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For the Week Ending July 21, 1894.

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AN AMERICAN BULLET PROOF SHIELD.

Mr. W. J. F. Lennard, a stairbuilder, of Brooklyn, N. Y., has invented a bullet proof shield claimed to be superior to that of Herr Dowe, the Mannheim tailor, described in the last issue of the SCIENTIFIC AMERICAN. It is said to be composed of cotton, felt, wood, and a chemical compound of parts mineral and vegetable. A public test of the bullet proof qualities of the new shield was made at one of the Brooklyn parks on July 12. It was in the form of a pad seventeen inches long, thirteen inches wide, and a trifle less than two inches thick, being somewhat flexible, and weighing eleven pounds. This pad was hung on the neck of a wooden figure, and shot at by a marksman with a 45 caliber army rifle, the cartridges being loaded with seventy grains of powder and 405 grains of lead. The bullets partially penetrated and embedded themselves in the pad, but did not go through it. The inventor afterward put on a similar pad, and was shot at by the marksman, the same gun and cartridges being used, when the shield proved an effective protection against the bullet. The inventor said there was no feeling from the impact of the bullet, except a slight sensation as if some one had poked him with a finger. The inventor does not claim that this shield would be effective against steel bullets, but only against lead bullets. His shield is the result of experiments for a composition to use in armoring ships, which he claims will be lighter and better than steel plates.

FAILURE OF A LARGE ARMOR PLATE.

An armor test of a Carnegie nickel-steel Harveyized plate, seventeen inches thick, took place at the Indian Head proving grounds on the Potomac near Washington, July 12, and like the eighteen inch Bethlehem plate tested May 19, ended in the failure of the plate. The same gun—the 12 inch rifle—was used in both cases. The plate was secured to a 44 inch oak backing, heavily braced. The distance of the gun from the target represented a range of about 1,200 yards. The Carpenter projectile weighed 800 pounds and was propelled by 260 pounds of brown prismatic powder; the muzzle velocity was 1,410 feet per second. The first projectile fired penetrated 13½ inches and then bounded back 50 feet. In the second Wheeler-Sterling shot the velocity was increased to 1,858 feet per second and the striking energy was advanced to 20,370 foot tons. The havoc wrought was terrible; the shot crashed through the plate and backing, deflected up, and landed 300 feet away. The head of the shot was somewhat injured, but the body of it was intact. The result was a great surprise to all concerned, especially to the makers, who had used all possible care in its fabrication, the plate being left in the Harvey furnace for twenty-eight days. Upon this test depended the acceptance of 287 tons of armor for the battleship Oregon, worth $246,000. The loss to the company for the plate, even if the armor is finally accepted, will be $20,000.

The Secretary of the Navy ordered another test the next day, using the same shells as were used in the June test of a Bethlehem plate. The Carpenter projectile penetrated the plate and stuck fast in it; the plate was cracked. The Navy Department will conduct exhaustive tests on Harveyizing armor before accepting more plates.

EDUCATION IN AMERICA.

We publish in the SCIENTIFIC AMERICAN SUPPLEMENT of this week a very remarkable paper on the schools of America, by Duane Doty, Superintendent of Public Instruction of Chicago. It is a summary of the last report, just issued, of the United States Bureau of Education. From the earliest days of the republic, the necessity of education for the people has been a generally accepted doctrine, and the impost of taxes for the purpose has been generally acquiesced in willingly. It is hard to see how any substitute for the public schools could be invented. It would seem more logical for each individual to pay for the education of his own family. But private schools would never be so widely distributed as are the public schools. In the rural districts, far from any village of account, will be found the public school, to which children resort from miles away in all directions. Private enterprise would never do the work done by the rural public schools.

The statistics and data contained in the article referred to are of deep interest. They go to show what an immense machinery is used in public school education, and reveal an industry of the largest dimensions devoted entirely to intellectual culture and advancement. The same statistics show the rapid growth of the system. Every year sees it more developed and more difficult of replacement. The great area of our country is one of the causes which will tend to make it permanent.

The paper referred to, however, is devoted to education in general, not merely to the public school system. It shows that as the higher departments are reached, the percentage of scholars attending private schools increases. But the facts that in the elementary grade of public school ninety per cent of the school population are educated and that in all schools and colleges together the public schools and colleges educate eighty-nine per cent are impressive. The agency which controls the education of so large a proportion of the population of the country is one which should receive the greatest consideration and care from those administering it, for education can be a power for evil as well as for good.

BROOKLYN MEETING OF THE A. A. A. S.

The scientific and educational institutions of Brooklyn have united in inviting the American Association for the Advancement of Science, with its affiliated societies, to hold its forty-third annual meeting in that city. The hotel headquarters of the officers and others will be at the St. George Hotel. The official time as announced will be from August 15 to August 24, although some of the special societies may meet earlier or later than those dates. The opening sessions will be held daily in the Polytechnic Institute, the evening addresses and receptions will be in the Academy of Music and Art Building, and the sections will meet in the rooms of the Packer Institute. Every facility for lantern illustration will be in constant readiness for the day meetings, as well as when required in the evening. Many eminent foreign scientists have accepted invitations to be present, which will add much to the interest of the occasion.

Excursions have been planned for combining science with social pleasure to various mines, quarries, mountains, cliffs, and marl beds; to Long Branch for the study of marine algæ; to Cold Spring to inspect the State fish hatchery; to West Point to inspect the Palisades and Highlands and Military Academy; various local trips to points of interest about the harbor, navy yard, etc., and finally, at the close of the sessions, an excursion to the Forestry Congress at the White Mountains. These plans are liable to be modified, and additional ones may be arranged for, of which notice will be given in due time. As far as possible these excursions are to be free, or at greatly reduced rates. The regular railroad rates to and from the meeting will be reduced, and special terms are to be had for hotel accommodations. Concessions will also be made by the express, telegraph, and telephone companies. In a word, everything will be done to make the Brooklyn meeting delightful and successful.

Full information can be had on application to the local secretary, Prof. G. W. Plympton, or to Mr. E. T. Johnson, relating to hotels and lodgings. It will be sufficient to address simply in care of A. A. A. S., Brooklyn, N. Y. Communications as to scientific papers, membership, etc., should be made to Prof. F. W. Putnam, permanent secretary, Salem, Mass.

THE GREAT RAILROAD STRIKE.

It is an accepted doctrine in political economy that the loss of one person's property is the loss of all. When a building burns in a large city, in some form or other the entire community has to bear the loss. Property is never destroyed without all suffering in some way. In the science of government a very general opinion is expressed in the saying that the best governed people is the least governed. Like some other sayings this cuts both ways; there is no doubt that a community of individuals, so orderly and well-behaved as to require but little government, would live very happily, and from their very nature would, in being self-governed, be little governed and well governed. But unfortunately the law has to deal with all classes of men. America especially has been receiving the outpourings of Europe for many years, and there is a strong feeling that the class of immigrants of the last ten or twenty years does not compare favorably with those of the preceding epoch.

The law throughout is based on the doctrine of expediency. A country governed by strictly logical laws would be far from practicable, at least under present conditions. The object of government being the preservation of order and peace and the prevention of crime, the law should secure these ends by the simplest and most efficacious means possible. Thus in a large city, if a given procession of innocently disposed people would be the occasion of a riot, no complaint could be made if the police took the practical though illogical step of prohibiting the parade and preventing the riot.

The great strike which has occupied so much of the attention of the country during the last few weeks is apparently on the point of collapse and illustrates the above points. The Federal troops have gone into action and seem to have done good work at the expense of very few lives. A vast amount of property has been destroyed, striking workmen have lost an immense sum in wages, and Cook County, Illinois, together with other railroad centers where rioting has taken place, will probably be burdened with a very heavy tax bill for the payment of damages to property incidental to the rioting. Incalculable harm has been done and the entire United States will have to foot the bill. It is easy enough to criticise the use of the Federal troops in the matter, it is natural for local militia to object to fight their own neighbors and friends, it is well for the upholders of the strong arm of the law to exult in the thought of the suppression of mob violence by military force, but a question of the utmost difficulty of practical politics lies back of it all. How are strikes with incidental riots and destruction of property and idleness of thousands of workmen to be prevented in future.

The evils of a strong government for the repression of riots on the one side are confronted with the evils of a weak government unable to cope with the evil-disposed classes. In the United States, by general consensus, the Federal power is recognized as the strong element, one to be called on as seldom as possible, and whose direct intervention is looked on with disfavor and as an unfortunate necessity. The individual States are less powerful and less arbitrary in their governmental actions. Both have united in coping with the rioters. But until strikes of the magnitude and evil effects of the present one are made impossible, until the paralysis of a country's business by enforced idleness of workmen supplemented by rioting becomes a matter of history never to be repeated, the laws of the country will not be perfect.

We may object to being too much governed, but a comparative despotism is preferable to a condition of things involving the calling out of soldiery to cope directly with what should be a peaceful populace of workmen. War with a foreign power is held to be a not unmixed evil; civil war, and fighting with mobs, are bad in every sense—in cause, in prosecution and in results.

To-day millions of people are suffering from the strike. Its consequences may last for many months to come. Pittsburg is still paying for the damages done during the riots of 1877. Expediency calls for the prevention of such occurrences, and an evasion of the strict laws of logic may be excused if such prevention can be brought about by a law, even if it be one of expediency only.

LAYING AN ATLANTIC CABLE IN TWELVE DAYS.

On the 2d of July the Faraday completed the laying of a new Atlantic cable, the actual time occupied in the work of laying the deep sea portion being but twelve days. When the Great Eastern, in 1866, completed the laying of the first successful Atlantic cable, the entire world joined in congratulations. The event was justly looked upon as marking an era in the progress of the world. Since that time, however, the making and laying of ocean cables has become a practical, everyday business, and the new cable was not only laid in the shortest time, but is a much better cable than any of its predecessors, having the largest copper conductor and being the speediest ever laid for its length.

Although the Faraday left Woolwich on June 12, she did not, owing to unfavorable weather, reach the vicinity of the previously laid and buoyed shore end of the cable, off Waterville, Ireland, until the 18th, and then, the buoy rope, having been wrenched off by a passing propeller, had to grapple for the cable itself, at a depth of about 250 fathoms. Such work now presents no substantial difficulties. The heavy grapnel, attached to 600 fathoms of chain and rope, was three times dragged across the cable's path, when the cable was hooked and hauled up, two miles inside of the end that had been buoyed. The end communicating with the shore was at once tested and spliced to the cable in the tanks, the other piece hauled aboard and the buoys picked up, when, at 10:30 A. M. on the 20th, the vessel was ready to start on the actual work of laying the deep sea cable. At the rate of about seven knots an hour the cable passed up round the core in the center of the tank, along the troughs and directing sheaves, under the sheave of the strain-measuring dynamometer, and sank to the ocean's bed. For several hours the depth varied from 250 to 500 fathoms, when a great declivity was reached and 1,000 fathoms were indicated, followed by a varying bottom, nearly three miles deep in places. Thence it gradually rose to 1,600 fathoms, dropping subsequently to over 3,000, as hill top and valley in the ocean bottom were passed, until the shallow water of the Newfoundland Bank was reached, some seventy-five miles from the buoyed end of the previously laid shore end on the American side, 502 miles from Canso, Nova Scotia. During all this time communication was constantly kept up with the Waterville station, the news of President Carnot's assassination being received on the Faraday the evening of its occurrence. When at 1,585 knots' distance from the Irish coast, and the soundings indicated a depth of 891 fathoms, the lighter deep sea portion of the cable was spliced to a shallow water type, which was continued to the still heavier Canso shore end. Fogs, icebergs, and bad weather prevented the finding of the buoy on this shore end, but after a good deal of dragging the cable was hooked and drawn aboard on the 30th, just ten days from the actual start on the other side, although the final splice was not completed until the morning of July 2.

The new cable was laid for the Commercial Cable Company, being the third cable of that line. It was manufactured and laid by Messrs. Siemens Brothers & Co., who have very extensive works at Woolwich, England, for the manufacture of electrical appliances. The Faraday was specially constructed by the Siemens Brothers for the work of cable laying, and has three large tanks for the storage of cable, with many ingenious appliances to facilitate the paying out, grappling, and hauling up and making all the delicate tests required in all stages of the work. The new cable has a much greater weight of copper conductor or core and of gutta percha insulation than any of the cables previously made. The shore ends and intermediate sections of the new cable comprise about 700 nautical miles and the deep sea portion is nearly 1,600 nautical miles in length.

Eight Hours in England.

The forty-eight hours week has lately come into operation in all the British government works, and new regulations have been forwarded to the works. A careful examination of these, says *Engineering*, indicates that in making the concession the Admiralty have withdrawn many privileges, which in great measure counterbalances the less number of hours worked, and by this means at least they bring the dock yards into line with the private establishments throughout the kingdom. The men will still have the four public holidays as hitherto without loss of pay; but the half holidays on the occasion of a launch, or of a visit of the Lords of the Admiralty, are to be discontinued. Nor will a half holiday be given for a parliamentary election, since the polling booths are now open until eight o'clock. Hitherto three minutes has been allowed the workman to go from the yard entrance to his work every time he enters the works, which meant thirty-three minutes per week. This is discontinued, and the men must be at the pay ticket box close to their work at the time of starting. The five minutes allowed to get to the pay table is discontinued. Hitherto an hour was granted in the morning or evening without stopping of pay in the event of urgent family affairs. No such excuse can now be accepted, while grant of leave without loss of pay to attend Confirmation is also to be discontinued, and blacksmiths will not now have ten minutes to wash each time they leave the works. Again, overtime pay, *i. e.*, time and extra, will only be granted after the men have worked a full 48 hours in the week. It frequently happens that a Saturday precedes or follows a public holiday—Good Friday, Whit Monday, etc.—and on such occasions the men used to work overtime before the holiday to make up the time to be lost on Saturday when not infrequently the machinery was running as usual. This is not to be allowed in future, even if the works are closed on the Saturday, the desire being to meet the men's demand for no overtime, except, of course, where the exigences of the service urgently require it. In this one almost recognizes an Admiralty Roland for the workmen's Oliver. As to the hours fixed, these vary to suit the seasons of the year, the day being shortest in the winter months, 7¼ hours, and longest in the summer and early autumn, 9 hours. On Saturday the duration is 5 hours throughout the year. The earliest start is 7 A. M., and from December to March it is 7:30 A. M., and the hour of closing the work is 4:15 to 5:30 P. M., 1½ hours being allowed at midday for dinner. These are the hours for Portsmouth, Chatham and Sheerness, while for Devonport and Pembroke, which are further west, they are a quarter of an hour later. The hours are for the beginning and starting of work, no allowances being made. The variation in the hours involved the readjustment of the day pay ratings to bring the 48 hours pay to the same as the 51 hours pay; but no change is made in overtime rates, so that in the latter case the same work must be done in the 48 as in the 51 hours week to earn the same sum. The writing staff will continue to work 45 hours, but overtime rates will only be paid after 48 hours have been worked, instead of after 51 hours work as heretofore. Enginemen, stokers, and furnacemen will work longer hours, as at present, to have the plant ready for the workmen.

Spontaneous Combustion.

When charcoal which has been allowed to absorb as much sulphureted hydrogen as it can take up is introduced into oxygen gas, the charcoal will burst into flame, owing to the energy of the action of the oxygen upon the sulphureted hydrogen.

This fact is stated in most text-books on chemistry, but no description that I have ever seen of this experiment is calculated to bring about the effect with certainty. The following is a simple method for illustrating this reaction upon the lecture table, which I have never found to fail:

A few grammes (from five to ten) of powdered charcoal are introduced into a bulb which is blown in the middle of a piece of combustion tube about twenty-five centimeters long. A gentle stream of coal gas is then passed over the charcoal, which is heated by means of a Bunsen lamp until it is perfectly dry. This point may be ascertained by allowing the issuing gas to impinge upon a small piece of mirror, and when no further deposition of moisture takes place the charcoal may be considered to be dry, and the heating may be stopped. The charcoal is then allowed to cool in the stream of coal gas until its temperature is so far reduced that the bulb can just be grasped by the hand, when the coal gas is replaced by a stream of sulphureted hydrogen. The sulphureted hydrogen should be passed over the charcoal for not less than fifteen minutes, by which time the bulb and its contents will be perfectly cold, and the charcoal will have saturated itself with the gas. (In practice it will be found convenient to prepare the experiment to this stage, and allow a very slow stream of sulphureted hydrogen to continue passing through the apparatus until the experiment is to be performed.) The supply of sulphureted hydrogen is then cut off, and a stream of oxygen passed through the tube. Almost immediately the charcoal will become hot, and moisture will be deposited upon the glass. The supply of oxygen should be sufficiently brisk to carry the moisture forward from the charcoal, but not so rapid as to prevent it from condensing on the glass tube beyond the bulb. In a few moments the temperature of the charcoal will rise to the ignition point, when it will inflame and continue to burn in the supply of oxygen. —*G. S. Newth, in Nature.*

A Coloring Matter for Grapevine Leaves.

The green portions of plants contain besides chlorophyl, as a rule, only a yellow coloring matter, called carotin, chrysophyl, or erythrophyl, which is insoluble in water. Several investigators find, however, that some kind of leaves give aqueous extracts of a more or less impure yellow color, an observation which is explicable from the fact that in most of these instances mature leaves were used. Young leaves yield an almost colorless extract. Yellow autumn leaves, however, contain considerable quantities of soluble coloring matters. Thus the authors found that fallen beech and horse chestnut leaves give deeply colored aqueous extracts. They have also succeeded in isolating a yellow coloring matter from vine leaves, the investigation being suggested by the use of these leaves for dyeing purposes in Persia. Like most vegetable coloring matters, this substance is a glucoside. It can be prepared by the addition of lead acetate to the decoction of the finely powdered leaves, treatment of the precipitate formed with sulphureted hydrogen, and subsequent extraction of the dried lead sulphide with boiling alcohol. The residue, obtained by evaporation of the alcohol, is freed from sulphur by means of carbon bisulphide, the glucoside remaining as an indistinctly crystalline brownish yellow substance. By boiling with dilute sulphuric acid it is split up into a sparingly soluble brown body and glucose. This coloring matter may, after washing with water, be purified by adding to its alcoholic solution an alcoholic solution of lead acetate and treating the previously washed and dried bluish green precipitate with ether containing hydrochloric acid, by which the impurities are taken up. The remaining coloring matter is then dissolved in alcohol and precipitated from this solution by the addition of water. It forms a reddish brown powder, soluble in alkalies with a brown color. Its aqueous solution produces upon chrome mordanted wool fine brown shades, and dyes wool mordanted with tin a fine yellow. The coloring matter may possibly be of practical value. The vine leaves were also found to contain up to two per cent of potassium hydrogen tartrate.—*E. Schunck, E. Knecht, and L. Marchlewski.*

Sugar as a Promoter of Muscular Power.

The subject of sugar as a food producing muscular power has been discussed by Dr. Vaughan Harley. During a twenty-four hours' fast, on one day, water alone was drunk; on another, 500 grammes of sugar were taken in an equal quantity of water. It was found that the sugar not only prolonged the time before fatigue occurred, but caused an increase of 61 to 76 per cent in the muscular work done. In the next place, the effect of sugar added to the meals was investigated. The muscle energy producing effect of sugar was found to be so great that 200 grammes added to a small meal increased the total amount of work done from 6 to 39 per cent. Sugar (250 grammes —about eight ounces) was now added to a large mixed meal, when it was found not only to increase the amount of work done from 8 to 16 per cent, but increased the resistance against fatigue. As a concluding experiment, 250 grammes of sugar were added to the meals of a full diet day, causing the work done during the period of eight hours to be increased 22 to 36 per cent.

Vaselone.

Vaselone is a substance introduced as a substitute for vaseline. According to an analysis by Villon, it is a solution of stearone and margarone in neutral mineral oil. Stearone is prepared by distilling stearin with lime. Margarone is prepared in a similar way from beef suet. Vaselone consists of 15 parts of margarone and 5 of stearone in 100 of thoroughly purified and odorless mineral oil. The fatty product obtained, after cooling, resembles vaseline, but is not as transparent. It is white, odorless, neutral, and not affected by acids and chemical reagents.