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For the Week Ending December 16, 1893.

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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, the Western Middle, and the Southern. The Southern field, which includes the Lykens Valley, is estimated to contain about one-half of all the anthracite remaining.

The evidence as accepted by the geologists shows that the original coal bed east of the Allegheny Mountains was not less in area than 17,000 square miles, whereas the present field, as stated above, has an area of only 480 square miles.

The disappearance or destruction of the coal bed, as indicated by the above figures, was unquestionably caused by *erosion*, *i. e.*, the action of water currents and ice, chiefly in the form of icebergs. Estimating the average amount of coal at 96,000,000 tons per square mile, the contents of the original field was 1,632,000,000,000 tons, of which the now existing field contains only a little more than one per cent.

In the large area in the southeastern part of the State, comprising eleven counties, erosion has carried away every trace of the original coal bed and many thousand feet of the underlying rock.

On the basis that the original bed was confined to the 3,300 square miles within which the present field is located, the loss by erosion was not less than 94 per cent.

From the knowledge derived from the mines already worked, it is roughly estimated that the original bed of coal averaged 75 feet in thickness. In many of the basins only the lowest beds have been preserved.

The amount of coal mined since mining was commenced in 1820 is about 2,225,000,000 tons and the amount remaining in the ground is 17,245,000,000 tons.

The work of mining, including the treatment of the coal in the breakers after it is brought from the mines, is attended with an incredibly great loss, it having been the practice from the commencement of miningto deposit in banks the so-called "waste," or unmarketable material, much of which consists of fine coal and coal dust, called "culm." The amount of this "waste" accumulated since 1820 can be partially measured when, *e. g.*, in the Lawrence colliery it has been equal to 53 per cent of the shipments, in the Stanton colliery 74 per cent; in the Parrish colliery, which may be taken as an example of a modern colliery, and where all the small sizes are saved, about 19 per cent goes to the dirt bank. On a thorough examination of the dirt banks in the Panther Creek basin, it is estimated that, from 1820 to 1883, 20 per cent more coal lies in the dirt bank than has been marketed.

A general estimate has been made, based on very extended examinations, that since the mining was begun the amount of coal and coal dirt sent to the culm heaps has been 35 per cent of the total production.

In addition to the constant loss or reduction of product by the presence of "waste," the work of mining is attended with an increasing expense as the depth of the excavations increases, in some mines being more than a thousand feet, and the Lykens Valley bed lies at a depth of more that 4,000 feet.

In some collieries from 15 to 20 per cent of the coal is used under the engine boilers.

How to recover the immense amount of coal in the waste banks and render it marketable is a question of great moment and has long been under consideration.

Some of the old waste banks have already been partially worked over, and from 50 to 75 per cent of good coal obtained. Most of this coal is very fine and more or less powdered, and its utilization of course depends on successful means for burning it, and thereby creating a market demand. Within a few years various schemes and new constructions of furnaces have been tried, with most encouraging success. Pea coal is already sold in rapidly increasing quantities, also buckwheat coal, size No. 1, and buckwheat No. 2 is somewhat in demand, it being mixed with bituminous. Attempts are making to burn the dust or culm by blowing it into the furnace, but expense would be increased if it were necessary to reduce it to an impalpable powder.

It is also claimed that eventually the "waste" will be largely used in the form of artificial fuel, being mixed with suitable binding material and compressed into blocks. Several plants for the manufacture are in successful operation, and the article is known in the market as "eggettes."

In addition to the loss arising from the accumulation of the discarded "waste," the loss arising from the necessity of leaving large pillars of coal as supports is great, and it is estimated that the amount of coal won from the whole field since mining commenced does not exceed 35, and possibly not more than 30, per cent of the original deposit in the sections mined.

THE Novelty Cutlery Company, of Canton, Ohio, have conceived a novel idea in the manufacture of pocket cutlery, razors, paper knives, ink erasers, etc. Underneath a transparent and almost indestructible handle is a photograph representing machinery or any other class of goods with the portrait, if desired, and address of the manufacturer, rendering the article an appropriate souvenir to present their friends and customers.

Lighthouses and their Keepers.

The following is from a paper by Edward P. Adams, read before the Boston Society of Civil Engineers.

Much of the following is condensed from Johnson's "The Modern Lighthouse Service," a publication of the United States Lighthouse Board.

The famous Pharos of Alexandria, built about 285 B. C., is the first light of undoubted record.

The lighthouse at Corunna, Spain, built in the reign of Trajan, and reconstructed in 1634, is believed to be the oldest existing lighthouse. England and France have towers which were erected and used as lighthouses by the Roman conquerors.

The famous Cordovan tower of France, at the mouth of the Gironde, in the Bay of Biscay, was completed in 1611, in the reign of Henry IV., and after a lapse of 280 years it is still considered the finest lighthouse in the world, though it has been increased in height.

The erection of Eddystone lighthouse of Plymouth, England, completed in 1759, made a new era in the construction of lighthouses. The fifty courses of granite were so dovetailed and fastened together that the tower was almost as rigid as if cut out of solid rock.

The great distinction between the later towers and their predecessors is that the stones of each course are dovetailed together laterally and vertically, so that the use of metal or wooden pins is needless. This method was first used at Hanois Rock, Guernsey.

The first lighthouse in America was built at the entrance to Boston Harbor in 1715-16, at a cost of about $11,500. Erected by the order of the general court of the Province of Massachusetts Bay, it was supported by light dues of one penny per ton on all vessels except coasters.

The first light-keeper in this country whose appointment is on record was George Worthylake, who was appointed keeper of the lighthouse at Little Brewster, Boston Harbor, in 1716, at L. 50 per year by order of the general court of the Province of Massachusetts Bay. When the Federal government had assumed charge of the Lighthouse Establishment, the appointment of keepers was made by the President, and quite a number of commissions bear the signature of George Washington or Thomas Jefferson, who took great interest in lighthouse affairs.

As the number of light-keepers increased, their nomination was made by collectors of customs, who were the local superintendents of lights, but the appointment was made by the Secretary of the Treasury. This usage still holds; but the nomination of the collector is forwarded to the Lighthouse Board, whose indorsement procures for it favorable or adverse action. The appointment, however, is temporary. It continues only until the candidate has been examined; after which, if he passes, a full appointment is given him. Otherwise, he is dropped from the service.

The appointment of lighthouse keepers is restricted to persons between the ages of eighteen and fifty, who can read, write, and keep accounts; are able to do the required manual labor, to pull and sail a boat, and have enough mechanical ability to make the necessary minor repairs about the premises, and keep them painted, whitewashed, and in order. After three months of service, the appointee is examined by an inspector, who, if he finds that he has the qualities needed at that especial station, certifies that fact to the Lighthouse Board, when, upon its approval, the full appointment is issued by the Treasury Department.

But one grade of keeper is recognized by law, but practically they are divided into a number of grades, with pay ranging, with few exceptions, from $350 to $820. The lowest salary is $100 and the highest is $1,000.

At first and second order shore lights there are two light-keepers. A second assistant is required where there is a steam fog signal in connection with the light. At isolated stations another assistant is added. At a few of the most exposed stations there are three and even four assistant keepers.

Keepers are usually appointed to the lowest grade and promoted or transferred according to merit as vacancies occur. At stations requiring but one keeper, retired sea captains who have families are frequently selected. At fog signal stations it is the intention to have one keeper or assistant who is able to operate machinery and keep it in repair.

Keepers are forbidden to engage in any business which will take them away from their stations or interfere with the proper and timely performance of their duties as light-keepers. But such work as curing fish, shoemaking, and tailoring is allowed, and the light-keeper is sometimes a justice of the peace. They are not allowed to keep boarders. At stations where there is sufficient land they have a convenient dwelling with fuel house and often a barn. Suitable boats are furnished stations not accessible by land. A kitchen stove is supplied, also a little coal and sufficient kerosene for lights, and good libraries of about thirty volumes are furnished, and exchanged from two to four times a year.

The amount appropriated for the salaries of keepers is at the rate of $600 per year, amounting to about $700,000 for all keepers in the service.

Plastomenite.

This is the name given to a new kind of smokeless powder invented by Herr W. Guttler. The solution is poured into forms, where it becomes a fairly hard substance, capable of being pressed, rolled, etc. The substance can be colored at will, and is, like celluloid, serviceable for numerous purposes. Plastomenite is used for blasting powder, powder for cannons and rifles, signal rockets, etc. The greatest advantage claimed for it is complete durability, while all other smokeless powders manufactured by the means of ether and nitro-glycerine invariably deteriorate. The combustion of plastomenite is also, it is claimed, so well balanced that it leaves no residue in barrel or cartridge, although the striking velocity of the projectile is unusually great. The initial velocity from a 6½ mm. caliber is 715 m., with a gas pressure of considerably below 3,000 atmospheres. It is said that neither cold nor hot weather has any effect upon the plastomenite cartridges, whereas all powders containing nitro-glycerine suffer from changes in the temperature. Hitherto plastomenite has principally been manufactured for sporting purposes, but its good qualities have attracted the attention of the German military authorities, and it will now be extensively tested in the army.—*Engineering.*

The 24 Hour Clock Face.

On the first of December Italy adopted the time of Central Europe. All the Italian time tables have, by order of the Minister of Public Works, been printed with the hours marked up to twenty-four, from midnight to midnight. The railway clocks have also been modified, and the hours from 13 to 24 printed in red Arabic characters in a circle interior to the old one.

At the Paris Exhibition, in 1867, Sig. G. Jervis, the Keeper of the Royal Industrial Museum of Turin, exhibited a clock face having a double series of hours, the higher numbers being placed on the exterior circle on account of the greater space there available. He also exhibited a time table drawn up on the 24 hour plan, and possessing many advantages over those in use even at the present time. After twenty-six years Mr. Jervis has the satisfaction of seeing the adoption of the improved clock dial and the 24 hour time table proposed by him.

The American Society of Civil Engineers adopted the 24 hour clock face some time ago.

The Capsizing of a Torpedo Boat.

A Gibraltar correspondent of the *Daily Graphic*, describing the recent accident to the Rodney's torpedo boat, says: "She had just fired a torpedo, when, for some reason which has yet to be explained, she suddenly capsized. Most of the occupants succeeded in getting clear at once, but one stoker, not so fortunate, remained entangled, and eventually went down with the boat, which sank in about ten minutes. On turning over, the screws of the boat continued to revolve with spasmodic efforts, and steam issued from the sides in large volumes. One of the crew could be seen running about on the bottom of the boat, and onlookers expected every moment to see an explosion of the boilers. The boat ultimately went down head foremost, like the Victoria, without an explosion. It was, in fact, a miniature Victoria accident, without the collision. Boats from the Immortalite, Narcissus and Rodney were soon on the scene, and every one was picked up except the stoker."

Pepper.

The pepper constituent, to which the sharp taste is due, is the piperine. This substance is not tasteless, as generally accepted, but by prolonged contact with the tongue develops the sharp taste which can be better demonstrated by tasting a piperine solution warmed to 50° C.; in the pepper fruit the piperine is dissolved in the essential oil, hence the decreased sharpness of old pepper is explainable by the resinification of the essential oil, causing decreased solubility of the piperine. The essential oil has the odor of the fruit, but in alcoholic solution is free from any sharp taste. As an oxidation product of the essential oil, in part at least, is a viscid unsaponifiable oil which also dissolves piperine, but itself is free from odor and taste. In addition to these three constituents, pepper contains cellulose, starch, and small quantities of coloring matter.—*Th. Weigle, Pharm. Ztg.*

Harvard at the Top.

The highest meteorological station in the world is said to be that at Charchani, near Arequipa, which is 16,650 feet above sea level, and is situated just below the permanent snow line. The Harvard College Observatory at Arequipa is 8,050 feet above the sea, and the new meteorological station is 8,600 feet above, the ascent being made, by the aid of a mule, in about eight hours. The station is equipped with self-recording aneroids and thermometers. The results of the observations are to be published in the annals of the Harvard College Observatory.