations of the experiments in some cases—testifying to the interest in them on the part of the public. His receipts from the lectures—some $13,000—he presented to Harvard University, Columbia College, and the University of Pennsylvania, founding scholarships in aid of students who devote themselves to original research.

A great Alpine climber, for many years he visited Switzerland, and there met his wife, also an enthusiast on mountain climbing, whom he married when he was 56 years old. She was the innocent cause of his death. He had been ill for some time, and was taking both chloral and sulphate of magnesia. By mistake his wife gave him a large dose of chloral, thinking it was the magnesia. As she realized what she had done, she told him. He cried, "You have killed your John." He jumped out of bed and called for a stomach pump. The physician was summoned, who gave an emetic which operated, but life could not be saved, although the doctors worked over him all day. The fatal dose was taken at 8:30 A. M., and death occurred ten hours later, 6:30 P. M.

SCREEN PHOTOGRAPHY IN COLORS.

As has been known for some time, the primary colors of the spectrum, red, blue, and green, when combined, produce white light. The utilization of these colors in reproducing photographs in the colors of nature has been proposed and demonstrated by Mr. Fred. Ives, of Philadelphia. His method has been lately improved upon by an optician of this city, Mr. R. D. Gray, and it was our privilege to witness his public demonstration of his improvements on the 8th instant.

He follows out the usual method of taking pictures for color reproduction, by first taking in the camera on an orthochromatic plate, with a red screen between the lens, a picture in which all the light values of the blue and white rays are excluded, allowing only the color values of the reds in the subject photographed to be reproduced. In making such a photograph, which takes the longest time, he usually has the lens stopped down to $f/8$ and gives an exposure of three minutes. He then takes another negative with the camera in the same position, in which nothing but the green of the object photographed has any effect on the plate. Still retaining the camera in the original position, the third negative is taken in the ordinary way with white light, or without any tinted screen behind the lens which represents all the value of the blue and white rays that emanate from the object. After these negatives are once made, it is simply a matter of ordinary photography to reproduce from them lantern slides or positives.

It should be mentioned that the lantern consists of three objectives and three condensers, in front of one of which is placed a blue glass, in another a red glass, and in another a green glass. These three optical systems are illuminated by three separate jets of lime light, or instead of lime light the electric arc light may be used.

To project the three separate positive pictures in a lantern, he has a square light wood frame divided into four compartments or four apertures, and he uses three of these apertures for holding the plates, and his method of aligning the respective plates with the lantern is somewhat ingenious and practical.

One of the most difficult problems connected with this system of projecting the color pictures upon the screen is to make them exactly coincide, and Mr. Ives had great trouble in doing this when he made a public exhibition, but Mr. Gray has perfected a very simple and ingenious device for bringing each picture into the proper alignment. He first takes one plate and secures that in one division of the lantern slide frame, and places it in the lantern; he then takes the second plate and places that in the second division of the frame, and then applies his adjusting attachment. One person stands at the lantern and one at the screen. The operator at the lantern then operates the adjusting screw until the position of the plate is such that the person at the screen decides that the two images coincide. The third plate is similarly adjusted in the lantern slide frame by a duplicate adjusting device. The whole is then removed from the lantern and each plate is sealed in position, so that, for that particular lantern, this lantern slide frame is all ready for use and will always register accurately upon the screen. The positions of the pictures in the lantern frame correspond to the colored screens through which they were originally made.

As a result of this method it is a very simple matter to place picture after picture in the lantern and run them through the same as an ordinary lantern, and Mr. Gray claims that while others have only shown a few slides made for color projection, he has been able to produce a larger number.

Having thus perfected the minute detail of adjusting the pictures and the apparatus for showing them, it was very easy and simple to project them on the screen, and the marvelous beauty and delicacy of the combined colors in showing the various grades of color in the pictures was surprising and most pleasing, and gave one a more adequate idea of the beauty of the landscape than an ordinary monotone photograph. In pictures of autumn foliage the delicate reds and yellows would appear to great advantage, in photographs of distant mountains the azure blue of the sky covered with scattered white clouds appeared with most natural effect, contrasting finely with the snow-capped peak and the brown and green foliage below, and in portraiture the color of the skin, the clothes and accessories were most admirably reproduced. The red and green in a watermelon picture were capital.

In using the lime light, when colors are combined, before the insertion of the slides, the appearance of the screen is white, with a slight tinge of blue. It is supposed that if the electric arc light is used in place of the lime light a still better result may be obtained.

The success of Mr. Gray in demonstrating the practicability of projecting photographs in colors is certainly an advance in this line of work. We believe he has applied the same principle to the reproducing of colored photographs in printing inks.

THE PENNSYLVANIA ANTHRACITE COAL FIELDS.

The late report of the commission appointed by the State of Pennsylvania to investigate the subject of "Waste in Coal Mining" contains matter of general interest.

The anthracite coal fields are found within an area of some 3,300 square miles, about 484 of which contain workable coal beds. This area would form a polygon by drawing a line from the northeastern limit in Wayne County westward to Bernice, then southwest to Dauphin, then northeasterly to Mauch Chunk, then to point of beginning, mostly in the counties of Wayne, Wyoming, Luzerne, Schuylkill, Carbon, Dauphin, Northumberland, and Huntingdon.

Prof. J. P. Lesley, in charge of the Geological State Survey, is of the opinion that originally the coal field covered the whole State and parts of the neighboring States, a remnant of which is found in the anthracite bed in Rhode Island.

The anthracite exists wholly in the area east of the Allegheny Mountains, and on the west of that range nearly the whole area rests on an almost unbroken field of bituminous coal.

The anthracite condition was, no doubt, produced from the original bituminous by the great convulsion uplifting and folding the rock strata which took place at the close of the carboniferous period.

The disturbed or uplifted area is well defined, but how much of the coal was changed to anthracite we do not know; probably not all, as would seem to be shown by the Broad Top coal field in Huntingdon County, which is semi-bituminous, though in the midst of the disturbed or present anthracite region.

The coal field has been, for convenience, divided geographically into the Northern, the Eastern Middle,