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Colt's Armory Testing Machine.

This machine has just been completed at Colt's armory, Hartford, Conn. It was designed by Mr. Charles B. Richards, the engineer of the Company, who is already well known to engineers as the inventor of the steam indicator which bears his name. The idea, of using an ordinary platform scale to measure the strain upon a specimen, is claimed to be original by Mr. Richards, and all of the details of the apparatus have been worked out by him.

The Company was led to build the machine, first, for its own convenience and necessities; and, secondly, on account of the apparent need of an accurate testing machine in inquiries into causes of boiler explosions, strength of materials for bridges and other metal constructions, and in general for measuring the strengths of American iron and steel and other materials.

We give herewith an engraving which, with a detailed description of the machine, will sufficiently explain its principles and mode of action.

A is the platform of a fifty tun scale, of which B is the weigh beam, with its sliding weight, C. Upon the platforms, a cast iron frame, D, about ten feet high, is placed to receive the fixtures for holding the upper end of a specimen intended to receive a tensile strain. The platform is five feet long by three feet wide, and has an oblong opening in its center, through which two long screws rise about two feet above the platform. One of these screws, E, is shown in the engraving, the other is hidden by the frame, D. The screws carry a strong crosshead, F, which can be raised or lowered by two nuts, one of which can be seen in the engraving. The screws and crosshead are not connected with the platform until the specimen is placed, and the specimen makes the connection.

The crosshead receives the fixtures for applying strains of all kinds to specimens of every shape. The lower ends of the screws, E, are attached to the short arms of a massive forked lever (not shown in the engraving), which is beneath the floor, and has its fulcra supported by the bed plate which forms the foundation of the scale. The long arm of this lever is coupled to the differential system of levers, G and H, the coupling being nearly in line with the fulcrum of the lever, G. The connections, between the lever, G, and the screws, E, which carry the crosshead, are so arranged that, by depressing the free end of G, the crosshead is pulled downwards, and by raising the fulcrum of G, the same result is produced.

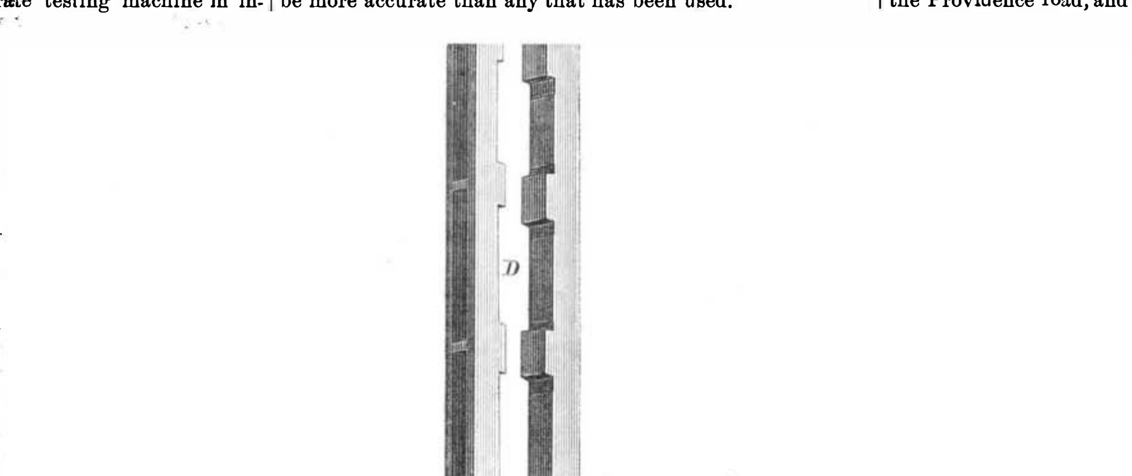
The weight to produce a strain on the specimen is applied at the free end of G, and a rod, K, is there suspended, to which plates and pans, L and M, are attached to receive weights of various values.

To raise the fulcrum of the lever, G, a small hydraulic jack, N, is used, to which the fulcrum is suspended. The jack is fixed upon a cast iron frame, O, erected upon the scale foundation.

If the foregoing description is understood, it is evident that if one end of a specimen, a rod of iron, for instance, be attached to the frame, D, above the crosshead, F, and the other end be attached to the crosshead, the rod may be stretched by bearing down the end of the straining lever, G, for the crosshead will thereby be pulled downwards. The arms of the levers are so proportioned that one pound applied at K will exert a strain of 120 pounds on the specimen, so a strain of 100,000 pounds will be exerted by the application of 800 pounds at K, and this strain will be measured by balancing the weigh beam.

The specimen is supported on the platform, A, and any weight which pulls it down will be indicated on the weigh beam with great accuracy. This result cannot be obtained by using straining levers alone, because the motion which takes place in the specimen requires a very great angular motion in the straining levers, which introduces several errors into calculations based upon the weight applied to the straining levers to produce the strain. Now in this machine it does not matter whether we know the weight applied at K, or not, the strain will nevertheless be always accurately measured by balancing the weigh beam.

As the sources of error mentioned above are common to testing machines in general use, we think this will prove to be more accurate than any that has been used.



COLT'S ARMORY TESTING MACHINE.

The crosshead, under the action of the straining weight, can be moved more than one inch without requiring readjustment. Any metallic specimen can, therefore, be stretched beyond its limit of elasticity in this machine.

For transverse strains, the frame, D, is removed, and the specimen is supported at each end upon the platform, beneath the crosshead, and the straining weight is applied by a knife edge fastened to the under side of the crosshead. To crush a specimen, it is supported on the platform, and subjected to the pressure of the crosshead, under which it will stand. Torsional strains can be applied to shafts by using the necessary fixtures for the platform and crosshead. [See advertisement on back page.]

THE Banking Committee of Congress has reported a bill requiring the officers of national banks to stamp all altered or counterfeit bills which pass their counters under any circumstances whatever. The bill is a good one and should be passed; it is one of the surest safeguards against the circulation of spurious notes.

IN the bitter cold of the arctic regions, 40° to 66° below zero, Fah., iron breaks like glass—so says Dr. Kane.

Railway Power Brakes.

Within the last two or three years, the inventive fraternity have brought forward many new devices for controlling railway trains, independent of hand brakes, and some few of these have achieved quite a success. The Boston and Providence Railway has now in experimental use no less than three different kinds of power brakes, one train each being fitted and operated by each of these devices. Included in this number is the Westinghouse atmospheric brake, which we have heretofore described somewhat at length, giving some account of its successful trial on the Providence road, and of its adoption on quite a number of important roads in different parts of the country, after full and repeated trials and proof of its efficiency. The good character of this device seems to be settled in this country, and the inventor is now in Europe introducing the device there.

Next on trial is the Steinard steam brake, which was first introduced on the Flushing and North Side Railway, and has been in successful operation there on its passenger equipment for some months. In the last volume of the *Railway Times*, we gave some account of the details of this device, which, we understand, is working very favorably on the Providence road.

The last of the three is the electric brake, which, though less known, is said to have proved quite successful on one of the interior roads, and so far worked favorably on the Providence. One of the noted features of the management of the Providence road, for many years, has been its liberality in the trial of all new devices in railway machinery; and to this liberality the public is indebted for many important improvements, without which they would have never been publicly recognized. We are glad that this liberal system of experiments is still continued, and we hope that Mr. Superintendent Folsom will, after this competitive brake trial has been fully carried out, give the public the results of his experience. There is hardly anything more important in railway machinery than efficient means for controlling the movement of trains from the foot board of the engine. The power should be certain and ample, and graduated in intensity to suit the emergency that may arise from possible collision, from unexpected obstructions on the track, and for stopping promptly but easily at stations. In the economy of railway operation, the engineer of the locomotive exercises a most important influence. If he is an intelligent person, he will understand that, in starting, if he throws the throttle valve open with a jerk, he takes a good many dollars, possibly hundreds of dollars, out of the wearing value of the rolling stock; and the hand brakemen, often of the most ignorant and unreflective class, can do the same injury by applying the brake so hard as to skid or slide the wheels, thus grinding out of a true circle, and making the wheels instruments of discomfort and possible danger, to say nothing of the needless expense. In making the engineer responsible for the *movement* of the train by enlarging his duties, as must be done by the use of power brakes, he will be likely to take a more decided interest in the ease of the movement of the train, whether in starting or stopping; he will take some pride in becoming an expert, if not an artist, in these matters, and if he is the man for the place, can save the company a good many hundreds and even thousands of dollars annually in the wear of rolling stock and rails. We are fully committed to the adoption and use of power brakes, for a great many good and sufficient reasons, and when there are so many good devices of steam, air, and electricity brought forward to meet this want, the railway managers ought to put themselves to some trouble to decide which is the best; and they can only do so by following the lead of the managers of the Providence road, and giving all these devices an intelligent trial.—*American Railway Times.*

INTERESTING LECTURE BY PROFESSOR TYNDALL---THE IDENTITY OF LIGHT AND RADIANT HEAT.

Dr. John Tyndall, F. R. S., recently lectured at the Royal Institution, London, on "The Identity of Light and Radiant Heat." There was a very large attendance, the theatre of the Institution being full to overflowing, so that many of those present could find standing room only. Sir Henry Holland, Bart., M. D., F. R. S., President, occupied the chair.

Professor Tyndall said that it was long a question in the scientific world whether light and heat were the same thing, or whether there was something very different between them. Melloni, in some of his experiments, found that light would not produce heat with his thermopile; but he forgot that the human eye is a very delicate instrument, capable of being excited by an amount of light which, when resolved into heat, would give so little increase in temperature that no thermometer in the world would detect it. Principal Forbes, of St. Andrew's, found that radiant heat, like light, could be polarised; and other philosophers have done much to establish the absolute identity of light and radiant heat. Mr. Faraday showed that the magnetization of a ray of light had its strict parallel in the magnetization of a ray of radiant heat; and he did this with delicate instruments—so delicate that it needed the utmost care and caution on the part of the observer in the laboratory to see the effects. Since then instrumental means had been increased, and so much so that he hoped that evening to be able to show, to the large audience before him, many effects which had hitherto been confined to the observation of those who discovered them and of students who followed in their footsteps.

Heat was sometimes associated with ordinary matter, so that it passed through it by "conduction." In another condition, heat flies through space just like light, and is then called radiant heat. Light and radiant heat come both to gether to the earth from the sun, so that the first task of the investigator is to separate the two and examine their properties.

Professor Tyndall here threw a short brilliant spectrum upon the screen, by means of the electric lamp and a single bisulphide of carbon prism. He then held a red riband in the red part of the spectrum, and pointed out that it there appeared of a brilliant red color; when he held it to the yellow, green, blue, or violet of the spectrum, it looked black. A green riband looked green in the green light; but black in all other parts of the spectrum. He then said that the red riband was not heated by the red rays, nor the green riband by the green rays; but when they were placed where they looked black, they were warmed by the rays falling upon them, because they absorbed the said rays, and wherever there is absorption there is increase of temperature. Black absorbs all rays, and it is black because it absorbs every color of the spectrum. Only where light is absorbed is heat produced by it, and the heat produced is the exact equivalent of the light absorbed. If a black riband could speak, it could say in what part of the spectrum it felt warmest; and it would say that it grew warmer as it was carried from the blue end of the spectrum towards the red, but that further on still, beyond the red, where nothing was to be seen by the eye, it felt warmest of all. It felt warmest when there were no rays competent to excite vision at all. Every eye in that theatre was receiving, from the non-illuminated part of the screen beyond the red end of the spectrum, rays which, measured by the force they were capable of exerting, were a thousand times more powerful than the rays from the part of the spectrum which was seen by the eye.

The lecturer added that he wished to prove this. He substituted a small round hole for the slit in front of the lamp, thereby producing a narrower spectrum with curved ends. He then placed a piece of red glass in front of the hole, whereby all the visible rays of the spectrum but the extreme red were cut off, and a small round circle of red light was seen upon the screen. He then brought a thermopile so near to the red circle of light that, although it manifestly did not touch or encroach upon the red rays, yet it caught the invisible heat rays beyond the red and was warmed by them. The consequence was that the needle of a large galvanometer connected with the pile swung round in the sight of all the observers, thereby proving the presence of heat. He then cut off all the visible rays from the lamp by means of a glass trough filled with a solution of iodine in bisulphide of carbon, yet the needle swung round as before when the thermopile was placed in the track of the invisible waves. These experiments, he said, proved that radiant heat was refracted by a prism just like light.

He also explained the nature of the thermopile, telling how it was built up of little bars of antimony and bismuth soldered together at alternate ends, and how, when one end of the pile was made warmer than the other, in even an excessively slight degree, an electrical current was set up, the effects of which could be measured by a galvanometer. The thermo-electric pile is the most delicate instrument known for indicating slight changes of temperature.

Professor Tyndall next proved that radiant heat was reflected from plane surfaces like light. Parallel rays from the electric lamp were thrown, upon the surface of a plane mirror placed at an angle of forty-five degrees, so as to reflect the light upwards towards the roof of the theatre. A lens above the mirror brought the rays to a focus, which could be plainly seen because of the illuminated dust in the air. The opaque solution of iodine in bisulphide of carbon was then placed in front of the lamp, so as to cut off all the light; but, when the thermopile was then placed where the brilliant visible focus had been, it was proved that dark radiant heat from the lamp still came to a focus there, as the needle of the galvanometer was powerfully deflected.

Above the lens used in the last experiment, he so placed a prism as to totally reflect the upward beam of light or heat, making it take once more a horizontal direction. When the light was cut off by the interposition of the opaque solution as before, heat rays were still reflected by the prism, as proved by the thermo-electrometer. This radiant heat is reflected like light by a right angled prism.

The lecturer next proved that radiant heat is reflected like light by curved mirrors, and can be brought to a focus like light by lenses. In each case, after showing the experiment with light, he cut off the visible rays by means of the iodine solution, and then by means of the thermopile showed that a radiant heat focus occupied the place where the light focus had previously been.

In the next experiment, he proved that crystals of Iceland spar which split a beam of light into ordinary and extraordinary rays will do the same with rays of radiant heat. A little circle of light was thrown upon the screen, and this, by the interposition of a piece of Iceland spar, was transformed into two little circles of light a few inches apart. When the thermopile was placed before either of these circles, and while all light was cut off by the trough of iodine and bisulphide of carbon placed in front of the lamp, the needle of the galvanometer was deflected as before, owing to the Iceland spar dividing the beam of radial heat into ordinary and extraordinary rays, just like light. While the needle was deflected by the extraordinary ray of radiant heat, when he turned the crystal of Iceland spar halfway round the needle returned to zero, because the turning of the crystal removed the heat rays from the face of the pile, and sent them to another spot.

Professor Tyndall next showed that two tourmalines, when crossed at right angles, stop all light, although the crystals themselves are transparent. In this position the one crystal stops all the waves which vibrate in a horizontal plane, and the other all the waves which vibrate in a vertical plane; consequently none can get through the two crystals, and darkness was the result. He then showed that, when a crystal of mica is pushed between the two tourmalines at a certain angle, it would partially twist round the rays from the first tourmaline, and thus allow them to pass through the second one. Thus, as the mica was inserted, it seemed to scrape away the darkness upon the screen caused by the crossing of the two crystals of tourmaline. Professor Tyndall next substituted two Nicol's prisms for the tourmalines, and the mica enabled some of the light to pass as before; and he showed that a piece of glass when squeezed, so as to throw a strain upon it, had its molecular arrangement so altered as to let light get through the prisms, much as if the mica had been used. In another experiment he showed that a piece of right handed quartz, cut perpendicularly to the axis of the crystal, gave a beautiful display of colors by circular polarisation.

While the two Nicol's prisms were in position, the lecturer placed a lens to bring the rays to a focus, and then cut off all the light by the interposition of the solution of iodine in bisulphide of carbon. Then he placed the thermopile where it could receive the dark rays, and there was a slight deflection; he proceeded to turn one of the prisms, and then a larger deflection resulted, showing that more heat passed through the crystal when in one position than when in another. This fact of the polarisation of radiant heat, he said, destroys many speculations once prevalent. It shows that waves of radiant heat vibrate transversely; polarisation has no meaning with respect to longitudinal vibrations, but where there are transverse vibrations there is a power of polarisation. He then placed the crystals where they gave a small deflection of the galvanometer needle; then by the interposition of the mica he obtained a large deflection, showing that it acted upon radiant heat as it did upon light. The pressed glass also allowed more heat to pass through the crystals.

MAGNETIZATION OF HEAT.

Next he performed Faraday's celebrated experiment of the magnetization of a ray of light, and followed it by the magnetization of a ray of radiant heat—one of the most delicate and complicated experiments ever shown to a public audience. First he took a parallel beam of light and heat from the electric lamp, then quenched the light by the bisulphide solution. The dark rays thus obtained were then passed through a Nicol's prism, and afterwards through a piece of Faraday's heavy glass, placed between the poles of an electromagnet; next they were passed through a second prism and were finally received upon one face of the thermopile, which they warmed. Rays of radiant heat from a tube of warm water were then allowed to fall upon the other face of the pile, and the heating power was regulated by a square disk, which could be placed so as to cut off more or less of the rays at will. Thus the two faces of the pile were brought to the same temperature, and then there was no deflection of the galvanometer needle. Under these conditions, when the electromagnet was excited by the passage of an electric current, so that the piece of heavy glass was placed in a powerful magnetic field, at once there was a deflection of the needle showing that some influence had been exerted on the radiant heat by the magnetism. This experiment was all the more complicated because a very small and sensitive galvanometer had to be used. Professor Tyndall, therefore, had to illuminate the little dial of the galvanometer with one of his electric lamps, and to throw an enlarged image of the dial upon the screen by means of a lens and a plane mirror placed at an angle of forty-five degrees; thus the movements of the needle were made visible to everybody present.

The lecturer then said, in conclusion, that the thing called radiant heat was part and parcel of the radiations from luminous bodies. At the other end of the spectrum, beyond the violet rays, there were some feeble rays of radiant heat; but in the short range of the visible spectrum lay all that wealth of color which is the chief source of beauty in nature and in art. If they asked him how came the light to be thus composed, and how it is that external nature so sifts this light as to give to the flowers of the field and the leaves of the forest trees their wealth of beauty, and how it comes to pass that we have a sense of the beautiful which has grown up in the midst of these agencies, and how it is that man derives perfection and elevation of mind from the contemplation of this beauty, he would answer that the cause must be left for philosophers to discover. He thought, nevertheless, that they would be able to give but an approximate solution, and that the real root of the matter would forever lie beyond them.—*William H. Harrison, in the British Journal of Photography.*

Laughing Gas.

Dr. Colton recently lectured in Brooklyn, giving some practical illustrations of the peculiar effects of nitrous oxide or laughing gas, which is composed of a mixture of two parts of nitrogen and one part of oxygen.

Now, said the lecturer, the air we breathe is composed of oxygen, hydrogen, and carbon. Any gas that will extinguish fire will not support life; therefore, if oxygen were removed from air we should die. This Dr. Colton illustrated by a couple of jars, in one of which was pure air, and in the other air without oxygen. A number of experiments followed. An ordinary gas burner was lighted, then gradually some laughing gas was applied to the common gas, producing a white and remarkably powerful light, making the gas lights around the room and on the stage appear quite dim. Dr. Colton stated that three miles of piping, for the conveyance of this kind of gas, is down in New York, and in a short time it would be used opposite the Fifth Avenue Hotel. Abroad it had been used some time to light large public buildings, such as the Grand Opera Houses at Paris and Vienna. The lecturer believed that, after a while, it would be introduced into all large cities.

The next part of the exhibition was the inhalation of laughing gas by several ladies and gentlemen who were invited on to the stage by Dr. Colton. Just sufficient was given to exhilarate. Since 1844, Dr. Colton had given the gas to 55,923 persons for dental operations, and none of them had felt the worse for it. He inhaled a small quantity daily, and felt the better for it. They had removed nineteen teeth from a Brooklyn lady that morning, and she never felt the slightest pain; indeed, she was astonished, when she awoke, to find that her teeth were out. Dr. Colton then gave the gas from a small bag to two or three ladies and ten gentlemen. The first lady danced with ease and even elegance, clutching the Doctor round the waist and making him dance with her. When the effect of the gas was off, she stood in the center of the stage, looking at the audience, and wondering, apparently, what she had been doing. She ran to the couch and covered her face with her muff. Then a tall gentleman had a try; he was talkative, and said, "You know how it is yourself—delightful! beautiful! delicious!" His speech, however, was cut short by a pitch forward towards the audience, and, had it not been for the ropes placed in front of the stage, he would assuredly have fallen over. A small dark man came next; he was pugilistic, and cleared the stage in no time. Then there was a dancer, who threw his legs about as if they did not belong to him, and had a desire to get rid of them; he was most amusing under the influence of the gas, and the audience were convulsed with laughter. A little boy was put to sleep for a minute, and laid out flat upon the stage: he was quite insensible. After this came a young man who snored like a pig while he was taking the gas. He was inclined to make a speech, commencing thus: "Happy—wonderful—worth seven miles of travel—happy don't express it—a little more—would go fifty miles." Other gentlemen took the gas, and the effect was similar.

Native Coke.

Messrs. Litman and McDowell, editors of the *Genius of Liberty*, Uniontown, Pa., send us a curious looking mineral with hair upon it, termed among the miners "coal with hair on." They ask us for further information. It is a beautiful specimen of *native coke* or fixed carbon. The "hair" or filiform structure is sometimes seen in artificial coke. It originated in the action of heat on bituminous coal. The long line of outcropping old red sandstone, brought up by the rising of Chestnut Ridge, and stretching from Indiana county, Pa., to Marion county, Va., crossing Fayette county diagonally, is proof of igneous action. Very likely a trap dyke exists in the vicinity of the coal bed. Native coke also occurs near Richmond, Va.

AN esteemed correspondent, M., of Princeton, N. J., sends us a letter in which he states that, some years ago, he picked up a number of the SCIENTIFIC AMERICAN in the office of a rolling mill. His attention was caught by an article entitled "How to make a toy steam engine;" and in company with a schoolmate, he began to construct one, and ultimately succeeding, his course in life was determined. From this circumstance, he attaches particular importance to practical scientific instruction, and rightly considers its general dissemination to be the chief element in our modern progress.