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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.

FASTEST AUTHENTIC RAILROAD RUN ON RECORD.

The fastest run ever made by a railroad train for the distance was that accomplished last month on the Burlington and Missouri River Railroad, between the two stations of Eckley and Wray, Colo. The two towns are 14.8 miles apart, and the run was made in an even nine minutes, which works out at a rate of 98.66 miles per hour. The train was made up of a mail car, baggage car, two chair cars, three sleeping cars, a dining car, and a private car, or nine cars in all. It was drawn by a ten-wheel engine with 19-inch by 26-inch cylinders, and 72-inch drivers; the line is on a downgrade with a maximum of 32 feet to the mile. The timing of the train was done in the observation car by five watches, one of which was held by the conductor, and the record is considered to be so accurate and well authenticated that it has received the official confirmation of the Chicago, Burlington and Quincy Railroad.

PERILS OF SUBMARINE NAVIGATION.

The submarine torpedo boat "Fulton," during the course of her coastwise trip to the South from New York Harbor, made a successful run to the mouth of the Delaware, but, unfortunately, as she was rounding the Breakwater, there was an explosion of gas within the boat, which more or less seriously injured five of the crew. The run seems to have been fairly successful, the "Fulton" having made several dives during the night as she was passing down the Jersey coast, on one occasion remaining submerged for a distance of two miles. Probably it would be unjust to ascribe the accident to any special features of the submarine as such, since explosions due to the same cause occur in gasoline launches. At the same time it cannot be denied that the use of gasoline as a fuel becomes particularly perilous in this type of torpedo boat, where the chances of escape in the case of accident are very remote.

THE GATHMANN GUN AGAIN.

According to reports from Washington, Lieut.-Gen. Miles has issued an order reconvening the Board of Army and Navy officers which conducted the test made last fall at Sandy Hook of the Gathmann gun, for the purpose of "considering the statements made by the president of the Gathmann Torpedo Gun Company, regarding the results of the tests of their 18-inch gun, as reported to the Board, and to make replies thereto." It will be remembered that the Gathmann gun was designed upon the theory that if you can deliver a shell charged with a large amount of guncotton against the hull of a battleship and detonate it there, the sides of the vessel will be blown bodily inward and the ship, of course, sent to the bottom. The test referred to was made at the request of the Gathmann Company in competition with a service 12-inch army rifle, firing ordinary shells. Each gun delivered its attack against an 11½-inch Krupp plate, backed up by a structure representing a section of a modern battleship's side. After three rounds, the Gathmann gun broke the plate in two without penetration, while the army gun penetrated its plate and completely tore to pieces both the plate and backing. The Board reported that while the army gun, firing maximite and explosive "D," was successful beyond expectation, the Gathmann gun failed to do any injury to the target commensurate with the size of the gun and the enormous charges of high explosive employed. It seems to us that the question is one of relative efficiency. The Army naturally desires to secure the most serviceable gun, shell and detonating fuse; and while the Gathmann gun did considerable execution, in our opinion it was not at all comparable with that done by the service gun; indeed, we cannot see how the Board could have arrived at any other conclusion as to the relative merits of the two types, than that which they gave in their report. For a lengthy description of these famous trials and photographs showing the condition of the two armor plates after trial, reference is made to the SCIENTIFIC AMERICAN of November 30, 1901.

FESSENDEN'S ELECTRIC WAVE-DETECTOR.

Widespread interest has been aroused by the experiments which have been carried on by Prof. Fessenden with a new form of aerial telegraphic receiver, which is claimed to give promise of considerably greater rapidity than the coherer with which the public is generally familiar. The experiments have been carried out under the auspices of the Weather Bureau, and have extended over a period of about two years. Some of the results achieved have been made public by the Bureau, and they are considered to foreshadow a great improvement in the speed of aerial telegraphy. The work has been carried on between Hatteras Inlet and Roanoke Island, over a distance of fifty miles, and messages have been sent and received without the use of the coherer, the place of which is taken by the new receiver, which Prof. Fessenden calls a wave-detector. He claims that he has worked it experimentally at speeds which would be equal to over five hundred words a minute, and this with only about twenty-five per cent increase of energy per signal over that which is used with the ordinary apparatus. We understand that the wave-detector consists of a wire whose conductivity is automatically increased and diminished through a range which can be determined by the adjustment of the apparatus, and that the making and breaking of the circuit is so delicately adjusted that the higher speeds are easily realized.

ATTUNED WIRELESS TELEGRAPHY.

After eight years of litigation Prof. M. I. Pupin, of Columbia University, whose brilliant inventions in long-distance telephony are fresh in the public mind, has been granted his application, made in 1894, for a system of selective resonance, or "tuning" as it is popularly called, of electrical circuits. As far back as May 17, 1893, Pupin delivered a lecture at the general meeting of the American Institute of Electrical Engineers, in this city, on "The Practical Aspects of Low-Frequency Electrical Resonance;" and on applying for his patent he was surprised to discover that similar applications had been made by a member of the French firm of Hutin & Le Blanc, and by Mr. Stone for the Bell Telephone Company. The decision in Pupin's favor was made known to him a few weeks ago, and the result naturally takes on special significance when it is learned that up to date something like two hundred applications for patents on systems of tuning electrical circuits have been filed at Washington.

At the time that his investigations were started, Pupin had in mind the application of tuning to ordinary telegraphic circuits; for wireless telegraphy could scarcely be said to be in the air at that time. Immediately upon the successful development of Marconi's investigations in aerial telegraphy, the question of tuning naturally took on a new significance. Briefly stated, Pupin's system provides for the construction, in connection with a given line, of a number of branch electrical circuits, so arranged that each corresponds to a certain pitch of frequency, with the result that by impressing an alternating electro-motive force of a certain frequency on the line (or, in the case of wireless telegraphy, on the ether) the corresponding receiver will respond strongly. The value of this principle as applied to wireless telegraphy for the purpose of preserving secrecy, or of directing, or more properly speaking confining, the Hertzian waves to the desired receiver, is obvious. Thus, at each of six separate stations, the receiving apparatus might be arranged for a certain frequency, say 200, 400, 600, as the case might be. To make sure of the desired station, and that one alone, receiving the message, it would simply be necessary to utilize in the sending station a current of corresponding frequency.

Prof. Pupin has recently concluded an arrangement with the Marconi Company by which they are granted the exclusive license to use his system of tuning; and as these patents cover not only the United States, but every country in the world except Germany, where the obstructions placed in the way of his securing his patents were such as to lead Prof. Pupin to give up any attempt to prosecute his claims in that country, it will be seen that the position of the Marconi Company is enormously strengthened by the right to operate under this system. The method of tuning to which Marconi has so often referred as having satisfactorily solved the problem of secrecy and control, is the one originated by Pupin; and the arrangement recently announced only awaited the granting of the patents, for its final ratification.

THE NAVAL APPROPRIATION BILL.

The bill reported by the Chairman of the Naval Affairs Committee of the House asks for the generous appropriation of $77,659,386. Naturally, the section of the bill which will excite the most interest is that relating to the increase of the Navy. Provision is made for two first-class battleships of the highest type, which are to cost not over $4,212,000 each and are to have a displacement of 16,000 tons; two first-class armored cruisers to cost not over $4,659,000 and to be of 14,500 tons displacement; and two 1,000-ton gunboats, whose combined cost is to be $3,802,000. The total cost of the six ships thus provided for will be $29,500,000, of which $9,000,000 is for armor and armament.

The Report states that on January 1, 1902, there were in process of construction eight battleships, six armored cruisers, nine protected cruisers, four monitors, fifteen torpedo-boat destroyers, nine torpedo boats and seven submarine boats. Although this total of fifty-eight ships under construction would seem to indicate the activity with which the construction of our Navy is being carried forward, we regret to say that the figures are misleading, for the reason that the private firms which have undertaken the contracts for these ships are wofully behind their contracts. Out of the whole fifty-eight, no less than thirty-five are behind from nine months to over three years. Thus the battleships "Maine," "Missouri," and "Ohio" should have been completed last summer; the four monitors in March, 1901; the fifteen torpedo-boat destroyers were contracted to be completed in April and May, 1900; the torpedo boats should have been completed between January and November, 1899, and the submarine torpedo boats between April and October, 1901.

This shameful state of things, for it is nothing less, proves that so far from the work of upbuilding our new Navy and properly safeguarding the naval interests of the country being in a satisfactory condition, it is in an extremely backward and, if we bear in mind the enormous activity of other nations, positively neglected condition. That this is not an exaggerated statement is evident when we consider that when these ships, which are all the way from one to three years behind time, were authorized, it was considered that they represented the minimum addition to our Navy that could be made consistently with the interests of the country, and that naval programmes which are three years behind mean a relative gain in strength by the navies of competing countries. Take, for instance, the case of Germany with its sixteen-year programme and its original intention of spreading that vast addition to its fleet evenly over the sixteen years. So far from doing as we are doing, letting the whole programme run behind to the extent of two or three years, the Germans have gone to the very opposite extreme, and have reduced the term of completion by six or seven years; not only that, but they have launched other and more ambitious programmes, and are building ships, not as we are doing, more slowly, but considerably faster than was originally proposed. We do not wish to be alarmists, nor are we when we state that whereas three or four years ago we stood slightly in advance of the German Navy, to-day, owing to the apparent indifference of the private shipbuilding firms to the interests of the country, we are considerably behind Germany and we are dropping behind at an accelerated pace. We say this with a full knowledge that a few months ago we made a comparison of the United States Navy with that of Germany on the basis of ships authorized and actually commenced, which showed us to have a lead over that country; but that comparison did not take account of the relative energy with which the two countries were living up to their naval programmes. We neither knew that Germany was pushing hers through with such haste, nor that this country was falling behind her own to such an alarming degree.

It is in view of the above considerations that we feel called upon to express the most profound satisfaction at the consent of the Naval Affairs Committee to recommend the building of some warships in government yards. The Report says: "In view of the fact that there is some public sentiment favorable to building ships in our government navy yards, it has been deemed advisable for the Committee to insert a provision in the appropriation bill of this year, leaving it in the discretion of the Secretary of the Navy to build any or all of the ships in government yards, but making it mandatory on him to construct at least one battleship or one armored cruiser in such navy yards as he may designate, as an experiment; and it is further provided that he shall keep an accurate account of all expenditures for labor and material and the inspection and construction of such ships, and report to Congress at each session; and upon the completion of said ship, he shall make a detailed report, showing the relative cost of one built by the government and one by contract." The report puts it altogether too lightly when it says there is "some" sentiment; for we are satisfied that outside of the shipbuilding companies themselves, who naturally are not favorable to government-constructed vessels, there is an almost universal demand that the costly plant of our navy yards, instead of lying idle when there are no ships under repairs, shall be properly employed in the construction of new vessels. The naval constructors to a man are most enthusiastically in favor of this measure. They point out that as matters stand at present, when repair work is slack the skilled forces at the various yards have to be largely broken up and dismissed, and that consequently there is a great loss of time and a scattering of disciplined forces which it is difficult and generally impossible to gather together again when repair work is plentiful. With a battleship and cruiser on hand at our three leading navy yards, New York, Norfolk and Boston, it will be possible to keep a force of first-class mechanics continuously employed, transferring them from repair work to new construction when it became necessary. Under the very able administration of our naval constructors, our navy yards have been brought up to such a pitch of excellence both in men and material, that they can turn out as good, and generally much better work than is produced by the private shipbuilding firms. The earlier ships built at navy yards were costly, simply because the yards of that time were saturated with the most corrupt political influences and were loaded down with political incompetents. Now the yards are absolutely freed from such control, and the work that is done is of the most thorough and up-to-date character. We most sincerely hope that Congress will see the wisdom of supporting this suggestion of the Committee. In no other way could it bring such a powerful leverage to bear in urging the private shipbuilding firms to consult the interests of the country by giving naval construction their first and not, as is now the case, their last consideration. That twenty-five of the new ships for the Navy should be from two to three years behind their contract date of completion is nothing less than a national scandal, for which the proposed construction of ships in government yards will prove to be a most efficient corrective.

AMERICAN AND BRITISH LOCOMOTIVES IN EGYPT.

Acting under instructions from the British Foreign Office, Lord Cromer has sent in a report on the comparative merits of British, Belgian and American locomotives in Egypt, which is accompanied by technical observations by Major Johnston, President of the Railway Board, and T. H. Trevithick, Chief Engineer. That the report is an impartial one must be taken for granted, as the tests upon which it is based are signed by a representative of the Egyptian railroads, and also by a representative of the Baldwin Locomotive Works, the makers of the American engines. Between 1895 and 1897, the great increase in the length and traffic of the Egyptian railways made it urgently necessary to order some seventy new engines. Among the tenders presented was that of the Baldwin Works, who offered twenty engines in twelve weeks. This was accepted, as were also tenders for fifty engines by one British and four Belgian firms.

The report is of the greatest interest, first, because of the evident fairness as stated above, of the tests and the impartiality of the report; and secondly, because it brings out very clearly both the advantages and disadvantages under which the locomotive industry of this country labors in its competition for foreign orders. The report is both favorable and unfavorable to the American locomotive. On the score of cheap first cost and speed of delivery we are easily ahead of British builders, while on the score of economy of operation, the consumption of fuel, etc., the American locomotive design seems to be unable to compete with the English engines. On the question of price, where the tenders were based upon Egyptian standard designs and specifications, the figures stood thus: In one tender the British figure was $11,200 and the Baldwin $13,500; and on another tender the British price was $16,250, as against a tender of $17,875 from Baldwin. "On the other hand," Lord Cromer adds, "the Americans offered to supply engines differing in certain particulars from the Egyptian designs and specifications, but which they held to be of equal power and equally suitable to the work which had to be performed. Under these conditions the American prices fall respectively to $9,275 and $12,375. That is to say, 19 per cent below British figures. The reason for this great fall in price is sufficiently obvious; they were able to introduce their stock standards and to advance work continuously without being hampered by, to them, unknown and unnecessary conditions. It appears, however, that it is not so much in the matter of price as in respect to the period required for the construction that the American manufacturers have had the greatest advantage. When British and American firms entered into competition, the former offered to complete the orders in forty-eight and ninety weeks, respectively. While the American offers, on the other hand, were for delivery in eighteen and thirty-five weeks if the Egyptian designs were followed, or in twelve to thirty weeks if certain changes in the designs were allowed."

In the competitive tests, however, the advantages lay decidedly with the British engine. In the freight trials, three British and two Baldwin engines competed, and each group made eight runs of 1,034 miles. The American engine hauled an average of fifty-four cars, weighing 760 tons, and the British engines an average of fifty-seven cars, weighing 868 tons. Doing this work the American engines consumed 62 pounds of coal per mile, the British engines 49.4 pounds of coal per mile, while the American engines evaporated 7.78 pounds of water per pound of coal, and the British 9.1 pounds. Mr. Machesney, the Baldwin's representative, and Mr. Higginson, the English representative, both signed the log at the end of each run. The coal was weighed and put on the tender in the presence of the two representatives, and what was left after the runs were completed, was also weighed in their presence. In the trials of the passenger engines nine runs were made by six American and two British engines, in which the average number of cars per train was thirteen and 1,345 miles was the distance run. In doing this work the American engines burned 46.3 pounds of coal per mile and evaporated 6.36 pounds of water per pound of coal, while the British engines burned 30.7 pounds of coal per mile and evaporated 8.2 pounds of water per pound of coal. The inferior efficiency shown by the American engines in these most interesting tests was certainly remarkable. Major Johnston attributes it to the following causes: Greater cylinder condensation, because of the greater exposure of the outside cylinders; increased twisting strains due to the outside cylinders; transverse strains on the coupling and connecting rods causing increased friction, due to the flexibility of the engine frame; increased friction due to the comparatively short eccentric rods and the use of intermediate rocking levers; whereas in the British type, the valve rod is directly attached to the expansion link. On the other hand, he points out the following advantages possessed by the American over the English type, and expresses surprise that they do not counterbalance more fully the disadvantages named: First, the balanced slide valves, which greatly reduce valve friction; and secondly, the more perfect regulation of the steam, owing to the elaborate rack sectors provided.

We think it is probable that the high efficiency of the English locomotive is to be found in this case rather in the boiler than in the engine; although no doubt the points in construction mentioned above have an appreciable effect. The plate frame permits the use of a firebox five inches wider than can be built within the bar frame; while the copper firebox and brass tubes of the English engines undoubtedly serve as better conductors of the heat than the ordinary steel type.

These results coming so soon after the report given by the Midland Railway, in which a similar economy was shown by English over American engines doing the same work, will attract considerable attention from locomotive builders in this country, and we would like to hear them give their own version of the great difference between the two types.

THE RECENT AUTOMOBILE ENDURANCE TEST.

Under weather conditions that were far from promising, but with bodies and machines equipped for anything the elements might have in store, eighty-two enthusiastic automobilists started on the one hundred-mile endurance test of the Long Island Automobile Club on the morning of April 26. The maximum speed of 15 miles an hour, which is the legal limit, allowed the contestants 6 hours and 40 minutes as the shortest running time they could cover the course in without being disqualified. Notwithstanding this, a dozen or more of the prominent French and American machines made the run as quickly as possible, with the result that they were disqualified. It is gratifying to note, however, that among the machines that finished early were about as many American automobiles as those of French manufacture. M. Emile Voight in a Panhard made the record time of 2 hours and 52 minutes, while the time of several other French machines was from 4 to 5 hours. Two Fournier-Searchmouts, a Knox and Oldsmobile, several Long Distance machines, and Toledo and Locomobile steam carriages arrived from half an hour to an hour later. Under the weather conditions they were obliged to finish in, which consisted chiefly of a sixty-mile an hour gale direct from the ocean, these light American machines compared very favorably with the more heavily built, powerful French racers.

A number of the gasoline and steam carriages, in order not to exceed the time limit, were obliged to go very slowly on the last part of the course. A Ward Leonard 5-horse power 1,010-pound machine arrived precisely on time, just 6 hours and 40 minutes after starting, and was followed by over thirty others at intervals of two or three minutes. The chauffeurs and their machines were covered with dust, stirred up by the gale that was blowing, and were rather grotesque objects to look upon as they arrived at the finish in Jamaica.

The decision of the judges has awarded a blue ribbon, which stands for a perfect run without a stop, to six of the competing steam carriages and fourteen of the gasoline type. This constitutes about twenty-five per cent of the contestants in each class. Three White steam carriages were entered under the same nonstop conditions as applied to the gasoline machines, being fitted with condensers for this purpose. Two of these machines won blue ribbons, and all three arrived at the finish within a few seconds of each other. All the other steam carriages were allowed stops to take on water and fuel. The test was a most severe one for this type of machine because of the strong wind blowing. This put out the fire in a good many instances, and made a stop necessary to relight it.

The hill-climbing contest at Roslyn was encountered successfully by all the machines. The roadbed was good and the ascent gradual, there being no sharp pitches. The hill is about half a mile long and the grade is not greater than 15 or 20 per cent. The steam carriages made the best showing when it came to climbing this hill, the gasoline machines equipped with three speeds taking it next best, and the two-speed gasoline rigs climbing it for the most part on the low gear, at a rate of five or six miles an hour. The best time on the hill was made by a Rochet-Schneider gasoline machine, which made the ascent in 1 minute 19 seconds, and was awarded two cups therefor. A locomobile was first in the steam carriage class, its time being 1 minute 42 seconds; an autocar and a Winton were the winners in the 1,000-pound and 1,000 to 2,000-pound classes for gasoline machines respectively.

The endurance run was a decided success, and showed very well what the modern automobile is capable of accomplishing in a gale of wind, while the one of last year demonstrated what it could do in a heavy rainstorm. It is to be hoped that the Automobile Club of America will have even better weather for its endurance run into Connecticut on May 30 and its speed trials on Staten Island the following day.

SCIENCE NOTES.

A new species of violet has been discovered by Miss Lillie Angell, of Minton Place, Orange, and Charles Louis Pollard, curator of plants at the Smithsonian Institution, has named the species *Viola angellæ*, after the discoverer. The leaves are cordate-ovate in outline, with a broad sinus, irregularly five to seven lobed, or some of them merely deeply sinuate. The lobes are all obtuse, more or less crenate, and the flowers are violet-purple, darker at the base. The leaves attain large dimensions.

The captain of the steamship "Australia," which recently arrived at San Francisco from Tahiti, believes that he has rediscovered the outcroppings of an island very rich in phosphates. The existence of this island was reported by Dr. John de Graves, now of Honolulu, as far back as 1859, since which time it has been searched for by vessels of the government and private persons. Stormy weather prevented the captain of the "Australia" from making as thorough an investigation as he desired. The United States Coast Survey vessel "Albatross" has made several fruitless searches for this island. The captain of the "Australia" states that the approximate situation of the island is 18 deg. 56 min. north latitude and 136 deg. 10 min. east longitude.

According to W. Syniewski (Bot. Centralbl., 87, 408), the composition of pure starch is always perfectly uniform, with the empirical formula, $C_6H_{10}O_5$. The more resistant constituent, starch cellulose, is a reversion product subsequently formed from the dissolved starch. The substances formed by the action of boiling water or of KOH on starch-grains are a product of the hydrolytic splitting up of starch. The simplest of these is a substance with the composition, $C_{54}H_{90}O_{48}$, to which he proposes to give the name amylogen. He further suggests that the term dextrin should be limited to the products of the hydrolysis of starch (with the exception of the sugars); those which do not reduce Fehling's solution, and are colored indigo-blue by iodine, being amylodextrins.

G. T. Beilby and G. G. Henderson have exposed platinum, gold, silver, copper, iron, nickel and cobalt to the action of ammonia at temperatures ranging from 400 deg. to 900 deg. In every case the physical effect of the treatment was to disintegrate the metal completely, while a large proportion of the ammonia was resolved into its elements. The fracture of metals which have been exposed to this action is spongy or cellular; under the microscope the metal appears as if it had been suddenly cooled while in a state of active effervescence. The penetration of the ammonia molecules into the metal is remarkably quick if the conditions are favorable. The authors believe that the physical effects which result from the action of ammonia upon metals at high temperatures are due to the alternate formation and dissociation of nitrides taking place between certain narrow limits of temperature, the reaction going in one direction or the other according as ammonia or hydrogen molecules preponderate in the gases which are in contact with the molecules of the metal at and below the surface. In several cases the formation of nitrides has been definitely proved. The absorption of small quantities of nitrogen by pure iron renders it hard and brittle like steel.—Proc. Chem. Soc.