SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN & CO., - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

TERMS TO SUBSCRIBERS

One copy, one year for the United States, Canada, or Mexico $3.00
One copy, one year, to any foreign country, postage prepaid. £0 16s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845) ..... $3.00 a year
Scientific American Supplement (Established 1876) ..... 5.00 "
Scientific American Building Monthly (Established 1885) ..... 2.50 "
Scientific American Export Edition (Established 1878) ..... 3.00 "

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MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, MAY 20, 1905.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE RECENT RAILROAD HORROR.

The shocking railroad disaster near Harrisburg on the Pennsylvania Railroad lines is strangely like the still more fatal accident that occurred on the allied lines of the same system, when over half a hundred lives were lost. In each case the wreck of the passenger train was caused by a freight train on the adjoining tracks. In the accident of over a year ago the loss of life was due to careless loading of timber on a flat car, the material being insufficiently secured against lateral displacement due to the jolting and lurching effects in passing around the curves. Some timbers were displaced and struck the cars of the passenger train, precipitating the disaster. In the present case, the wreck was caused by the buckling or crumpling up of a long freight train, to which the brakes were being suddenly applied to prevent a collision between the freight train and a switching engine. The buckling of the train threw the cars against the express, wrecking the train and causing the detonation of some high explosives that were on the derailed freight cars. Much of the horror of the accident, which involved the death of over twenty people, and the injury of probably a hundred others, was heightened by the frightful explosions and the subsequent burning of the wreckage which contained many of the imprisoned passengers. The marvel of the wreck is not that so many, but so few, were killed.

We wish to draw attention to the fact that this catastrophe shows, in a most dramatic way, what a great peril the passenger trains on four-track railroads are exposed to in having to sweep past the whole length of the many 40- and 50-car freight trains, which they meet so frequently in traveling through busy manufacturing districts such as those traversed by the Pennsylvania Railroad. It is a fact well understood by railroad men that the enormous length to which freight trains have grown of late years exposes them to exactly the kind of accident which caused the recent disaster, namely, the crumpling up of the train when the brakes are suddenly applied if the action of the brakes is not uniform throughout the whole length of the train. If a freight train of 40 or 50 cars and weighing over 2,000 tons is traveling say at 20 miles an hour, and the air brakes are applied and act simultaneously and with equal efficiency on every car, the whole train would be brought to rest without any danger of crushing or displacing the cars. But if the action of the brakes should be faulty, and the brakes should be set hard on say only the first half or third of the train, the enormous momentum of the last half or two-thirds, expending itself on the portion upon which the brakes are in full action, brings a crushing strain which the cars are unable to withstand, and they are forced into one another or twisted from the track and thrown sidewise onto the adjoining tracks. It is well known among railroad men that accidents of this kind are extremely frequent, and that they constitute a standing menace to fast trains on the adjoining passenger tracks—a menace that cannot be safeguarded by signals, not, at least, if the wreck should take place when the express is within a short distance of or passing the freight train. This is one of the perils to which the recent rapid growth of freight traffic, and the endeavor to cheapen its transportation by using enormous engines and trains of exaggerated length, have brought us. The only safeguard against it is the exercise of eternal vigilance on the part of the engineers of passenger trains, and the most careful use of the air brakes on the part of the engineers of long and heavy freight trains.

TWO GREAT OCEAN CONTESTS.

The eyes of the world just now are fixed with fascinated interest upon two great contests on the high seas, the like of which the world surely has never witnessed before. In each case the prize is a big one, and its possession means so much to the contestants, that every nerve will be strained to the utmost for its coveted possession. It is in this element of keen rivalry alone, however, that the two great struggles have anything in common. Outside of that they are as far asunder as love and hate, exhilarating life and bitter death.

On the Atlantic eleven noble yachts are speeding to the eastward as fast as swelling canvas and straining sheets can drive them. The prize is the greatest that can be offered in our noblest field of sport; for the winning flag will represent, beyond dispute, the supremacy of yachting on the high seas.

On the Pacific, two mighty armadas are engaged in a life-and-death struggle, the like of which, we may say again, has never been witnessed in the history of the world. Two hundred modern ships of war, embodying, among them, the very latest constructive skill of the naval architect, and, on one side at least, the highest professional skill and leadership of the officers, and daring and devotion of the crews, are moving to meet in the shock of a struggle, the prize of which is an empire of fabulous wealth and untold possibilities.

Is there not something of encouragement and sincere gratification to be found in the fact that at this hour a peaceful struggle between less than a dozen yachts for a golden cup should so completely have absorbed the interest of the public as to make them lose sight, for the moment, of the stupendous conflict impending in far eastern waters?

Of the yachting contest, we have spoken at some length on another page. In forecasting the possible outcome of the great struggle between the fleets under Togo and Rojestvensky, we must be careful to bear in mind that any mere tabular statement of the material contained in the opposing fleets may be very misleading. Before we can judge the actual fighting strength, we must know something of the quality of the material, its age, and its efficiency—considerations which might easily change a balance which seemed to be in favor of one fleet until it became a balance entirely in favor of the other. To make clear our meaning, let us take the case of the total number of heavy armor-piercing guns carried by each fleet. One might say, remembering that the battles of the war have been fought at long range, that only guns of 9, 10, and 12-inch caliber should be reckoned as effective in a fight between armored vessels capable of standing in the front line of battle, and that only heavily-armored ships of the battleship and coast-defense type should be included. Judged on this basis, and disregarding any other considerations, Rojestvensky would appear to have a sufficient preponderance of gun fire to absolutely crush Admiral Togo and sweep him from the eastern seas. Now that Admiral Nebogatoff has effected a junction with the Baltic fleet, Rojestvensky can theoretically put into the front line of battle eight battleships and three coast-defense vessels, carrying between them a total of forty-five heavy armor-piercing guns of from 9 to 12-inch caliber, and of these twenty-six are 12-inch guns. Against these Admiral Togo could put in the first line only five battleships, carrying twenty 12-inch guns.

When we come to look into details, however, we find that although the Japanese have a numerical inferiority so great, their ships are all modern, and their guns of high velocity. Among the Russian battleships three, at least, are so old and their heavy guns are of such short length and low velocity, that they must be reckoned as distinctly of the second class; while one of them, that is protected with compound armor, must be reckoned as almost obsolete. Furthermore, the 9-inch guns are of such low velocity and limited carrying power that they have less penetration by fully thirty per cent than the 8-inch guns carried by the Japanese armored cruisers. If these older battleships are fit to fight in the first line of battle, so surely are the eight armored cruisers of the Japanese, with their high-velocity 8-inch guns, of which they mount thirty-two altogether, and their 7-inch face-hardened armor, which is probably as effective at long ranges in bursting and breaking up armor-piercing shells as the soft, compound armor carried by at least one of the Russian battleships. Add to these facts that the Japanese have an overwhelming superiority in light cruisers, scouts, and torpedo boats; that they are fighting in or near their home waters; and that the Russian fleet depends for coal upon colliers that are liable to capture when once the fleet has passed into Japanese waters, and it will be seen that the total advantage does not by any means lie with the Russian fleet, powerful though it be.

COMPLETE THE COAST DEFENSES.

On January 16, 1886, the Endicott Board of the army outlined a system of sea-coast defense for the adequate protection of our seaboard. During the past nine years work has been done on the emplacements and the guns as fast as appropriations by Congress would allow. Up to date $110,000,000 has been expended; and it is estimated that it will take $65,000,000 more to complete the work. The guns already emplaced include ninety-three 12-inch, one hundred and nineteen 10-inch, ninety-three 8-inch, three hundred and fifty 12-inch mortars, and one hundred and eighty-five rapid-fire guns. This means that eighty-three per cent of the heavy guns, sixty-six per cent of the 12-inch mortars, and fourteen per cent of the rapid-fire guns required for our coast fortifications are already mounted. So far, so good.

Unfortunately, as matters now stand, the value of this fine equipment is reduced by about sixty-six per cent, because it is not provided, or is very ill-provided, with the range-finding apparatus which is necessary to the efficiency of a modern long-range battery.

Unless big guns of 10 and 12-inch caliber be provided with accurate range-finders, they cannot make good shooting beyond ranges of two miles; but with accurate range-finders, these guns are effective against the enemy up to an extreme range of six miles, and the smaller caliber guns at proportionately decreasing distances. The ineffective work done by the heavy guns at Port Arthur against the Japanese fleet has been a matter of general comment, and the following explanation has been given by the Russian general of artillery, Martushev: "The remarkable action of the Quantoon fortress artillery," at Port Arthur, "as manifested during the repulses of the Japanese fleet, leaves nothing to wish for in what concerns the shooting at middle or short ranges. But when the ranges are 10,000 or 12,000 meters, this artillery does not shoot at all, or fires without results. If it were otherwise, it could never have happened that the bombardments at Port Arthur, lasting sometimes several hours without interruption, were without results, when under the circumstances every minute ought to have caused the loss of some ship, small or big."

Brigadier-General J. P. Story, chief of artillery, U. S. A., states in his last report that it would be impossible, if the position-finding equipment were completely installed on our fortifications, for hostile vessels to remain at 10,000 or 12,000 meters from our batteries of 12-inch guns or mortars for two or three hours, and not be destroyed. He then proceeds to make the following astounding statement: *"I regret, however, to have to say that even at this date most of our fortified harbors are no better supplied with position-finding equipment than apparently is Port Arthur."*

Evidently some of the amazement which we have been expressing at the apparent lack of preparedness of the Russian authorities, displayed at Port Arthur, may well be reserved for the extraordinary condition of things thus revealed in our own defenses.

In its annual report of 1903, the Board of Ordnance and Fortification recommended that $2,000,000 be appropriated each year for the next few years, for range-finders and other instruments for fire control, etc., and stated that it was aware of no object for which sums of money could be more effectively expended, or from which greater benefit would be derived. In its annual report for 1904 the Board made the further statement that, in the present state of coast defense, money can be more advantageously expended for fire control than for any other permanent installation.

It has been a characteristic of modern military inventions during the past few years, that several small and comparatively inexpensive devices have been produced which enormously increased the effective value of heavy and costly war material. We may mention the soft cap for armor-piercing projectiles, the telescopic sight, and the modern position or range finder, now under discussion. So great is the influence of such inventions, that their possession by one of two contending forces might easily determine the fortunes of a battle, or even of a whole campaign. As one illustration of this, we may mention that in the naval battle of August 10, the Japanese did and the Russians did not carry telescopic sights on their guns—a difference which in itself was quite sufficient to determine the issue of that fight.

We commend these facts to the careful consideration of Congress, to whom it must surely be evident that no appropriation could be granted to better effect than the annual $2,000,000 necessary to render our present costly coast defenses fully efficient.

THE INTERNATIONAL RAILWAY CONGRESS.

Although the International Railway Congress in Washington was primarily a gathering of the foremost railroad men of the world for the discussion of the technical and commercial side of the great subject of railway transportation, the exposition of American railway appliances, which was held on the grounds adjoining the Washington Monument, played a most important part in connection with the great international gathering. Although it was understood that the foreign delegates would travel widely in the United States before returning to their various and widely-scattered homes, and would, therefore, have the opportunity to become acquainted with the American railroad in its active operation, it was realized that the limited time at their disposal would prevent many of them from obtaining as intimate a view of our railway plant and appliances as they might wish to secure Hence the suggestion, which soon took practical shape, to hold an exposition of railway material at Washing-

ton, and erect buildings and set apart grounds of sufficient area and size to contain a complete exhibit of American railway plans and appliances. This was practically the first exclusive exhibition of its kind ever held, and, apart from the main exhibition building, there were several buildings erected by the largest and most widely known manufacturing firms who deal exclusively with railway material. The exhibition fulfilled its purpose of bringing the railway delegates in touch with the latest improvements, and as these are the men upon whose word the adoption of new plants and the placing of large orders really depends, it is believed that the exposition will have an important effect in increasing the exports of American-made railway supplies and material.

The questions that came up for discussion at the Congress were grouped in five main sections, as follows: First, Ways and Works; second, Locomotives and Rolling Stock; third, Working; fourth, General; and fifth, Light Railways. Under the head of Ways and Work there were four sub-sections, the first of which dealt with wooden sleepers or cross-ties, and was concerned with a study of the selection of kinds of wood and also a study of the processes of preservation of railway sleepers or ties. Then followed articles and a discussion of Rails for Lines with Fast Trains, in which the question of cross-sections of heavier rails, the best metal for rails and ties, rail joints, suspended joints, and supported joints were gone into at great length. The third sub-section was concerned with improved rail crossings, spring and movable point frogs, and continuous rail crossings. The fourth sub-section was devoted to a discussion of Concrete and Embedded Material. Under the head of Locomotives and Rolling Stock one of the most interesting papers dealt with the great increase which has taken place during the past ten years in the size and power of locomotives, an increase amounting on some roads to as much as 45 per cent. The important question of automatic couplers was discussed in papers showing the advantages and disadvantages of such couplers; the improvements effected in their construction, and their use in conjunction with other couplers.

No papers dealt with under this head commanded more absorbing interest than those concerning electric traction, in which its progress on important lines of railways was traced, and the much-discussed questions of the comparative value of continuous, alternating, and polyphase current received lengthy attention.

In Section 3, devoted to the Working of the Railways, the sub-section possessing most interest was that devoted to the Automatic Block System, in which the recent improvements in automatic block signaling were discussed, and it was shown what progress had been made in their introduction. In Section 4, devoted to General Subjects, the questions of slow freight rates, bookkeeping, duration and regulation of work, and provident institutions were the subject of papers and full discussion. In the last section, Light Railways, it was shown what influence the construction of light railways may have had on the traffic of the main lines and working of light railways. The second section under this head was devoted to the consideration of the direct financial co-operation by the State and by localities interested in the development of light railways, and a paper was given outlining the results obtained in Belgium by the institution of a central authority for studying the projects, and supervising the construction and organizing the working of secondary railways constructed with the financial assistance of the State and of the district affected. The third section considered the organization of a cheap service on main railway branch lines which carry little traffic and on light railways. The subject of the last section, Traffic Conveyed by Automobiles, brought the Congress to the consideration of what may safely be termed the very latest development of railway transportation. It dealt with the question of the organization of service of auto-motors on routes where there was not enough traffic for a railway. The development of the separate steam or gasoline-propelled railway car is as important a change, in its more limited sphere, as the electrifying of the main lines of some of the steam railways.

The magnitude of the International Congress may be judged from the fact that the home and foreign delegates together numbered nearly one thousand, and that there was not a single one among these many who was not qualified to rank as an expert in some branch of the complex construction, organization, and management of the world's railroad systems. These delegates come from every corner of the earth; they have built and operated railroads under every possible condition of topography, climate, population, and private and government control. The intercommunication of ideas by papers, addresses, and discussions must result in a general improvement of method, the rejection of old and the incorporation of new and better construction, plant, and operation; results which will be furthered by the personal contact and private exchange of views and experience between individual members.

Vice-President Fairbanks, who in the absence of the President presided at the opening of the Congress, gave a broad touch of human and international interest and meaning to the Congress in some happily-chosen words, when he said that the sessions of the International Railway Congress "bring into closer fellowship distinguished and able representatives of many nations inspired by a wholesome, common impulse. They bring together those who are engaged in promoting the arts of peace and who are desirous of advancing the welfare of mankind. They enlarge the circle of international acquaintance and tend to preserve international amity. They emphasize the fact that our common good is to be promoted by the maintenance of a broad, fraternal, international spirit. While deliberating upon methods to promote the efficiency of the railway, let us hope that you may cultivate a purpose to promote the adjustment, through the arbitrament of reason, so far as may be done consistently with national honor, of those perplexing problems which sometimes arise to menace the world's peace. The nation which seeks an honorable settlement of differences with its neighbors in some other manner than by the sword, is not decadent; it is not wanting in national virility. It is merely manifesting an advanced degree of civilization. It is evidencing the fact that the barbaric strain has run out of its blood. The railroad is one of the most potent agents of modern civilization. With the steamship it has done as much, perhaps more than any other agency to break down the barriers of ignorant prejudice, and unite the world in a common feeling of brotherhood."

AN ELECTRIC PROCESS FOR MANUFACTURING PEAT.

An electric process for the treatment of peat has lately been adopted in England at the Johnson and Phillips works. The peat is transformed into a hard combustible which is well adapted for use under boilers. The operation is said to last about two and a half hours and the material costs less than ordinary coal. The combustible which is thus produced has a high calorific value and gives scarcely any smoke. A plant on a large scale is shortly to be installed in Ireland, and if successful it will be an important move in the direction of utilizing peat as fuel under the best conditions. In the present process the peat as it comes from the bogs is placed in cylinders which revolve at a high speed, and well pressed, while a set of air fans are used to drive off the water which forms about 80 per cent of the total. A set of electrodes is placed in the cylinders and connected with a dynamo. The circuit is completed through the mass of the peat between the electrodes. The resistance which the peat offers to the current causes a considerable heat, and the latter breaks up the peat and pulverizes it, but without causing it to lose any of its properties. In order to increase the conductivity of some kinds of peat, they add certain chemical products. After this process the peat is treated by a set of kneading rollers which give it a plastic consistency so as to enable it to take any desired form. From here it passes to an automatic press which forms it into briquettes. It is then ready for use and is taken to the store-room. It is to be remarked that although the passage of the current through the peat gives rise to a heating effect, the results obtained in this way are quite different from those which another method of heating would produce. By a fire heat the particles of the peat lose their different constituent matters, while the electric heating causes them to disintegrate, thus freeing their cellular material and distributing it throughout the entire mass of the peat. Thus all the particles become adapted for combustion. To obtain a harder material, the disaggregated peat is given a longer treatment with the current. The air is kept out by a tight cover, and the mass is then treated with an adhesive solution so as to unite the particles. The experiments have been made with the above process on a large scale and at a great expense, and it is said to have been greatly improved in the details and can now be applied commercially.

ARTIFICIAL COTTON.

Some recent experiments have been made in Bavaria in regard to preparing artificial cotton from pine wood, and it is said that the new process allows it to be made cheaply enough so that the artificial cotton may compete with the natural product. In the method which has proved the most successful the wood, which has had the bark removed, is cut into thin sticks or fibers one-sixteenth of an inch or less in thickness. These are placed in a large horizontal copper cylinder lined with lead, into which steam is passed. When the separating action of the steam on the wood fiber has been prolonged sufficiently, an acid solution of sodium sulphite is added and the cylinder is heated under a pressure of three atmospheres during thirty-six hours. The wood, which has become completely white, is washed and then passed through a crusher. After washing again, the fibers are further whitened by a chloride of lime treatment. The matter which is thus obtained is dried and constitutes a pure cellulose which is then heated under pressure with a mixture of nitric and hydrochloric acids and chloride of zinc. The pasty mass thus formed is mixed with a little gelatine and castor oil, which give a certain resistance to the fiber. The cellulose is then formed into fine threads by a spinning machine, and these are washed in a carbonate of soda solution and dried. These threads are said to form a very good fabric when woven, and can easily be dyed. Although the experiments have as yet been carried on only in the laboratory, there is no doubt that the process may be applied on a large scale, thus coming into the European market as a competitor for the imported cotton.

SCIENCE NOTES.

A series of discoveries of great value to antiquarians and geographers have been made in the barren desert of the Fayoum by Mr. Seton Karr, the explorer. These investigations show that at some bygone period the old Kurun Lake consisted of a chain of minor oases running in a northwesterly direction from the existing lake and about fifteen miles distant from the actual border line. The explorer brought to light a large number of millstones, plates for grinding meal, and flint implements of the unmistakable Fayoum pattern, strewn over the whole length of the plateau lying parallel to the lake. A number of these trophies, some of which are surmised to belong to the neolithic period, while all afford undoubted evidence of primitive village communities, have been deposited in the Cairo Museum.

The British consul-general at Naples describes in the course of a recent report a new, easy, and commercially profitable system of cultivating truffles that has been discovered by two eminent Italian botanists, Prof. Mattei, who occupies the chair of botany at the Naples University, and Dr. Serra, of Castellammare, who also holds an important position in the botanical world. They have patented a mycelium, and they consider that once the ground has been thoroughly treated therewith, generation will be so spontaneous that further use of what may be called the "protoplasm" becomes unnecessary for a number of years; for the cultivated tuber will propagate itself the same as the wild one has done for unnumbered generations. They further assert that the crop which they propose to sow almost immediately will be ready to be gathered from October onward. Each oak tree is calculated to produce among its roots from 5 to 10 kilogrammes per year, which means that at $2 per kilogramme each tree will produce from $10 to $20 per annum. The chief hope of the botanists referred to, of material profit, however, lies in the *Terfezia leonis*. This species of truffle originates from the roots of *Helianthemum guttalum*, a herbaceous annual which can be sown from year to year where it will best flourish. It is the easiest of all the varieties to grow, and is practically independent of water. In Tripoli the *Terfezia* practically takes the place occupied by the potato in more northern countries. It grows there to the size of an orange, and when taken from the ground is cut up and dried, and carried as food for the caravans which cross the desert. It can be cooked when required, either in water or in camel's milk, and will keep good for an indefinite period.

An important research expedition, which has for its objects the thorough investigation of the hydrography and biology of the central and western sections of the Indian Ocean, which are not explored by the "Challenger" expedition, is to be carried out under private auspices. The British Admiralty survey yacht "Sealark" has been obtained for the purpose. The party will first proceed from Colombo (Ceylon) to the group of coral atolls and submerged banks known as the Chagos Archipelago. This field opens considerable facilities for research, since no clear data regarding this portion of the Indian Ocean has been gathered since 1837. Thence it will go to Mauritius in August, to replenish stores, proceeding subsequently to the surface reef of Cargados and along the Seychelles group and Saya de Mabha bank. This route has been selected for the purpose of conclusively determining the depth of the ocean bed between Mauritius and Seychelles, about which there is at present much diversity of opinion. After leaving the Seychelles the expedition will survey the Agalegas group, finally returning to Colombo. Elaborate soundings and temperature tests are to be carried out, and the determination of the existence of any relatively shallow banks connecting India with the South African continent, or Mauritius with the Seychelles, the mutual relationships of the Chagos atolls, the general ocean changes that have occurred since the last surveys, and the nature of the currents at varying depths. Frequent dredgings will be undertaken for biological purposes, and the examination of the pelagic flora and fauna at various depths from 50 to 500 fathoms, as well as the ocean bed, and all parts of the coral reefs visited. The expedition hopes by this careful survey to obtain some definite information concerning the vertical distribution of animals and plants. The expedition will be absent for several months.