SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN & CO. - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

CHARLES ALLEN MUNN, *President*
361 Broadway, New York

FREDERICK CONVERSE BEACH, *Sec'y and Treas.*
361 Broadway, New York

TERMS TO SUBSCRIBERS

One copy, one year, for the United States or Mexico.....$3.00
One copy, one year, for Canada.. ..... 3.75
One copy, one year, to any foreign country, postage prepaid, £0 18s. 1d. 4.50

THE SCIENTIFIC AMERICAN PUBLICATIONS

Scientific American (Established 1845).....$3.00 a year
Scientific American Supplement (Established 1876)..... 5.00 "
American Homes and Gardens..... 3.00 "
Scientific American Export Edition (Established 1878)..... 3.00 "
The combined subscription rates and rates to foreign countries, including Canada, will be furnished upon application.
Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, JULY 13, 1907.

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.

NAVY TO BUILD "OCTOPUS" TYPE OF SUBMARINE.

The submarine torpedo-boat board, which recently conducted a series of tests of submarine boats, has decided unanimously in favor of the superiority of the "Octopus" type. This view is indorsed by the Board on Construction, and is approved by Secretary Metcalf of the Navy. In agreement with the report, the award of $3,000,000 authorized by Congress at its recent session for the purchase of submarine boats, will be made to the Electric Boat Company of this city. The competition upon which Congress decided, when it made an appropriation two years ago of $1,000,000 for submarine boats, was recently concluded off Newport. This original appropriation was increased, at the recommendation of the President to the last Congress, to $3,000,000, and the time fixed for holding the test was limited to the 29th of May of this year. Although the details of the report have not been given out, it is known that the "Octopus" was considered to have outclassed her competitors on all essential points. She was considerably faster both at the surface and in the submerged condition; showed better ability to maintain a constant level of submergence; and developed at least equal structural strength when sunk in great depths of water.

ELECTRIC POWER PLANTS ARE RESPONSIBLE.

After a contest in the courts which has lasted for seven years, it has been decided by the Appellate Division that the responsibility for fires resulting from defective wiring and insulation rests upon the electric power companies. The legal contest which has just been ended was begun in February, 1900, when an insurance company brought suit against the New York Edison Company as being responsible for the burning of a block of buildings at Third Avenue and 190th Street in this city, the claim being made that the fire was caused by improper insulation. In this particular case, nine insurance companies paid a loss of $100,000 on the fire; and, subsequently, sued the Edison Company. The first action was brought by the German-American Insurance Company, which won in the Appellate Division, and later in the Court of Appeals. The Edison Company was not satisfied to let the matter rest, and brought suit against the insurance companies, which, however, obtained a favorable decision. The testimony given at the trials proved that the wires had been put up on the building which was burned down, without the consent of the owner and in a negligent and reckless manner. It is estimated that there are in the United States damages every year amounting to about $25,000,000, due to defective electrical construction and insulation. Henceforth the responsibility for this will be laid upon the electric companies, instead of falling as hitherto on the insurance companies.

THE STEEL RAIL PROBLEM.

The agitation over the steel-rail scandal promises to bear fruit. A conference was recently held at the offices of the Steel Trust, at which were present representatives of the steel companies and of every important railroad in the country; and at the close of the conference the chairman of the trust, who presided at the meeting, announced that an agreement would be reached which would be satisfactory to the public. Although no official report of the conference has been issued, it is understood that the steel companies expressed their willingness to make a rail that would come up to the requirements of the railroads, provided that the railroads would pay five dollars a ton more for the rails; or thirty-three dollars in place of the present price of twenty-eight dollars per ton. It was generally recognized that a change is necessary in the shape of the rail, and it is probable that the standard type adopted will contain considerably more metal in the base, with a view to securing a more even distribution of temperature in the various portions of the rail during the process of rolling, and also of providing a rail that will be better able to withstand the reverse bending stresses which occur at all times and, particularly, during the frosts of the winter months. Now that the manufacturers and the railroads have got together, and strong committees representative of each are engaged in a joint and friendly investigation of the subject, the public has some assurance that the future output of the rail mills will be more reliable, even if more costly, than that which has characterized the past few years. The question of price is one that does not concern the general public, which merely demands that railroad travel shall be made safe again; but we understand that the leading railroads have expressed their willingness to pay a higher price if they can only secure a thoroughly reliable rail.

CONTRACT AWARDED FOR TWO "DREADNOUGHTS."

The awarding of the contracts for the two 20,000-ton battleships marks the beginning of a new era in the history of naval construction in the United States. It is true that the "South Carolina" and "Michigan," now under construction, embody the characteristic feature of the new type to the extent that they are armed exclusively with the 12-inch gun, of which each vessel carries eight. But the appropriation for these two ships, and their size, was determined by Congress before the one-caliber-all-big-gun battleship had been accepted as the type of the future; and hence, they are not strictly representative of the class. The new ships, however, are purely of the "Dreadnought" type, all the elements of their design being subordinated to their definite duty of carrying into battle the largest possible number of 12-inch guns. Of these each ship will carry ten, disposed in five separate turrets. It has ever been the aim of the naval constructor so to mount the guns that each one of them shall be able to cover the widest possible arc of the horizon, and do so without interfering with the training of the other guns, that is, without masking them or being itself masked. It was the determination of our constructors to abide strictly by this principle, that has enabled them to secure a concentration of fire from their ten guns which is twenty-five per cent greater on the broadside than that obtainable with the ten guns of the British "Dreadnought." This desirable result has been secured by mounting all of the five turrets upon the longitudinal center line of the ship, with the result that every gun can be trained through a wide arc on either broadside; whereas only eight guns can be so trained on the ten-gun British ship. It is true that the "Dreadnought" has a heavier end-on fire, due to the fact that two of the turrets are carried in the wings, or on the beam of the ship, an arrangement which enables her to deliver a fire of six 12-inch guns ahead, or astern, as against four such guns in our new 20,000-ton ships. But since these wing turrets mask each other in broadside fire, it follows that the heavier fire end-on has been secured in the "Dreadnought" at the sacrifice of broadside fire—and it is well understood in naval tactics that future battles will be fought by preference in the broadside rather than the end-on position. It will be evident, then, that the advantage of a twenty-five per cent more powerful broadside fire has been obtained without any extra cost of weights for gun emplacements, except so far as the extra length of ship necessary for this arrangement must be debited to that account.

The "Dreadnought" is of 18,000 tons displacement, therefore our 20,000-ton ships have some 2,000 tons advantage in displacement, much of which our naval constructors have been enabled to devote to protective and defensive qualities. Just what use has been made of this displacement has not been announced by the Navy Department, for it was not desirable that such important information should be made public. We are in a position to state, however, that our new vessels, being larger and being designed with all the valuable facts which have been developed during the trials of the "Dreadnought" available, are structurally stronger and stiffer, and are superior both in the thickness and area of their armor, and in the provision of bulkheads, double floors, and other structural devices designed to localize torpedo injury and preserve the buoyancy of the ship.

The experience of the Russo-Japanese war, particularly at the battle of the Sea of Japan, proved that it is better to provide a limited number of guns upon a hull that can be absolutely depended upon to keep those guns afloat, than to load double the number of guns upon a hull which can be riddled with high-explosive shells and sent to the bottom before the engagement can be said to have fairly begun. Other things being equal, it is the ship which can longest preserve its buoyancy that will win the fight, and it is satisfactory to know that in our two new 20,000-ton battleships we shall have two vessels which will probably stand more hammering, with one exception, than any battleships designed at the same time as themselves.

Big as these ships are, however, they will be surpassed by the new Russian battleships, which are to displace 21,800 tons. It is authoritatively stated that the whole of this extra displacement (for they will carry only the same number of 12-inch guns as our own ships) is to be devoted to the protection of the buoyancy. Among other means adopted to this end is the complete armoring of the ships, from a level considerably farther below the waterline than has been the practice in the past, up to the level of the upper deck; that is to say, the whole of the hull is to be armor-clad. In this connection it is interesting to remember that the idea is not original with the Russians; for as far back as the year 1890 the French built a cruiser, the "Dupuy de Lome," whose whole hull from 4½ feet below the waterline to the upper deck is completely clad with armor. Evidently, when the Russian government turns over these monster ships to their commanders, she wishes to be in a position to say to them, "You have now beneath your feet a ship which cannot be sunk; fight her, therefore, as long as there is a gun that can be trained upon the enemy."

Of our two new battleships, one has been let to the Newport News Company for the remarkably low price of $3,987,000, if she is built under the Department's plans, or for $4,090,000, if built under the company's plans as modified by the Department. The other ship has been let to the Fore River Company, for a contract price of $4,377,000. The former ship is to be built in thirty-six months; the latter, in thirty-four and one-half months. The ships will be identical, except for the fact that the Fore River Company will use the Curtis turbines, and the Newport News Company, turbines of the Parsons type. One of the ships is to be named the "Delaware," and the other will carry either the name "New York" or "Empire State."

BOARD OF UNDERWRITERS ON CEMENT CONSTRUCTION.

With a view to determining the fire-resisting qualities of cement and concrete, and formulating a standard specification for their use, a special committee of the Board of Underwriters has been engaged in an exhaustive study of the subject. Because of the San Francisco conflagration, the past year, in particular, has been fruitful in knowledge of the fire-resisting qualities of these materials. The chairman of the committee refers, in his report, to one difficulty of the investigation arising from the fact that the action of concrete, when combined with reinforcing materials, has been hitherto only partly understood, and experimental data on the subject is, even at this day, comparatively scarce. The Board, however, has issued a revised edition of a model building code, which it is urging the municipalities throughout the country to adopt. One section of the code refers exclusively to reinforced concrete construction, and the committee strongly urges that the design of concrete buildings should be undertaken only by engineers of special training and experience in this line of work. In our opinion this is the most important recommendation made in the whole of this section of the report. We have always believed that the peril of concrete construction lay in the supposed ease with which it could be built, and in the common belief that the design of reinforced concrete structures was a very simple matter, and the building of the structure even simpler still. No greater mistake could possibly be made. The design of a reinforced column or beam calls for as much and even more technical knowledge and skill than the design of an ordinary steel column, plate girder, or truss, in steel bridge work. In bridge designing the well-established data and formulæ necessary to the working out of the problem are available; but in designing reinforced concrete work, there are no such complete data at hand. The art is a new one; and the exact behavior of reinforced concrete under certain conditions is, even to-day, largely a matter of theory. Hence, the question of the amount and proper position of the steel reinforcement is one that calls for the exercise of a judgment which has been ripened by experience. It is essentially a civil engineer's problem, and every architect who undertakes the design of concrete steel work should be master of the main principles of the civil engineer's profession.

Furthermore, it is a mistake to suppose that concrete-and-steel construction, because of its apparent simplicity, can be done by ignorant labor under the supervision of an unintelligent foreman. The report says that the experiences of the last year have given additional proof of the gross carelessness and incompetence which have prevailed in many important works. There have been several instances of the collapse, during construction, of large and expensive buildings, which have been traced in every case to the neglect of well-known rules of safety. In one case,

where there was lack of intelligent superintendence, the cheap labor did not appreciate the need for careful workmanship, and the result was the use of too little cement, or too little water, or improper mixing, followed by the collapse of the wall before it had reached half its full height. In several cases the concrete, while under construction, was allowed to freeze, and as soon as the forms were removed its inevitable collapse followed. In other cases the wooden molds or forms had not been properly cleaned out, and shavings, blocks of wood, and other refuse had been so imbedded in the concrete as to introduce a fatal weakness at important points in the building. In another case reinforcing rods were put in the wrong place, or omitted altogether, and these faults coupled with unsafe design, caused one of the most serious of the recorded wrecks of concrete buildings.

The popularity of hollow-concrete block construction has increased rapidly during the past year, and the report specifies six conditions which, if followed, will give the highest fire-resistance qualities in a hollow-concrete block building. First, the thicker the shell of the block, the better the resistance; secondly, the block should consist of a brand of Portland cement that conforms to the standards of the American Society of Civil Engineers, or some similar specification of high authority; thirdly, the block should contain not more than four parts of sand or other material to every one part of cement; fourthly, the best block is that which is made with the wettest mixture practicable; fifthly, the block should be carefully cured for not less than thirty days before it is used, and, during this time, it should be frequently moistened by water spray or steam; lastly, in hollow-block buildings, care should be taken to use solid blocks for the course on which joists or girders rest; that is to say, care should be taken never to allow the concentrated load of such members to rest upon or depend from the inner side of a hollow shell, since this may very readily break off.

THE GRAND PRIX INTERNATIONAL AUTOMOBILE RACE.

The third great international automobile race of the year was run on a triangular circuit near Dieppe, France, on the 2d instant, the result being the fastest time that has ever been made in any long-distance race of this character—70.77 miles an hour. The winning car was an Italian Fiat racer driven by Nazzaro. Szisz on a Renault was second, with an average speed of 69.46 miles an hour. Thus the positions of these two champions were just the reverse of their positions in the Grand Prix of last year, when Szisz won on his Renault at an average speed of 62.84 m.p.h., and Nazzaro was second on his Fiat at a speed of 60.2 m.p.h. The race last year was much longer, however, and it was run on two consecutive days. The total distance was 745 miles, while the course was 62 miles in length. The fastest circuits were made at 73 and 72 miles an hour. The Dieppe course was shorter and not particularly difficult. It extended southwest to Londinières, then north to Eu, and finally southwest to Dieppe. Its actual total length was 76.988 kilometers, or practically 77 kilometers (47.84 miles) in round numbers. Ten circuits of the course were required to be made.

No less than 37 machines, consisting of 2 English, 24 French, 3 German, 3 Italian, 3 Belgian, 1 Swiss, and 1 American make, started, and 16 of these completed the race. Of the one Italian, German, Belgian and seven French firms which entered three cars each, but one succeeded in bringing all three across the line at the finish. Three Brazier cars finished third, seventh, and twelfth, with their usual regularity. Accidents and breakdowns put most of the others out of the running, while tire trouble does not seem to have bothered the contestants greatly, presumably on account of the elaborate arrangements for tire renewal and the use of detachable rims. It was largely on account of these conveniences, no doubt, that the average speed has been raised nearly ten miles an hour in a single year.

The second annual Grand Prix race was run on the basis of fuel consumption, and it was lack of fuel which caused Lancia, who also drove a Fiat, to lose third place. His fuel gave out on the last lap, leaving him stranded by the roadside. The cars were allowed 61 gallons each, which required them to run 7.84 miles on a gallon. That one car should win the race at a speed of 70¾ miles an hour and still have nearly three gallons remaining, while another of the same make was unable to finish on account of lack of fuel, seems rather remarkable, and hardly explicable on the ground of difference in the driving of the two cars. Possibly Lancia, with his usual bad luck, lost some of his fuel. At any rate, he could not blame Walter Christie in this race for putting him *hors de combat*, as was done in the Vanderbilt Cup race of 1904, in which Christie just grazed the Italian as he was pulling out into the road after making tire repairs, and, by smashing his rear wheel, snatched the victory from him. Nor could Christie blame Lancia for his usual bad luck, as a result of which our patriotic countryman, who drove the only Yankee speed creation that participated, succeeded in completing only four rounds at an average speed (including time lost for stops) of about 40 miles an hour. His engine is said to have broken a valve, and, according to cable reports, he also had trouble with one of his clutches sticking.

The race this year was noteworthy from the fact that, with only a single exception, all the machines that were entered started, and that most of them started at the time set. Heath with his Panhard was the only exception. On account of difficulty in starting his engine promptly, he was delayed for a minute or more at the start. Most of the contestants carried about a quart of gasoline in a separate can, for the purpose of priming the carbureter when starting at various places along the course.

Three minutes after the last machine had started, Lancia rushed past the grand stand at terrific speed, followed closely by Duray in his De Dietrich. Wagner, on his Fiat, made the first round in 39 minutes and 53 seconds, which was at the rate of 71.97 miles an hour. At the end of the third round he was leading and his chances were good, but on the fourth round something went wrong with the motor, and he was out of the race. For the remainder of the race Duray led, and was continually gaining on every competitor until just after he finished the eighth round, when a bearing broke and his car came to a stop. Lancia, Szisz, and Nazzaro were the other leaders. The Frenchmen hoped that Szisz would be able to increase his speed sufficiently to pass Nazzaro; but he failed to do this, and finally finished second in 6 hours, 53 minutes, and 10 seconds, as against Nazzaro's time of 6 hours, 46 minutes, and 33 seconds. Baras, on his Brazier, was third in 7 hours, 5 minutes, and 5 3-5 seconds (67.52 m.p.h.) and Gabriel on his De Dietrich, fourth, in 7:11:37 (66.5 m.p.h.). Two Darracq machines finished 59 seconds and 261 seconds after Gabriel. As stated above, a second Brazier car was seventh, and this was followed by two Bayard-Clement cars, the times of which were 7:34:16 and 7:39:56, respectively. Hemery, on a Mercedes, was tenth in 8:25:25; a Motobloc finished eleventh; the third Brazier, twelfth; a Renault, thirteenth; two Germains, fourteenth and fifteenth; and a second Motobloc sixteenth. The time of the last car was 10:24:57, which corresponds to an average speed of almost 46 miles an hour.

The fastest lap of the race was made by Duray on his De Dietrich car in 37 minutes and 54 seconds, which corresponds to an average speed of 75.73 miles an hour. The race is considerably the fastest that has ever been run, being nearly 5 miles an hour faster in its general average than the Ardennes race of last year. It was noticeable for the numerous breakdowns and for the failure of many of the French and German makers to make a good showing. It is the third great race that Nazzaro has won this year, the other two being the Targa Florio Stock Car Race in Italy, and the German Emperor's Cup Race in Germany, last month. The Italians have certainly made great strides in automobile manufacture, and in the development of a reliable and speedy car they are apparently second to none.

GASOLINE MOTOR CARS ADOPTED FOR BRANCH LINE SERVICE ON THE UNION PACIFIC RAILROAD.

An extremely interesting innovation in railway passenger transportation in this country will be inaugurated this month, during which, it is announced, the Union Pacific Railroad will place in service twelve gasoline railway motor cars. The cars are intended for branch-line traffic, where the fast and frequent service required cannot be maintained by ordinary trains except at a loss.

The latest type of these cars developed at the Omaha shops of the Union Pacific makes 60 miles an hour with a 300-horse-power engine, reaches high speed within six car lengths, and can be stopped within 120 feet. With these advantages the cars can be put on a much faster schedule than is possible with the steam locomotive.

Outwardly the newest of the cars, which are built entirely of steel, resemble a turned-over racing yacht. The forward end tapers sharply, and the roof and rear are rounded off to reduce the air resistance and avoid the vacuum produced by a square car. Rounded windows give to the passengers a wide range of outlook, and increase the nautical appearance of the car.

In cold weather the cars are to be heated by hot water from the cylinder jackets. They are lighted by acetylene gas shining through opalescent panels.

For sanitary reasons the floors of the cars are built so that they can be thoroughly cleaned by flushing with hot water. The familiar system of ventilation has been replaced by roof ventilators, which exhaust the inside air by suction, fresh air being taken in from the car roof in front. Vibration is reduced to a minimum by the way in which the motive power is balanced.

The cost of operating the cars varies from ten to twenty cents a mile, according to the density of the traffic, but the records kept prove beyond doubt that the railway motor car will make possible great improvements in handling branch-line passenger traffic.

SCIENCE NOTES.

An additional research is now being prosecuted at the Harvard College Observatory, with the object of determining the distribution of variable stars in various regions of the sky. The method is a photographic one, and consists of superposing negatives of a certain region on a contact print taken from a second negative of the same region, obtained at a different time. In the instances described, five negatives of each region were employed, four of which were compared with prints from the remaining one. The stars showing signs of change are marked, and on subsequent reduction, some of these may prove to be known variables, some to be new variables, some are still suspected of variability, and some may be due to photographic defects. From the number of actual new variables found by superposing plates of the same region, an estimate may then be made of the number still undiscovered. In the trials so far made the results appear so promising that it seems best to cover the whole sky by the method as soon as possible, and thus provide for determining the probable distribution, and later the work can be confirmed and extended by means of photographs with a larger instrument. As the result of this preliminary count, it appears that the greater proportion of existing variables have been detected, and of those still undiscovered it is probable that all are faint, none being estimated as brighter than the eighth magnitude, or having a range of variation of more than a magnitude.

The odor of plants is due to active constituents in the volatile essential oils, the proportion of which varies at different periods of the growth. In order to study the formation and distribution of the essential oil MM. Charabot and Lalowe have made a series of determinations of the amounts present in different stages in different parts of the plant, taking absinthe (*Artemisia absynthium*) as typical of an odor-forming plant. They find that in the first stage, a long time before blossoming, the roots are free from essential oil, while the leaves contain about eleven times as much as the stalks. In the second stage, the beginning of blossoming, the roots become richer than the leaves in the oil, though all the organs show a considerable increase, the proportion in the leaves, for instance, being about doubled. In the third stage, advanced blossoming, the accumulation of oil in the roots is more pronounced, but there is a diminution in the stalks, leaves, and particularly in the blossoms, showing that there is a consumption of odoriferous constituents in the process of fertilization. In a typical experiment the relative amounts yielded by the plant on July 10 and August 4 were 1,055 and 766 milligrammes. Hence it is evident that for the practical purpose of extracting the scent from flowers it is advisable to prevent fertilization, or, better still, to extract the essential oil at an earlier period. In the fourth stage, when blossoming is over, the relative proportion of oil in the roots is greater, and there is also a slight increase in the proportion in the stalks. The small absolute increase in the amount of oil then yielded by the whole plant is to be attributed to the appearance of new leaves.

Among the most recent finds which have been made at Carthage by Rev. P. Delattre are a number of sarcophagi which present a great interest. In many of these the top cover is sculptured in relief with a figure of life size, carved out of marble, and beautifully tinted in various colors. One very fine specimen was found in the necropolis at a depth of twenty-five feet. On the cover is a figure of a woman executed in the Greek style, with a long garment reaching to the ankles and a veil covering the head. Great technical skill is shown in treating the different tissues. The flesh parts are well polished, and the eyes are painted, giving a life-like aspect. The hair is gilded. Inside the sarcophagus were found the remains of the person, with some bronze objects. A second sarcophagus was that of a person supposed to be a priest. The sculptured figure has abundant hair and a curling beard. It wears a long robe with short sleeve. Here also the eyes are painted, and are very expressive. Among the remains are a massive gold ring with a portrait similar to the above, also three other gold rings, amulets, etc. One of the most recent finds was a sarcophagus with the sculptured figure of a woman wearing a long tunic of fine wool of a pinkish hue, with a gilded belt passing under the breast. The lower part of the body is enveloped in what appears to be two great vultures' wings, according to the Egyptian style. The whole figure bears traces of painting and gilding. As to the remains, they are imbedded in a resinous matter, as is often seen. M. Delattre examined the specimens carefully to observe the painting before they came up to daylight, as the colors faded almost at once, and he found the color and gilding to be quite brilliant both on the figures and on the moldings of the sarcophagi. These specimens form an important addition to the Carthage Museum.