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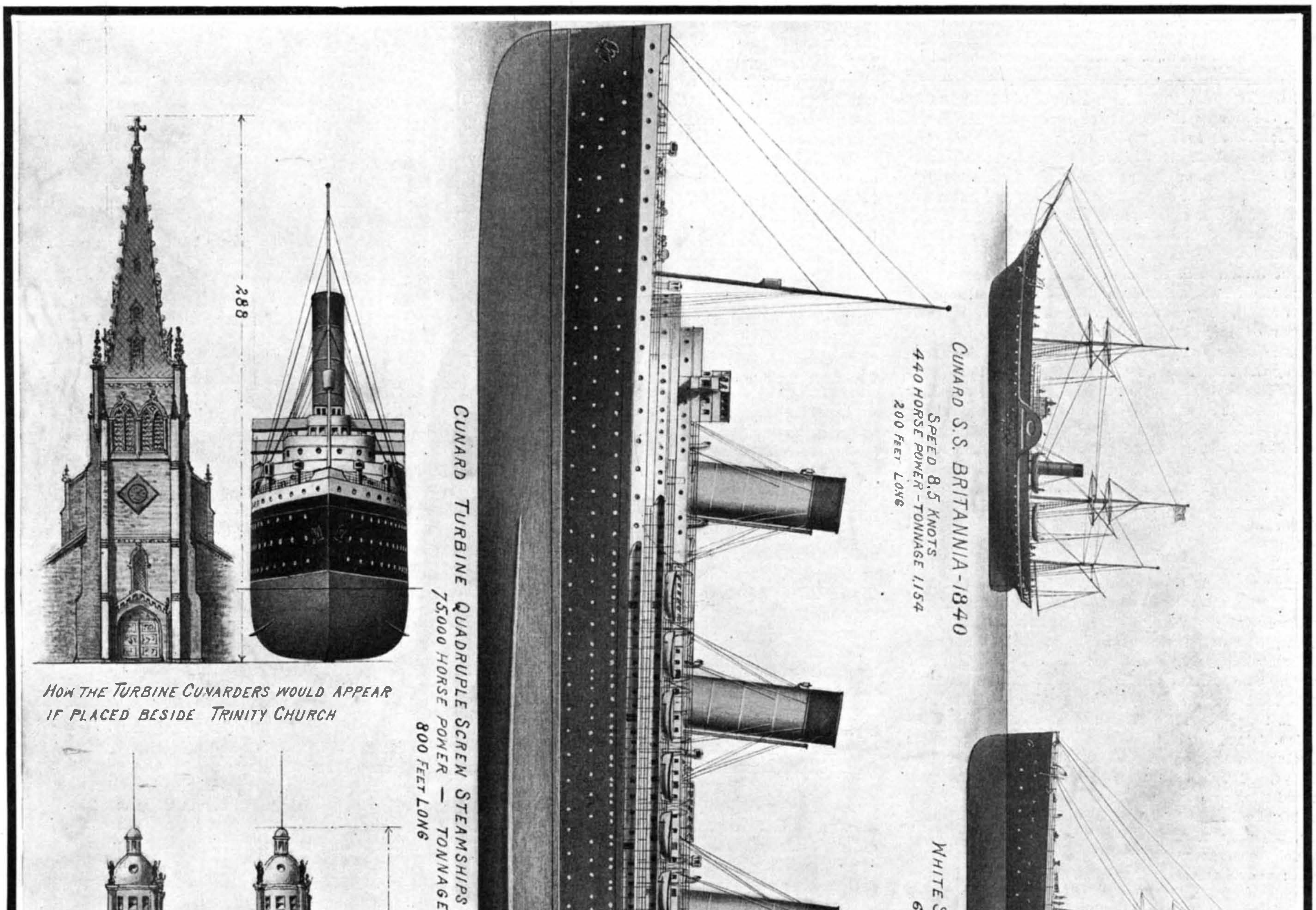

Length, 800 feet. **Beam,** 88 feet. **Draft,** 35 feet. **Displacement,** 40,000 tons. **Speed,** 25 knots. **Engines,** four turbines of 75,000 horse-power, driving four propellers.

THE HUGE PROPORTIONS OF THE NEW 25-KNOT TURBINE CUNARDERS.—[See page 179.]

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NEW YORK, SATURDAY, SEPTEMBER 10, 1904.

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 ART COMMISSION AND PUBLIC STRUCTURES.

The creation of the Art Commission was one of the most fortunate provisions of the new charter of the city of New York. In the scope of its judicial powers and the make-up of its personnel the Commission is admirably adjusted to its important duties. The work of the Commission is purely honorary, and it needs but a glance at the list of members to realize that its decisions will be rendered solely with an eye to the highest interests of the city. Under the charter, the Commission has jurisdiction over the acquisition, reconstruction, or removal of works of art, and over all designs of municipal buildings, bridges, and other city structures that may be referred to the Commission by the Mayor or Board of Aldermen. This jurisdiction has been actively exercised since the year 1898, and during the past six years over 200 subjects have been submitted for approval.

On January 1, 1902, the powers of the Commission were greatly enlarged by a provision requiring that all municipal structures exceeding in cost one million dollars must be approved by the Commission. Whereas previous to 1902 the Commission merely had jurisdiction over such buildings as might be submitted, now all public buildings that cost over one million dollars pass directly within the scope of the Commission, and do not have to be referred to it by the Mayor or the Board of Aldermen.

Now, that this second provision confers no mere empty authority has recently been established by the courts. The charter provides that expenditure of the city's funds without the approval of the Art Commission is illegal in such cases as come within its jurisdiction. Thus, for instance, if the designs for a public structure costing several millions of dollars should be disapproved by the Commission, and the contractors nevertheless proceed to carry them out, or if the contractor should fail to submit them to the Art Commission, payment of any money to the contractor under such circumstances would be illegal. The decision of the courts above referred to as bearing on this subject was on an application for an injunction against proceeding with the erection of Blackwell's Island bridge, except on the original plans, and involved the legality of a proposed expenditure of about seven million dollars. In its opinion the court said: "The Art Commission called in by the Mayor, and invested with the veto power by law, has rejected the original design. That disapproval disposed of it. The bridge could not, therefore, be constructed in accordance therewith."

By far the most important case that has come before the Art Commission is that of the new Manhattan Bridge, which involves an expenditure of about twenty million dollars; and recently a great deal of confusing and profitless discussion has taken place, in this connection, as to the actual scope of the authority of the Commission. It has been claimed that this body, not being composed of expert engineers, is necessarily unable to pass upon any but the æsthetic features of this bridge or any other engineering structure that may be submitted to it. It will be seen, from what we have said above, that, on the contrary, its powers are absolute as to the acceptance or rejection of a proposed structure. Its jurisdiction is not specifically limited to the artistic and architectural features only; it covers the structure as a whole.

Now it must frequently happen that the subjects submitted, especially if they are of an engineering character, will contain elements upon which the Commission must be advised by expert opinion before it can render an intelligent decision. This fact was recognized when Mayor Low appointed a commission of five eminent bridge engineers to pass upon the then current plans for the Manhattan Bridge, so as to provide the Commission with an independent estimate of the engineering features of the structure, upon which they might base their action. Obviously, this was the proper course for the Mayor to take, and upon the presentation of the report, favorable action was speedily taken by the Art Commission.

The new Bridge Commissioner, however, wishes to reject the design accepted by the Art Commission, and asks that body to indorse his own plans, which are for a structure of an entirely different character. In making a choice between the two designs the Commission, as matters now stand, finds itself confronted by a difficult dilemma; for the new plans are backed by the opinion of the Bridge Commissioner only. They have received no consideration by any independent board of experts, such as indorsed the Art Commission's accepted plan, and that body is, therefore, entirely without any expert advice as to the engineering merits of these plans.

Under the circumstances, in order to enable the Commission to make an intelligent comparison of the relative merits of the two designs, the obviously wise course would be for the Mayor to follow the example of his predecessor in office, and appoint an engineering commission. Surely, the Bridge Department has everything to gain and nothing to lose by such a searching investigation of their strain sheets and working plans as this Commission would make. If their report should establish the fact that, from an engineering and constructive point of view, the new designs will provide a bridge stiffer, stronger, cheaper, and quicker of erection than one built on the accepted plans, there is not the slightest doubt that the Art Commission would render an immediate decision in its favor, and the present intolerable delay of this greatly-needed public work would be ended.

THE AGRICULTURAL IMPORTANCE OF BACTERIA.

Nitrogen is to the soil in which our plants grow much what the oxygen of the air is to us; for without it the death of vegetation must ultimately ensue. For that reason we add the necessary quantity of nitrogen to the tilled soil in the form of fertilizers. It happens, however, that the supply of fertilizers, which in turn is dependent upon the supply of nitrates in the world, is limited. Like the coal fields of Pennsylvania, the nitrate beds from which nitrogen compounds are obtained must ultimately be exhausted. And because the free nitrogen of the air in its elemental state cannot be assimilated by vegetation, it is no wonder that the agricultural chemist has taken it upon himself to devise some means for restoring to the earth the nitrogen which it must give up to the growing plant, and without which the plant could not grow.

Just how the nitrogen of the air could be converted into nitrates suitable for fertilization is a problem that has been attacked time and time again with scant success. Crookes proposed a plan not without merit, a plan by which the nitrogen of the air was converted into nitric acid through the agency of the electric spark. In the current issue of the Supplement another solution of the vexing problem is outlined, which comes from an entirely different quarter of the scientific world. For centuries farmers have known that different crops should be grown in the same field with each succeeding year. Some crops following clover and other plants were found to flourish admirably. Careful analyses by agricultural chemists have shown that the benefits derived by this rotation are due directly to the increased stores of nitrogen placed at the disposal of the benefited plants. It would necessarily have followed that plants of the clover type were able to render available nitrogen which would otherwise be unassimilated. Further investigation showed that this nitrogen was fixed in a manner entirely unsuspected, and that we need have no fear of the exhaustion of the nitrate beds which supply us with the chief ingredients of our fertilizers.

The *Leguminosæ* family of plants, among other distinctions, have well-defined nodules at their roots, highly charged with nitrogen and constituting the habitat of certain bacteria indispensable in nitrogen assimilation. Elaborate experiments proved that the destruction of these bacteria was equivalent to the destruction of the plant life itself. Bacterial life, then, and nothing else, contains the secret of nitrogen production. It having been settled with reasonable certainty that the fixation of nitrogen in the case of *Leguminosæ* is directly traceable to bacteria, the next investigation to be carried out had for its determination the life process of these bacteria—the conditions under which they thrive, the amount of light, heat, and moisture that they require, the manner in which the plant appropriated the nitrogen brought to it from the air, and finally, the possibility of artificially stimulating plant life by inoculating soil with the bacteria. These investigations have been carried out with striking success. At no very distant day the farmer will either inoculate his field with a culture of bacteria adapted to the crop he wishes to grow, or incorporate with his soil earth of a field where the crop has already been successful. The uncertainty of a good crop will then have vanished, and a farmer will be assured of the best obtainable crops from the seed which he has planted. Guesswork will have given place to absolute certainty.

POSSIBILITIES OF PEAT AS FUEL.

The discovery of extensive deposits of valuable peat in many parts of this country, and the invention of improved machinery for cutting, extracting, and compressing it into commercial size bricks, must eventually have a most important bearing upon the question of economical power production. Unquestionably we are rapidly approaching a time when steam and electrical uses will be less dependent upon anthracite coal than in the past. With a continuation of our industrial expansion, anthracite coal must soon be regarded more in the light of a luxury than a necessity. Fuel economy must begin with the fuel itself, and not limit itself to the invention of machinery for extracting a larger percentage of thermal units from the material burnt.

The immense amount of material in one form and another scattered around in the shape of waste must be utilized in order to keep down the present high bills for operating power stations. The heavy deposits of peat naturally must call for attention. Raw peat has not been considered an economical or satisfactory fuel in this country. It has been questioned whether it could ever be extracted and put on the market in such a condition as to attract power producers in a way that would make it a commercial success. With over 85 per cent water, and scarcely 13 per cent of combustible material, with about 2 per cent of inorganic matter, raw peat has not apparently offered very great inducements to manufacturers.

The problem of extracting this 13 per cent of combustible material from the peat at a cost which would enable the owners to sell it at a commercial profit, and at the same time make it cheaper for producing steam than either coal or liquid fuel, has not been an easy one to solve. Peat cutting and compressing machinery has reached a remarkable state of development in the past decade in Germany and other continental countries. This machinery has reduced the cost of working the fuel into commercial forms, and has at the same time improved its burning qualities.

One of the most important of recent methods of handling peat in Germany is to reduce the combustible material through grinding and maceration, and then mix it with other inflammable material to insure superior heat-producing qualities. The different materials mixed with the peat pulp are usually dry sawdust, anthracite culm and bituminous coal dust. These are added to the wet peat when in a dry state, and they are run through the grinding machinery with it. The result is that the two are mixed thoroughly, and the dried product is very inflammable and steady in its burning. The added ingredients give to the peat a more compact density, which adds to its value in many ways. It is less liable to break and pulverize in handling, and it does not disintegrate in the furnace so readily.

As high as 30 per cent of bituminous coal dust, 40 per cent of anthracite culm, and 15 per cent of dry sawdust are added to the peat pulp. When thus mixed the bricks are pressed into shape by hydraulic machinery, which makes them suitable for almost any kind of use. The amount of worthless coal dust that accumulates at the coal yards as well as at the mouths of the mines cannot be utilized to any greater advantage than by helping to form a new fuel of this character.

The conversion of peat into coke is a comparatively new process that may be considered as the most scientific method of utilizing this fuel. Chemical engineers of all countries have sought to accomplish this end. As a new industrial process it has already become established in parts of the leading peat-producing countries, especially in Germany and Russia. The peat is converted into coke by carbonization in retort ovens. To make it more profitable and successful, the effort has been successfully made to recover the gas, tar, and other by-products of distillation. These by-products represent a gain of no small figure, and they add to the profits of the undertaking in a way that promises to make the process extremely valuable.

The peat is carbonized in closed ovens, which are heated by burning under them the gases generated by the coking process. In other words the process is self-sustaining after the fire of wood or coal is first started to produce the coking. A very small amount of fuel is thus used at the start, and thereafter there is no expense whatever in burning fuel. The gases are carried from above to the burning chamber where they are consumed to continue the process.

To make the process even more complete and profitable, the escaping heat of the retort ovens is utilized for heating the drying ovens. This escaping heat is carried through a dry-air chamber to an upper receptacle where the raw peat is placed for drying. The raw peat must be dried to a crisp point where carbonization follows quickly when introduced into the coking oven. Ordinary wet peat, when put into the carbonizing ovens, wastes heat to such an extent that the process in the past has been rendered unprofitable. More than this, the drying of the peat for carbonization in ovens prepared for it has been found unsatisfactory owing to the cost of fuel required to heat the ovens. By utilizing the escaping heat of the retort ovens, and utilizing the waste gases for firing the ovens, a double process of economy is obtained.

The by-products of peat coke are obtained in the form of commercial distillates. About one-third of the peat used for coking is converted into pure coke, one-third into gas liquor, and one-third into tar. From the gas liquor there are derived several other commercial products. One of these is the valuable methyl alcohol, which is assuming such important commercial value in our industries. Another is acetate of lime, and a third sulphate of ammonia. With these different articles selling at present market prices, one pound of peat is raised in value to nearly five times that paid for it in the open market.

The peat coke is a firm, jet-black substance that is as pure as charcoal. It has a thermal value of nearly 7,000 calories, varying a little according to the quality of the peat used. Its value for certain industries is considered much higher than coke made from any other process. It is particularly highly prized for smelting foundry iron, copper refining, and other metallurgical processes. For blast-furnaces it is also excellent, but it is too high-priced for general use in smelting iron ores. In Germany it sells as high as $9.50 to $11.50 per ton, and as its supply is still small the demand at these prices exceeds the supply.

The coke for burning purposes is a smokeless fuel, and it possesses all the merits of our best anthracite and charcoal. It can consequently be used in place of charcoal in all industries where a smokeless fuel is absolutely necessary for success. It is employed in place of anthracite only in a comparatively limited field, and it may never come in as a substitute for this fuel to any extent.

As a fuel for direct use in power plants, peat has less actual thermal value than coal or even the brown or lignite coal which is of comparatively recent geological formation. Peat is of such recent geological formation that it is only slightly carbonized. Its thermal value depends upon its composition. In some parts of the country the "mud peat" has a very low order of vegetable composition, and its value is relatively small for fuel purposes. These mud-peat bogs, however, furnish excellent fuel material when they are properly cut and dried for compression. The "mud peat," when dried by air until "bone-dry," has a calorific power of from 9,600 to 14,000 British thermal units per pound. This represents about 65 per cent of that of the best American coal. The wet peat of the mud bogs, or those furnishing the best material, weighs from 100 to 125 pounds per cubic foot. This weight, when dried in the open air or by hot-air blasts or in ovens, is reduced to 50 or 55 pounds. In this condition the fuel is hard and tough. It is not easy to cut it with a knife or saw, but it can be cracked or split with a heavy implement quite easily.

THE SORTING OF ATOMS.

BY PROF. A. W. BICKERTON.

The discovery of radium, and the compound nature of an atom, has so fascinated the popular mind, that scientific discoveries of equal importance with regard to the whole atom have been neglected. The great physicist whose early death was such a loss to science—Clerk Maxwell—told us that without energy, by intelligence alone, that if the atoms could be sorted into their different velocities, the whole conception of the fate of the cosmos would change. Such a power has been found to be in action, and the demons demanded by Clerk Maxwell are replaced by natural physical laws, and this discovery has shown that Clerk Maxwell is right, for the possibility of an immortal cosmos grows up with the knowledge of this power of the sorting of atoms, and Lord Kelvin's magnificent generalization of dissipation of energy, although still true as regards the solar system and the visible universe, fails when treating of the cosmic whole.

A jar of gas is a dust swarm of nature's ultimate particles. It is a giddy reel of moving molecules; sometimes the particles are detached atoms, as in the case of such gases as the newly discovered helium, argon, neon, etc. Sometimes the molecules are groups of atoms, as in the case of oxygen and carbonic acid. A particle of free oxygen consists of two similar atoms locked in a close embrace. If a piece of smouldering carbon be plunged into a jar of oxygen, there is such a great heat produced by the attraction of the molecules, that it bursts into a brilliant light. Heat is a violent motion of molecules. The heat produced causes the oxygen pairs to strike one another so violently that they part company, and both of the two isolated atoms are then clasped by a carbon atom, and built into a group still more firmly locked together than were the oxygen pair. Carbon has a great attraction for oxygen. We call the force that attracts them "chemical affinity." So tremendous is the pull, that, as the atoms rush together, the blow they strike causes the particles to shiver so violently that the whole mass becomes white-hot. Heat may be a vibration or shivering of the ultimate atoms, or it may be the free flight of the particles we have called molecules. The hotter a gas, the more rapid the dance of its countless particles; so the new molecular groups of carbon and oxygen that we call carbonic acid move with tremendous velocity, striking each other and the sides of the jar. Had we sealed the jar when we plunged the glowing carbon into oxygen, so great would have been the force with which the particles would have struck the sides of the jar, it would probably have been blown to pieces. The pressure that produces explosions is caused by a bombardment of the ultimate particles of matter.

Some gas particles are light and some scores of times as heavy, but light or heavy, the same number of particles are required to fill the same jar. So the density of a gas depends on the weight of its molecules. Carbonic acid is so much heavier than the air that the gas can be poured from one jar to another; while so light is hydrogen that an open vessel has to be held upside down to hold it. If we half fill a jar with oxygen, and then fill the remainder with hydrogen, the hydrogen will float above the oxygen. Yet, such is the dance of the molecules that the hydrogen particles will travel downward, and the oxygen upward, until there is a uniform mixture throughout the jar. If, however, the jar be a tall one, it will be found that the hydrogen will reach the bottom four times as quickly as the oxygen reaches the top, for the hydrogen particles move four times as quickly as the particles of oxygen. When a gas particle is four times as light, it moves twice as fast. When it is sixteen times as light, it moves four times as fast, and so on. As the physicist puts it, the speed of a particle of gas varies inversely as the square root of its molecular weight.

The hydrogen particle is sixteen times as light as the oxygen particle, so it moves four times as fast.

The atoms are exceedingly minute. A pea is made up of many millions; so when free they can get through very small holes. They wander easily through the pores of a plaster partition, also through most membranes. Hence, if an India-rubber balloon be filled with hydrogen, the atoms soon find their way out. Fill a collodion balloon with this gas, and it floats; presently it becomes smaller and then sinks. The hydrogen has wandered away, and a smaller number of air particles have wandered in to take its place.

All through the atmosphere, in addition to being carried by winds, the atoms thus wander, so that, if we allow time enough, the composition of a confined mixture of gases gets to be uniform throughout, and this, whether the gas be held in its place by gravitation, as it is in the atmosphere, or be laid carefully layer above layer in a closed jar.

But nature can also sort as well as mix atoms. Chemical affinity enables us to sort a mixture by putting something in that will take one and leave the other constituents of a mixture. Thus air is a mixture of oxygen and nitrogen. If we burn phosphorus in it the oxygen is taken away, and the nitrogen left.

But nature has another mode of sorting molecules, by making them outrun one another, when all are traveling in one direction. In such a race, if hydrogen had a velocity of sixteen, oxygen would only have a speed of four, while uranium would be traveling at the rate of one only. But how can the atoms be started on such a race? By grazing impact of stars or dead suns. In the Philosophical Magazine for August, 1900, it is shown that such a grazing impact will result in the parts that meet one another being cut from the remainder of the stars, coalescing, and forming a new body, and this body may have so small a mass and be at so high a temperature that the velocity of its molecules will be great enough to escape the body entirely.

When all are fairly started on their outward journey, the light atoms will be in advance, and the other cosmic elements in concentric shells, in the order of their atomic weight. It will be as though shot, bullets, and cannon balls had each similar energy, the shot having an enormous velocity to make up for the mass of the cannon balls; and this is the law of the distribution of energy among molecules. Molecules at the same temperature have the same energy. It will easily be seen that not merely can the light molecules escape from the body produced by the collision, but they may have a velocity sufficient, and in fact often would have velocity sufficient to escape the very universe itself; and having escaped it, might travel across the intervening space to other cosmic systems, but when at the point most distant from either, they would travel more slowly than in any other position. The velocities observed in Nova Persei were many thousands of miles a second. And it is easily seen that in the case of indiscriminately moving particles, where they move slowest there they will tend to be more thickly spread than elsewhere. Hence here is a new aggregating agency the reverse of gravitation, that causes a concentration depending on the lightness and power of flight of atoms, whereas gravitation tends to collect the heavier particles. So that in old universes, the heavier molecules will predominate, but incipient universes will be built up of the light atoms. In the course of time other agencies come into work that modify this segregating action. These agencies are very fully discussed in a book on the subject entitled "The Romance of the Heavens."

The formation of these aggregations of light molecules carries us to a stage beyond the theory of dissipation of energy, and a study of the whole subject shows that the cosmos as a whole is a cyclical process in which we have rejuvenescence of universes, just as it has long been seen that collision would give us rejuvenescence of dead suns; and the cosmos as a whole is thus seen to be infinite and immortal.

Thus this fact of nature's power of sorting molecules which goes under the name of "selective molecular escape," entirely alters our conception of the whence and where of the universe.

AUTOMOBILE NOTES.

The fact that out of seventy-six cars that participated in the St. Louis tour at one place or another, but one American car failed to reach its destination on account of a serious break down, should be distinctly encouraging to our manufacturers. The only other machines of American make to drop out were a huge Peerless racer, which ran into a railway train, and an Oldsmobile touring car, which was burned in a garage. A large Mercedes touring car which met with many breakdowns, finally broke its crankshaft thirty miles before reaching St. Louis, while another car of the same make went through without mishap. This would tend to show that it is a difference in men and individual machines, rather than the inferiority or superiority of any one type, that accounts for failure or success. The lightweight cars had a decided advantage in many ways, besides less tire trouble. A car equipped with solid tires broke a steering-knuckle. The last day's run was through very muddy roads, and it is worthy of note that most of the cars got through.

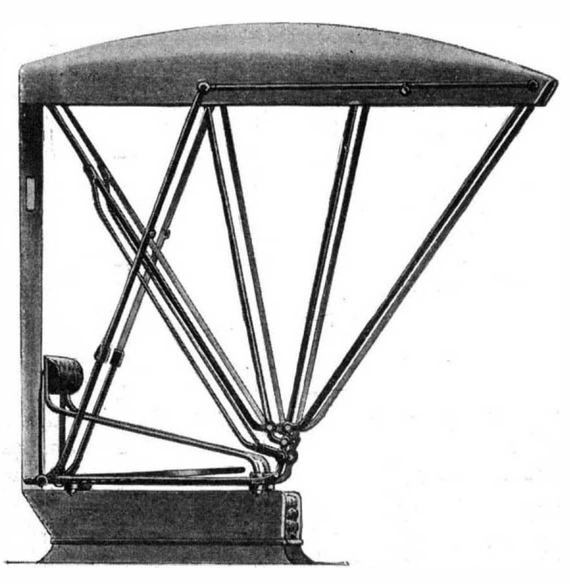
The creating of a non-stop (i. e., without stopping the motor) record of 3,400 miles in connection with the St. Louis tour by running from New York to that city and back again—a feat which was accomplished by Mr. F. A. La Roche in a Darracq touring car—was doubtless the hardest test of this character a machine has ever been given. When it is understood that the car was run night and day for thirteen days over the worst of American roads without its motor having a second's rest, one marvels at the degree of perfection the automobile motor has already attained. Altogether, the motor ran fifteen days and two hours unceasingly, which is a much longer time than has been the case in any non-stop test heretofore.

Apropos of touring, an attempt is being made by L. L. Whitman (who last year crossed the continent in an Oldsmobile) to repeat the journey with an air-cooled car. The four-cylinder Franklin is the machine he is using. He reached Denver in sixteen and one-half days, or in thirteen and one-half days better time than the previous record, so in all probability the time of sixty-one and a quarter days for the complete journey, made last year by Tom Fetch with a Packard car, will be beaten.

Many motor car accidents have been attributed to the collapse or bursting of pneumatic tires while traveling at high speed, causing the car to swerve violently and come into collision with an object. Practical motorists, however, have considered this a fallacious contention, and for the purpose of illustrating the error of the deduction, Mr. S. F. Edge carried out a series of interesting experiments recently at the Crystal Palace, London. For the purposes of the demonstration, a section of the track was covered with broken glass and boards were laid down with the sharp edges of chisels projecting, while in addition a specially prepared sheet of iron was employed which was thickly set with iron spikes. Mr. Edge used the 100-horse-power car which had contested in the Gordon Bennet race, and drove it over the prepared patch at 50 miles an hour. One front tire was punctured, but the car did not swerve. On repeating the process one of the back tires was deflated, but still the car kept perfectly straight. The front tire on the near side was then deflated, while the cover on the near side rear tire was removed over the entire circumference of one edge, so that it was holding on by one edge only instead of two, and in a deflated condition instead of inflated. He then started off with the intention of wrenching off the back tire if possible. The car was driven in a perfectly straight line, notwithstanding the two flat tires for some distance, and then the demonstrator swerved it from side to side when driving it at about 45 miles an hour. The cover flew off, but even then, on the bare rim, the car could be steered in a perfectly straight line. The result of these experiments showed that it is not the collapse of tires to which accidents are due, but to improper driving and insecure holding of the steering wheel, unprepared for any emergency, on the part of the driver.

TILTING ATTACHMENT FOR VEHICLE TOPS.

The accompanying engraving shows a novel attachment for the foldable tops of vehicles, which may be readily applied thereto, and which affords convenient and reliable means for instantly raising or lowering the foldable top, and for cushioning its descent when quickly lowered, so as to prevent jar or injury to the prop braces, bows, and other parts. Just back of the seat of the vehicle is a rock shaft, which carries a pair of tilting arms at each end. These arms are formed with clasping flanges at their outer ends, which are adapted to engage the prop braces of the



TILTING ATTACHMENT FOR VEHICLE TOPS.

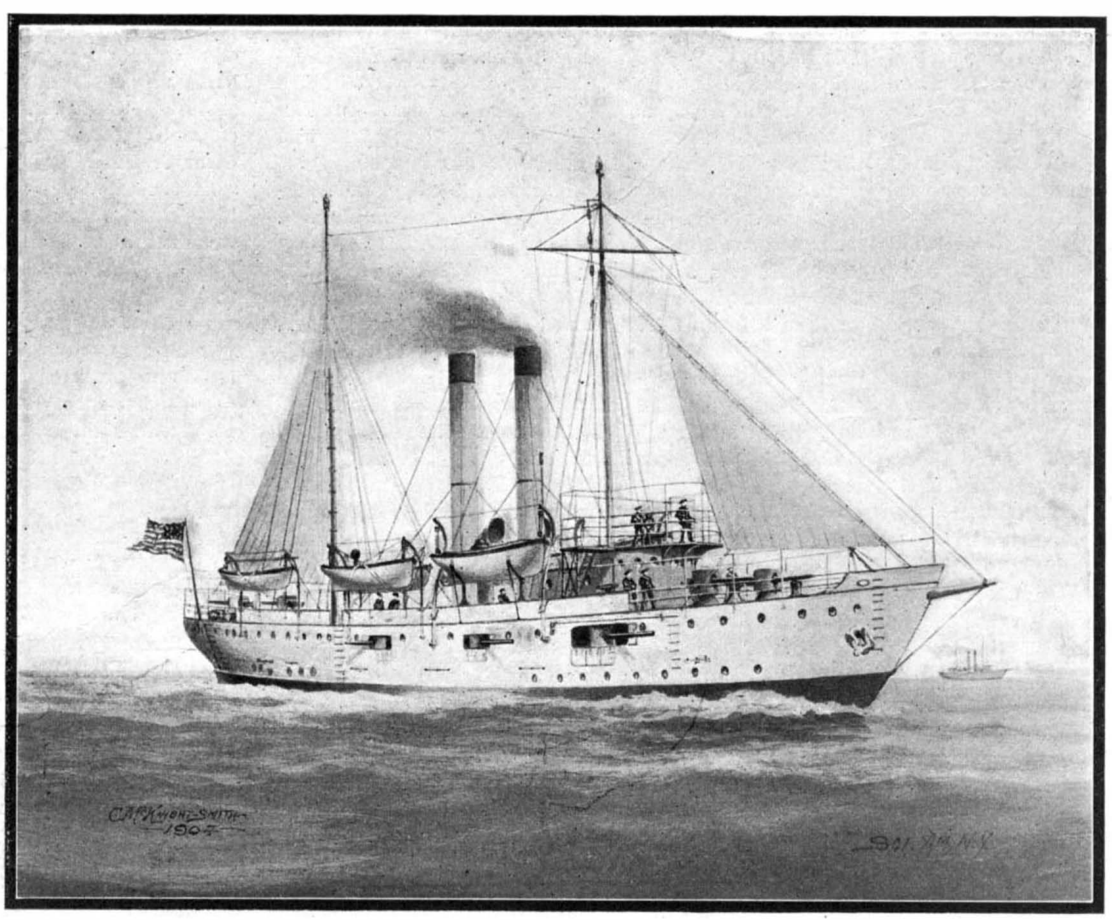
vehicle top. The rock shaft is operated by a lever secured to it near the right-hand end. This lever lies almost horizontal when the buggy top is raised, as shown in the drawing. A pair of spring buffer arms are secured to the side rails of the vehicle seat, and at their upper ends engage the rear bow of the vehicle top. It will be seen that when the operating lever is quickly rocked rearward, and the vehicle top is thrown rapidly into foldable condition, the rearward falling movement of the top will be cushioned by the resilient buffer arms, so that no injuries will result.

It will further be apparent that the clasped engagement of the tilting arms with the side members of the rear bow will stiffen the bow and prevent undue wear at the pivot connections. The buffer arms will also prevent side rattling movement of the bow, and thus co-act with the tilting arms to keep the top from swaying sidewise when in folded condition, which is injurious and quickly loosens the pivot joints of the bows. The operating lever is very conveniently positioned so that the occupant of the vehicle can operate the lever while seated in the vehicle. The device will be found very valuable in case of an emergency, such as a runaway, when it is necessary that the vehicle top be lowered immediately to permit the easy exit of the occupants of the vehicle. Mr. Daniel W. Leonard, Centralia, Wash., is the inventor of this attachment for vehicle tops.

THE UNARMORED COMPOSITE GUNBOAT "DUBUQUE."

On July 1, 1902, Congress authorized the building of two armored composite gunboats, which would be of about the same size and general type as the six similar vessels of the "Annapolis" class authorized in 1895, and completed about the time of the Spanish war. The contract for the construction of these two vessels was signed May and July, 1903, and the vessel herewith illustrated, the "Dubuque," was recently launched from the yard of the contractors, the Gas Engine and Power Company, Morris Heights, N. Y. The "Dubuque" is 174 feet long, 35 feet broad, and on her mean draft of 12 feet 3 inches she has a displacement of 1,085 tons. She will be driven by twin-screw vertical triple-expansion engines at an estimated speed of 12 knots an hour. Her boilers will be of the Babcock & Wilcox type, and the engines are designed to indicate 1,000 horse-power on trial. The hull is constructed of steel framing and yellow pine bottom planking. All the wood that enters into her construction above the lower deck will be fireproof. Her armament will consist of six 4-inch rapid-fire guns, four 6-pounder rapid-fire guns, two 1-pounder, and two Colts. The distribution of the 4-inch guns is as follows: Forward on the upper deck there will be two guns on center pivot mounting with attached shields, placed abreast of each other; aft, on the same deck, will be another pair, while the other two 4-inch guns will be mounted forward on the gun deck and will fire through casemates. The four 6-pounders will be mounted in broadside on the same deck amidships.

The "Dubuque" will have two smokestacks and will be schooner-rigged with a stump bowsprit, and a signaling yard on the foremast. It cannot be said that these boats have any great pretentions to nautical beauty, the position of the bowsprit, the peculiar form of the bow and the two rather attenuated smokestacks serving to make up a combination that does not commend itself at first glance to the nautical eye. However, these vessels are built for work and not for looks, and no doubt they will prove excellent little sea boats with comfortable accommodations for the officers and crew, and with ample speed and gun power for the police duties which they will be called upon to perform.



Length, 174 feet. **Beam,** 35 feet. **Draft,** 12 feet, 3 inches. **Displacement,** 1,085 tons. **Speed,** 12 knots.
Armament: Six 4-inch guns; four 6-pounders; two 1-pounders; two Colt's automatic.

UNARMORED COMPOSITE GUNBOAT "DUBUQUE," RECENTLY LAUNCHED AT MORRIS HEIGHTS, NEW YORK.

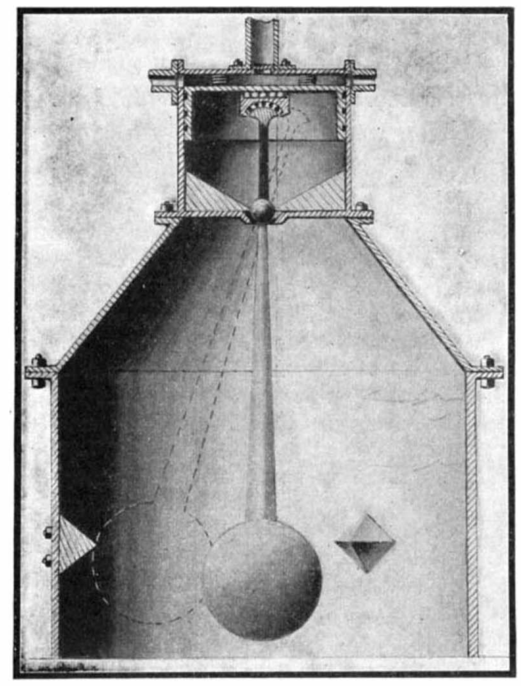
Egg Tests.

A new and simple method for testing eggs is published in German papers. It is based upon the fact that the air chamber in the flat end of the egg increases with age. If the egg is placed in a saturated solution of common salt it will show an increasing inclination to float with the long axis vertical. A scale is attached to the vessel containing the salt solution so that the inclination of the floating egg toward the horizontal can be measured. In this way the age of the egg can be determined almost to a day. A fresh egg lies in a horizontal position at the bottom of the vessel; an egg from 3 to 5 days old shows an elevation of the flat end, so that its long axis forms an angle of 20 degrees. With an egg 8 days old the angle increases to 45 degrees; with an egg 14 days old to 60 degrees, and with one 3 weeks old to 75 degrees, while an egg a month old floats vertically upon the pointed end.

Although he is president of the Iowa National Bank at Des Moines, H. S. Butler finds time to give his attention to matters of invention, and is the patentee of a number of devices of considerable merit. Mr. Butler says that invention is his recreation. His latest work in this direction is a corn planter, by which the grains are deposited with greater accuracy than with the use of the machines now in use. The grain has a fall of but a few inches, so that it can be placed exactly where it is desired; whereas, with most of the planters in use at present, the fall is much greater, and the grain is more likely to drop to one side or the other. Mr. Butler is also the inventor of a post-hole auger.

PENDULUM POWER.

An ingenious method of utilizing the roll of a vessel at sea or the swaying motion of a vehicle on land for power purposes is shown in the accompanying illustration. The apparatus used consists of a pendulum so arranged as to operate a piston when oscillated by the motion of the vehicle or vessel on which it is stationed. By this means an air pump or like motor may be actuated. The pendulum swings within a



APPARATUS FOR UTILIZING THE ROLL OF A SHIP.

dome-shaped casing which carries a cylinder at its upper end. In the bottom of the cylinder a spider is secured in which the pendulum has ball-and-socket bearing. This permits the pendulum to swing in any desired direction, and in order to use its motion for actuating the piston in the cylinder the pendulum is provided with an extension arm connected at its upper end by a ball bearing with a plate which, in turn, has ball-bearing connection with the inner face of the piston. When the pendulum swings from its normal vertical position, as shown by dotted lines in the illustration, the piston is caused to move downward either by its own weight or with the assistance of several coil springs, and thereby draws the air into the upper end of the cylinder through a pair of valved inlets. When the pendulum swings back to a central position, the piston is pushed upward, forcing the air out through the central valved outlet into a suitable reservoir or the like, from which the compressed air may be utilized for driving other machinery. In order to prevent the pendulum from swinging around in the casing, a number of projections are arranged in a circle on the inner face of the casing, in alinement with the ball of the pendulum. The projections are preferably pyramidal in shape, so as to insure a proper rebounding of the pendulum ball when it strikes them. Mr. Andrew T. Prather, of 452 16th Street, Douglas, Arizona Territory, has recently secured a patent on this apparatus.

Radium and the Diamond.

In the course of some experiments concerning the effect of the emanations from radium upon diamonds, Sir William Crookes made a curious discovery. When a diamond was placed in the path of the radiations it was converted from the carbon crystal into the common form of graphite, while in addition its color was quite changed. As a result of this strange metamorphosis Sir William Crookes suggests that the radium rays may prove of great commercial value to the jeweler since by this means diamonds which are of an indifferent and defective color may be appreciably increased in their commercial value by treatment under the radium rays. He also observed that prolonged action of the radium also increased the intensity of the pale-colored gems.

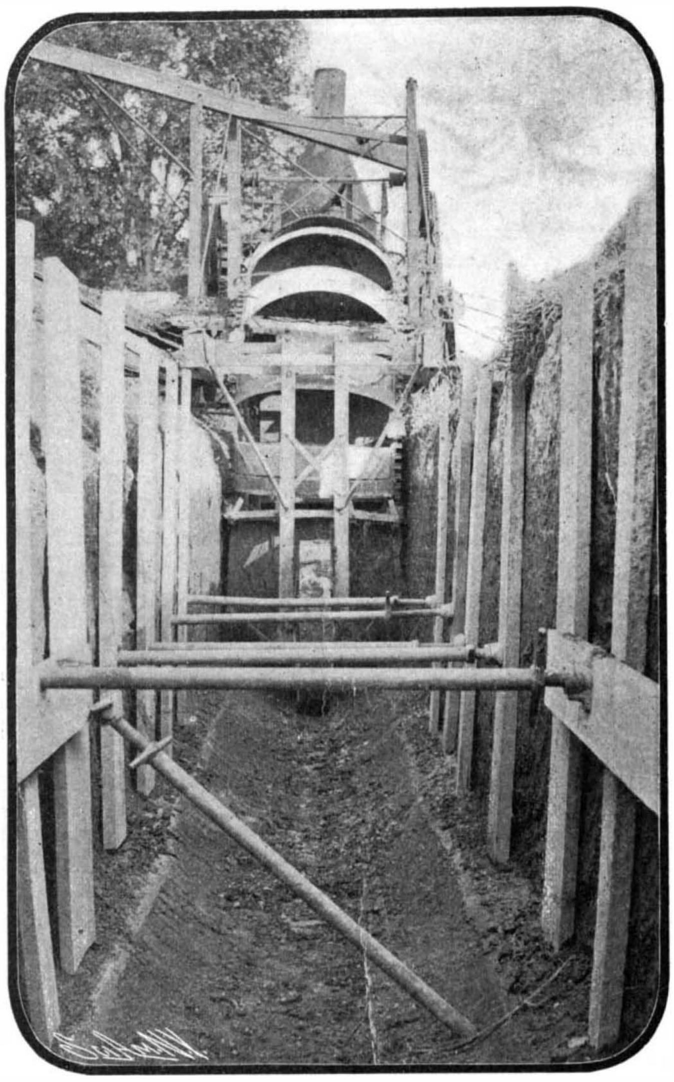
THE BUCKEYE TRACTION DITCHER.

BY FRANK C. PERKINS.

One of the most unique labor-saving devices recently brought out is the Buckeye traction ditcher, designed to cut trenches and ditches. By means of this machine tile trenches are dug entirely without the use of hand labor, and this is of great importance, as the time of year when this work must be done is frequently when it is practically impossible to find an adequate number of men available.

In order to do this class of work successfully a machine must be able not only to cut trenches while the earth is moist and soft, but it must work equally well when the earth is hard and dry. The Buckeye traction ditcher was designed by James B. Hill, a mechanical genius of Ohio, and it is said to be capable of successfully working in swamp lands; at the same time it is able to withstand the severe strains encountered in hard pan.

The rigid frame of a 54-inch machine carries the boiler, engine, and all of the necessary details which are required to furnish as well as transmit power to the excavating wheel, which is hung independently of the main frame, and works in a frame of its own which is supported by the wheel itself and also by a leveling shoe which slides along in the bottom of the trench, thoroughly leveling the little inequalities which are occasioned by the vibration of the machine and pebbles taken up from the bottom. The 54-inch wheel cuts a trench 54 inches wide and the 14½-inch machine cuts a trench 14½ inches wide, the latter width being used for 11-inch tile.



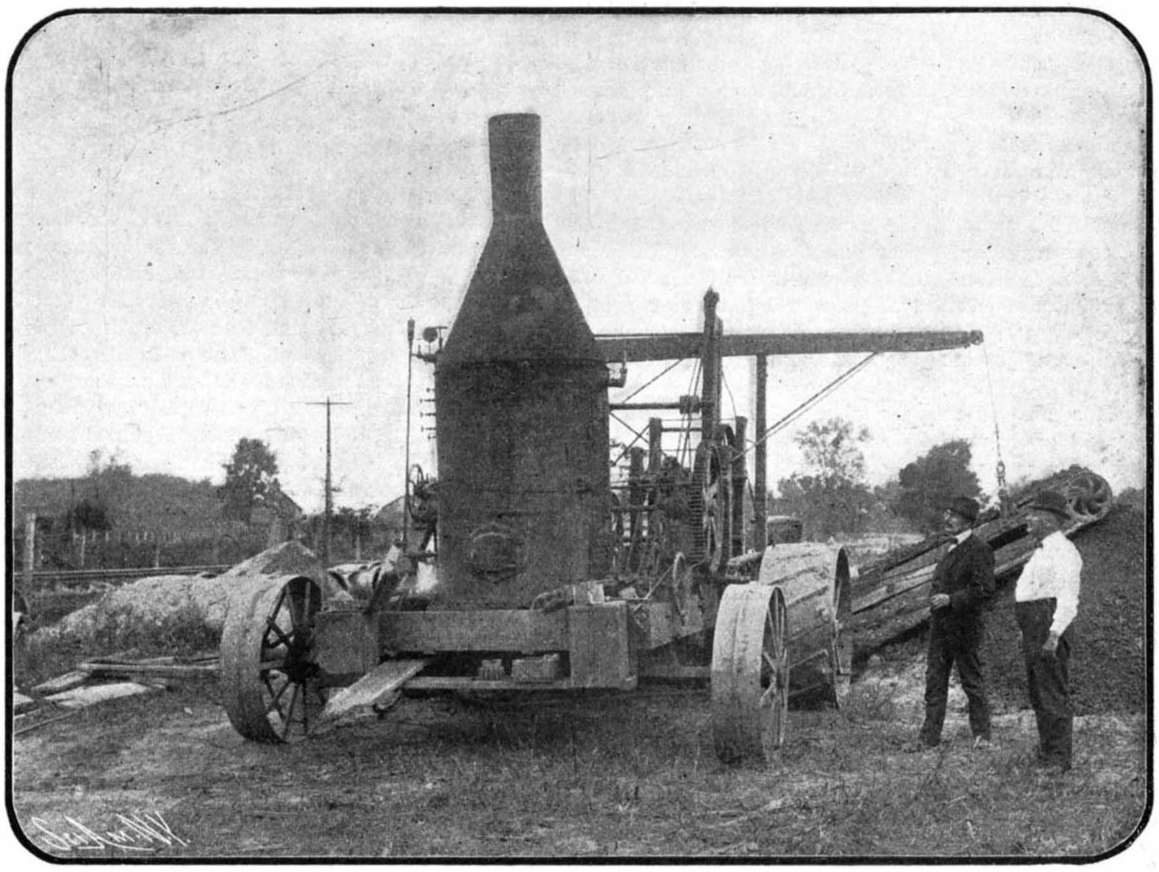
A Trench Dug by the Machine.

The boiler on this machine is constructed of flange steel of a tensile strength of 60,000 pounds per square inch and is equipped with mud and fire door rings. The engine is of the center-crank horizontal type, using the locomotive style of crosshead, and link reverse duplex engines are used on the large machines, while a single engine is used on ditchers cutting trenches 14½ inches wide. The engines are coupled to a steel crank-shaft the throws of which are set on the quarter—that is, 90 degrees from each other—the same as on a locomotive. The bedplates of the engines are riveted to a steel base plate and this is bolted to the main frame of the machine. The engines are coupled up with one feed pipe in the larger sizes, a single governor being employed, and both exhaust pipes are also connected into one.

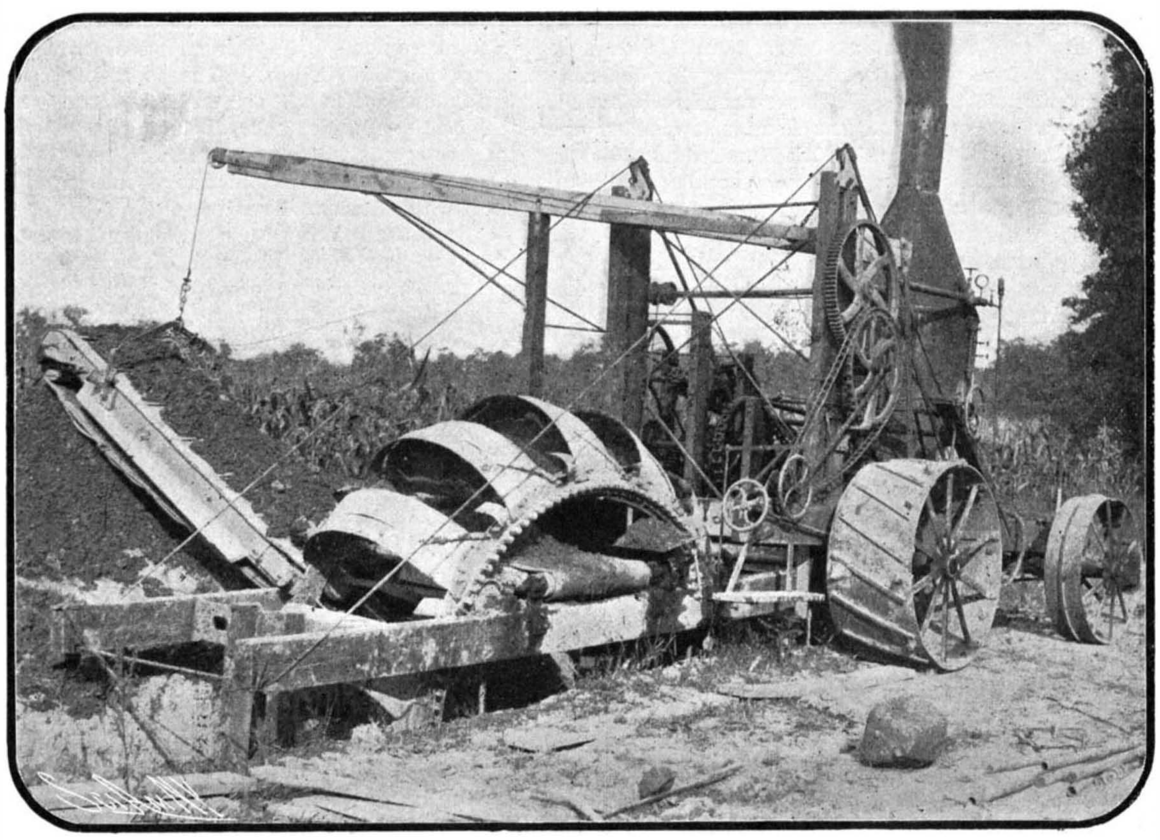
The "business end" of this machine, the same as the bee, is at the rear. The excavating wheel is constructed of malleable iron and steel and the wheel proper consists of two circular rims held together at a proper distance from each other by the steel bucket-backs, which are riveted in place. In front of the backs and over them are the steel hoods or bucket-tops which hold the earth cut loose by the cutters.

The center cutters are placed in front of the hoods or bucket tops and the cutting edge of the center cutters is a half-circle in shape. A little ahead of the center cutters are placed the side cutters, two to each center cutter, one on each side of it. The cutters are all forged by trip hammers and are shaped over forming blocks which make them "flaring," giving them the proper angle for free cutting, giving them free clearance, so that their cutting edges alone come in contact with the earth.

The cutters are held to the excavating wheel by bolts, two in each side cutter and four in each center cutter. These bolts are amply strong to hold the cutters to their work in the hardest earth. But they are just light enough so that they will shear off in case the wheel strikes quickly some solid obstruction which would break the machine. They are the safety valves of the machine, the same as wooden pins are safety devices on a grain drill.



Rear View of the Ditcher.



View Showing the Buckets of the Machine.

THE BUCKEYE TRACTION DITCHER.

The excavating wheel is driven directly above the point where the actual cutting is being done, and there is said to be no power lost in friction after it reaches the wheel. This is shown by the guide rollers that keep the wheel in position which are actually loose when the wheel is cutting. The power, it is claimed, is entirely expended in cutting and lifting the earth, and the side of the wheel opposite in going down counterbalances the part coming up. The driving of the excavating wheels is accomplished by means of two heavy sprocket wheels whose teeth engage with segments riveted to the rims of the wheel.

In places where the earth is inclined to be sticky, when just at the right (or rather wrong) consistency, the earth "sticks" to the sides of the buckets, in the small machines, so that it is necessary to provide a means of mechanically getting rid of the earth at the proper time.

Two cleaners have been provided which work automatically, one upper and one lower.

The upper cleaner is held in place by inverted V-shaped steel forgings which are clamped at one end or leg, and bolted at the other end or leg to the frame of the excavating wheel. This cleaner is constructed with three arc-shaped and diamond-pointed spades, which are bolted to the cleaner head and are of such shape and are spaced so that one is always in position for the oncoming bucket, which, as soon as the cleaner is reached, by its own action, forces the spade into and down toward the opening of the bucket, thereby positively discharging the material upon the elevator or "dirt-carrier" apron. This action brings another spade in position for entering and cleaning the next oncoming bucket.

This cleaner is controlled by friction collars, one of which is secured rigidly to the cleaner shaft and the other is a sliding connection and is held to the cleaner by a diaphragm-shaped spring.

The lower cleaner works quite differently and is constructed with but one cutting edge, and is forged from a bar of steel, arc-shaped to give it strength, and with two legs whose outer ends are hinged to the under and rear part of the excavating frame and just forward of the inside edge of the excavating wheel.

The driving mechanism consists of a train of gears, cut from the solid metal, which are held to their work and in position by malleable side-bars. These gears vary in width of face and also ratio of speed with the different size machines. The larger the machine, the wider is the face of these gears, and also the greater is the difference in ratio, as on a large machine there is much more earth to be moved, and also this earth must be carried further. The train of gearing spoken of, drives the cross-shaft, which carries the large bevel gear, which meshes into and drives the bevel pinion on the rear end of the elevator. Incorporated with the bevel gearing and forming a part of it is a friction disk. This frictional drive is necessary, because of the fact that when working in stony soil small stones sometimes become lodged in the sprocket chains of the elevator. Again, a large stone sometimes becomes wedged between the bucket backs of the descending part of the wheel and the outer edge of the elevator apron. In those cases the friction disk will slip and thus prevent the breakage of any part of the machine.

The operator stands or sits on his platform and by sighting over the guide toward the grade stakes he keeps the bottom of the excavating wheel on a true grade. As soon as the machine has traveled a few feet the rear shoe is then placed in position and clamped in place, after which the cables are taken off. The wheel is now carried at its rear by the rear leveling shoe and at the front by the chains or cables, as the case may be, which are controlled by the operator by means of the grade wheel.

This most interesting labor-saving device cuts to a perfect grade and it does it with a single cut at any depth up to its capacity from 4½ feet deep to 12 feet deep. It is said to operate rapidly, cutting at the rate of 3 lineal feet per minute at a depth of three feet in ordinary earth and greater or less depths at proportionate speeds.

THE COMPLETION OF THE NEW YORK SUBWAY.

Four years after the signing of the $35,000,000 contract for the construction of the New York Rapid Transit Subway, and approximately on the day set for completion, this great work will be thrown open for the use of the public. The event will be marked by considerable civic festivity, and rightly so, for the Subway will not merely bring instant relief to the millions who for the past few years have suffered intolerable crowding under the present inadequate means of transportation, but it is in itself, judged in comparison with other great engineering works of a like character, positively without a rival. Paris, Berlin, and Budapest have their subways; but in total length and carrying capacity they do not compare with our new system of rapid transit. Nowhere can there be found such a stretch of magnificent four-track road as extends from City Hall Park to One Hundred and Fourth Street, a distance of 6.7 miles, to say nothing of the 18 miles of three-track and two-track road that go to complete the system.

The section of the Subway that will shortly be opened represents the first contract, which was let four years ago for the sum of $35,000,000. The amount named was merely for the construction of the road. As a matter of fact, the equipment, which includes the cars, the electric signaling apparatus, and the great power station at Fifty-ninth Street with its various substations, scattered along the route of the road, cost $12,000,000 more, making a total expenditure of $47,-000,000 that was necessary before the road could be thrown open to the public. The total length of the line is 24.7 miles. Of this 19 miles is underground, and 5.7 miles is elevated structure. Of the whole subway 6.7 miles is four-track, 7.4 miles is three-track, and 10.6 miles is two-track. There is a total of 5 miles of switches and sidings, and the total track mileage, that is to say, the total length of complete track with its two rails and ties, is 70 miles.

The power-house for the operation of the line is located at Fifty-ninth Street and North River. It is a huge building, the greatest of its kind in the world. It measures 200 feet in width by 690 feet in length. Centrally through its entire length it is divided by a wall which separates the engine-room from the boiler-room and coal bins. This coal bin, which is located immediately below the roof and above the boiler-room, has the enormous capacity of 25,000 tons of coal. The coal is fed by chutes directly down to the hoppers of the mechanical stokers, from which it is automatically fed to the furnaces. The ashes are dumped into the basement, from which they are carried directly to barges at the dock on the river front. Coal is brought in barges to the same dock, where it is unloaded by elevators and carried up by automatic conveyors to be dumped into the coal bins. Six lofty smokestacks are required for the boiler-room, and a novel feature is that the brick portion of these stacks terminates near the roof. The sub-structure of the stacks consists of massive steel towers of sufficient strength to carry the weight of the exterior brick stacks.

The character of the motive power and generators in the engine-room is similar to that at the Seventy-sixth Street power-house of the Manhattan Elevated Railways, the two systems, indeed, being connected up so that power may be drawn from each power-house for either the Subway or the elevated railways. The generators are driven by Allis-Chalmers compound engines of 8,000 rated horse-power, with a maximum capacity under 50 per cent overload of 12,000 horse-power. These engines are very similar to those at the Seventy-sixth Street power station, but are slightly more powerful and embody certain improved details. In this power station will be installed a separate set of generators for lighting the Subway which will be driven by direct-connected Westinghouse-Parsons turbines. The ultimate capacity of this huge station, when everything has been installed, will be 132,000 horse-power, thus making it the largest in the world.

From the station, the current will be distributed to sub-stations, located in convenient positions adjacent to the Subway, where it will be stepped down and transformed for use at the motors. There will be two classes of service, the express and the local, the former utilizing the two inside tracks of the four-track road and the center track of the three-track road, the other utilizing the two outside tracks. The express trains will be made up of eight cars, five of these being motor cars and three trailers. The motor cars carry 200-horse-power motors, one for each truck, making a total horse-power of 400 for the car, or 2,000 for the train. When we bear in mind that the crack express engines of our steam railroads have only about 1,500 horse-power at command, to haul trains that weigh twice and three times as much as these express trains in the Subway, it will be understood what a splendid reserve of power the Subway motorman will have at command. The expresses will start from City Hall and make stops on the four-track system at Fourteenth, Forty-second, Seventy-second and Ninety-sixth Streets. From there on, stops will be made as determined by schedule, the expresses using the center track of the three-track portion of the road, and it is probable that One Hundred and Tenth or One Hundred and Twenty-fifth Street will be the next alternate stopping places for express trains after Ninety-sixth Street.

The third track system extends from One Hundred and Fourth to One Hundred and Forty-fifth Streets, where the road passes beneath Washington Heights in a two-track tunnel. Emerging near Dyckman Street station it continues as a three-track elevated system to the end of the line. These express trains are to be run at a speed, between stations, of 45 to 50 miles an hour. They will be scheduled to run under two-minute headway with 45 seconds stop at the stations above named, the average speed, including stops, being 30 miles an hour. The average speed of the local trains, which will run under one-minute headway, will be 16 miles per hour, including stops. These respective speeds will give a running time of 15 minutes for expresses and 30 minutes for locals, from the City Hall to the Harlem River.

It is evident that with a train service so frequent and fast, particular care will be necessary to guard against collisions and other accidents. We present, on page 181, some illustrations showing the method of block signals and automatic train-stopping devices that have been installed. The block signal system is that known as the pneumatic-electric, whose principles of operation have been frequently described in this journal. The switches and signals are operated by compressed air, the valves of the operating cylinders being themselves operated by electric magnets that are controlled from the signal station. The blocks between stations and their respective signals, which latter are of the type shown in our illustration, are so interconnected and inter-locked that no two trains can possibly be in the same block at the same time. The signals are worked automatically by means of contacts that are operated by the passage of the train, each train setting its own protecting signals behind it as it passes into a given block. Thus far the description will apply to the automatic block-signal system as used on many of our steam roads; but in the Subway an additional precaution has been taken which should absolutely preclude the possibility of rear collisions. Opposite the signal, on the right-hand side of the track, is placed a trip which is thrown up when the signal is against the train, and lies down in the horizontal position when the signal is in the "go-ahead" position. This trip is so arranged that if a train overruns the signal when it is at "danger," it will open the train pipe, setting the brakes and at the same time automatically cutting off the power.

Several of our photographs give an excellent impression of the first-class nature of the work. The ties, the rails, and the ballast are of the highest type, the rails weighing 100 pounds to the yard and tie-plates being interposed between the rail base and every tie. The third-rail system is used, and we illustrate the method of protecting passengers and employes from contact with the third rail. This consists of a board which is firmly supported by means of brackets at a sufficient height above the rail to allow the contact shoe to enter between the covering board and the third rail, and travel in that position without striking the board. Ultimately it is the intention to place a vertical covering board at the back of the rail, thus completely inclosing it except on the side next the motors. Another of our illustrations shows a cut-off switch operated by hand which can be pulled down by the trainman, for the purpose of cutting out a section of the line upon which a temporary breakdown may have occurred. The Subway stations and the sections of the track that they serve have been so arranged that it will be possible to cut out the section of single track upon which a breakdown occurs, without interfering with the current in the other three tracks. This is an improvement over the Elevated system in which it is necessary to cut out all four tracks for purposes of repair. The circuits are so arranged that only a limited stretch of track is rendered dead by the opening of these switches, and there is no question that the period of interruption due to short circuits, etc., will be greatly diminished by this arrangement.

Another of our illustrations shows the type of ticket booth which is used throughout the system. It is of a simple construction that harmonizes fairly well with the general decorative features of the stations. An interesting feature from the engineering point of view, that we illustrate, is the point just beyond One Hundred and Fourth Street, where the two tracks that run to the Bronx diverge from the main line. The turnout is accomplished by gradually depressing the two inside tracks until they are at a sufficiently low level to pass beneath the easterly track of the westerly branch of the Subway. The two tracks are carried in a tunnel underneath the northwesterly corner of Central Park and continue in an underground tunnel and on an elevated structure to Harlem River and the Bronx. This division of the line is far from complete—the delay being due to the difficulty encountered in tunneling beneath the Harlem River. The connection between the north and south sections of the tunnel has recently been completed, and it should not be many months before trains can be run from the One Hundred and Fourth Street junction to the northerly terminus of the line at Bronx Park.

Life History of Radium.

The view that uranium is the parent substance of radium was advanced by Rutherford and Soddy on the ground that it is one of the few elements having a higher atomic weight, that it is the main constituent of radium ores, and that the proportion of radium in good pitchblende corresponds roughly with the ratio of activity of radium and uranium. An examination of a number of specimens of uranium salts purchased from seventeen to twenty-five years ago showed that these all contained a larger proportion of radium than the more modern specimens. This result is in accordance with the theory enunciated by Rutherford and Soddy, but may easily be due to modified methods of preparation. F. Soddy (Nature, 70, p. 30, May 12, 1904), states that a kilogramme of uranium nitrate was purified until the proportion of radium present was less than 10^{-12} gramme as tested by the maximum amount of accumulated emanation. At the end of twelve months the amount of accumulated radium was certainly less than 10^{-11} gramme instead of the 5×10^{-7} gramme calculated from the ratio of the radio-activities of radium and uranium. The quantity of radium produced was therefore less than one ten-thousandth part of the theoretical quantity, and this result practically settles, in a negative sense, the question of the production of radium directly from uranium. It is, of course, possible that intermediate substances might exist, and that radium would only be produced at a later stage, but there is no experimental evidence in support of this view.

The Current Supplement.

The current Supplement, No. 1497, opens with an excellent article by Day Allen Willey on "Mechanical Cooperage." The article is accompanied by photographs taken in the largest brewery in the United States. An excellent discussion of superheated steam for locomotives in Germany tells what has been done across the water in a neglected branch of engineering. The English correspondent of the Scientific American writes instructively of irrigation development in Egypt. An ingenious spiral screw arrangement for levers is described and pictured. The prime minister of England, the Right Hon. A. J. Balfour, recently delivered a thoughtful address before the British Association for the Advancement of Science, which he entitles "Reflections Suggested by the New Theory of Matter." The attitude assumed by Mr. Balfour is one of interrogation rather than of conviction. The St. Louis correspondent of the Scientific American has three articles in the Supplement. The first tells of the exhibit of New York State; the second of royal sleeping cars in 1842 and 1904 (this article being illustrated with a picture of the first sleeping car ever used, that of Queen Adelaide); and a model of the 10,000-horse-power alternating current generator.

Correspondence.

The Black Race.

To the Editor of the Scientific American:

In answer to the question suggested by Prof. Dexter in your paper of August 20, 1904, I venture an idea. It has been admitted by scientists generally that in the sun's rays are present certain radiations of the nature of X-rays, which are chemically active. These rays affect the human organism injuriously; e. g., in sunstroke the brain is permanently injured, which usually results in softening of the brain or immediate death. History presents a remarkable instance, which has often been commented upon, of the Roman soldiers enduring long marches under tropical sun, with very few cases of sunstroke, notwithstanding the large armies marching. This is attributed to the protection afforded by the polished metal helmets worn, the metal apparently resisting the injurious radiations in the sun's rays. Now, regarding the black races of the tropics, may not nature have provided the dark pigment in the skin and hair for the purpose of affording protection to the human organs from the dangerous chemical radiations of the sun? The heat produced by the sun's rays is therefore the less dangerous agent. For this reason the increased heat absorption of the black skin, as compared with white, is of little consequence. It is well known that men have remained in rooms with the temperature of the air equal to that of steam (212 deg. F.) without injury.

Thomas W. Cooper.

Detroit, Mich., August 21, 1904.

The Work of a Tornado.

To the Editor of the Scientific American:

In your issue of July 30 is published an interesting description of the damage wrought by the recent tornado (or as you term it "cyclone") at St. Charles, Minn., in which the writer introduces some attempts at explanation of the different effects wrought upon the damaged buildings, which to his mind seem to be due entirely to a high wind.

Now it must be evident on very slight consideration that no wind, however high, could have produced some of these effects, as, for example, that shown in the upper left-hand corner of your illustration, illustrating the damaged dentist's office, which had the front wall and a part of the side wall of the second story blown out, while the house was otherwise apparently uninjured.

Without attempting here an explanation of the tornado's origin, I believe its nature is perfectly well understood, consisting of a free circular vortex of air about a moving vertical axis, the air rushing toward the axis from all directions, and assuming necessarily and inevitably a vortical motion. As is well known, the radial or centrifugal force exerted at different distances from the axis becomes continually greater (the linear velocity of the wind remaining the same), by the formula for centrifugal force $F = mv^2 + r$; or in other words, the barometric gradient becomes continually greater as the center is approached, and this is another way of saying that the pressure of the air diminishes with increasing rapidity as the axis is approached, until at the axis it becomes theoretically zero, the velocity becoming infinite at the limit. Now as the axis moves rapidly over the earth's surface, it follows that at any point lying at or near the path of the axis the barometer experiences a very sudden and extreme drop, which causes a corresponding expansion of the air at this point. If then, any air is confined, as, for instance, by the walls of a building, the effect produced is identical in its nature with that of an explosion. Suppose, for instance, the sudden drop in pressure is 10 inches of mercury or five pounds per square inch, which is nothing extraordinary. This would produce a sudden excess of lateral pressure on the interior of a wall 10 feet square of 72,000 pounds, or 36 tons—enough to demolish any ordinary structure. It is not, therefore, surprising that this condition of affairs should have the effect of breaking windows and raising roofs, as gas explosions are known to do.

It follows that the proper way to avoid effects of this sort, where a tornado is anticipated, is to open the doors and windows of the building. Doubtless in the case of the tornado above alluded to, the shop door on the first floor was open, which permitted the confined air to escape without damage, while the windows in the upper story were shut. In like manner it may be observed that in the case of the schoolhouse all the window panes were broken in the main building, where the roof stuck on; but in the wing, where the roof was lifted off, only a few of the panes were broken. But the case of the furniture warehouse, in which 500 chairs were scattered in all directions, seems to be the best illustration of the explosive effects produced by confined air under such circumstances.

Incidentally the misuse of the word "cyclone" to mean tornado should not pass without comment. It is regrettable that this word should be so abused in common parlance to mean something for which we already have a perfectly good word, and which is altogether different from its proper signification. It should be scarcely necessary to say that a cyclone is not a tornado, but is one of those widely distributed circular storms which are constantly sweeping over the earth's surface in temperate zones, known by the weather bureau as "lows."

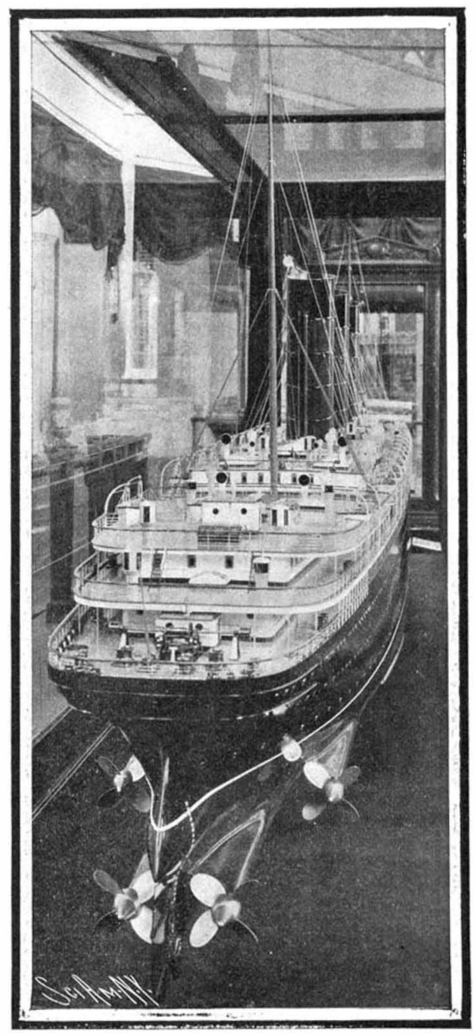
George W. Colles.

Milwaukee, Wis., August 20, 1904.

THE NEW CUNARD TURBINE STEAMERS.

BY THE ST. LOUIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Among the nautical exhibits in the Transportation Building the most complete is that of the Cunard Steamship Company, which consists mainly of a set of handsome models illustrating the progress of the shipbuilding art, as shown by the various transatlantic steamships which have been turned out during the sixty-five years of the company's operations. The group of models is flanked by a large diagram which shows the progressive development in size, horse-power, and speed of the ships during the period under consideration. The smallest model is that of the historic "Britannia," the pioneer vessel of the company. This little craft, which was launched in 1840, was 200 feet in length (which by the way is only about 50 feet longer than the racing yacht "Reliance"), 34 feet 4 inches in beam, 24 feet 4 inches in molded depth, and she had a gross tonnage of 1,154 tons. With an indicated horse-



STERN VIEW OF MODEL OF 25-KNOT TURBINE CUNARDERS AT THE ST. LOUIS FAIR.

power of 440 she was capable of making a speed of 8.5 knots an hour. It is not our intention here to trace the development of the boats through the age of wood, which lasted till 1852, or through that of iron, which ran from 1852 to 1879, when the first steel vessel of the company made its appearance as the "Servia," of 9,900 tons and 16.7 knots speed. The three largest models are placed in line ahead and they represent the "Lucania," of 625 feet length and 22 knots speed, the "Caronia," one of the two new boats now under construction, to be placed on the line in 1905, and between them is the model of the new 25-knot turbine steamers. Of the two sister ships of the "Caronia" type, one is to be propelled by reciprocating engines, the other by engines of the turbine type; and as the two vessels are to be identical in everything except their motive power, an excellent opportunity will be given to determine the exact relative fuel efficiency of the two systems, to say nothing of the comparative data that will be obtained bearing upon the question of oil consumption, wear and tear, and the cost of attendance. These two vessels are to be 650 feet in length, 72.4 feet in beam, and 43.9 feet in molded depth; the tonnage will be 21,000, and with 21,000 horse-power they are expected to make a speed of between 18 and 19 knots an hour.

Of course the model that attracts most attention is that of the new 25-knot, 40,000-ton turbine steamers. The fact that the surrounding models are built to the same scale renders it possible to make an instant comparison, at least in point of length and bulk, between the new ships and the other large vessels. The result is striking; for the "Lucania," for all her length of 625 feet, looks positively a small vessel in comparison. The most notable features in the turbine steamers are the great height of the freeboard, the great diameter and lofty reach of the smokestacks, and the vast unbroken sweep of the upper decks. For reasons which can well be understood in this age of keen competition, the company has not seen fit to place upon the placard of this model any of the dimensions; but it is probable that when the vessels are launched their length will be found to run close to 800 feet, their beam to about 88 feet, their draft to 35 feet, and the displacement will be not short of 40,000 tons. By studying the model it will be seen that the side plating of the vessel has been carried up one deck higher than has been common in previous large ocean liners, thus adding about ten feet to the freeboard, and giving three lines of port holes. From abreast of the forward smokestack to the bow the plating is carried up yet another deck, thus providing a flush forecastle deck extending from 50 feet or more aft of the bridge clear to the bow. There is therefore no well to become flooded with water when the ship is driving into a head sea. The freeboard at the bow must be fully 45 feet and amidships it cannot be less than 32 to 35 feet. Above the water line there are six decks, three of them contained within the hull proper, and the other three being carried on extensions of the framing and affording vast promenades open to wind and weather. The smokestacks, which reach about 170 feet above the keel, are even larger than those of the "Lucania," which are 21 feet in diameter. They are elliptical in cross-section, and on the longer axis they measure 31 feet.

The horse-power necessary to drive this vessel at 25 knots an hour and provide a sufficient reserve for heavy weather will be not less than 75,000 and possibly more. It will be divided between four shafts. The outer propellers extend through the hull at a considerable distance forward of the stern post while the inner pair of propellers are located in the usual position near the stern post. This division of the power between four shafts will, of course, conduce greatly to the security of the ship, and will make sure that, even with one propeller disabled, she will be good for something over 22 knots an hour. It is expected that these vessels will be in service in the season of 1906.

The huge proportions of the new ships is shown very graphically in the comparison on the front page of this issue. The figures are drawn to the same scale. If placed on end, the big ship would be more than double the height of the Park Row Building, the largest office building in the world. If the 420-foot "Baltic," of 1871, and the 200-foot "Britannia," of 1840, were placed end to end, they would still be 180 feet short of equaling the total length of the turbine liner. Trinity Church spire—that old-time standard of lofty measurements—is 288 feet in height. If the new liner were placed in the churchyard alongside the church, its upper deck would be level with the ridge of the roof, its smokestack would reach half way up the spire, and the truck of its foremast would be within 30 feet of the cross that crowns the spire.

The Source of Radium.

Joly suggests in Nature that radium may not be derived purely as a disintegration product but as an atomic combination of radio-active products with some of the elements present in pitchblende. Thus radium would represent the synthesis of an element, not its decomposition, and the new atom not being very stable would be short-lived. Hence its radio-activity. The genesis of radium might be sought in molecular intermixtures of the radio-active elements with the various bodies conspicuously present in pitchblende. Ramsay considers that a more promising field of research appears to be to try to ascertain whether the immense amount of energy evolved in various forms during the disintegration of the radium emanation may not be able to cause chemical change of a constructive nature—for example, to change bromine into iodine. An attempt has been made to see if this was the case, but without a positive result.

The total number of British vessels entered with cargoes and in ballast at ports in the United Kingdom from foreign countries and British possessions in 1903 was 35,741, with a tonnage of 34,349,028 tons, as compared with 35,895, with a tonnage of 32,302,436 in 1902. The British vessels which cleared numbered 35,061, with a tonnage of 34,862,945 tons, the total in 1902 being 35,045, with a tonnage of 32,600,471 tons. The foreign vessels entering in 1903 amounted to 29,743, with a tonnage of 18,166,104, and in 1902 the number was 29,580, with a tonnage of 17,317,681 tons, while the foreign ships that cleared in 1903 reached the total of 29,320, with a tonnage of 18,241,267 tons, as against 29,462, with a tonnage of 17,652,131 tons in the previous year.

GOVERNMENT LIFE-SAVING STATION AND THE FERRIS WHEEL.

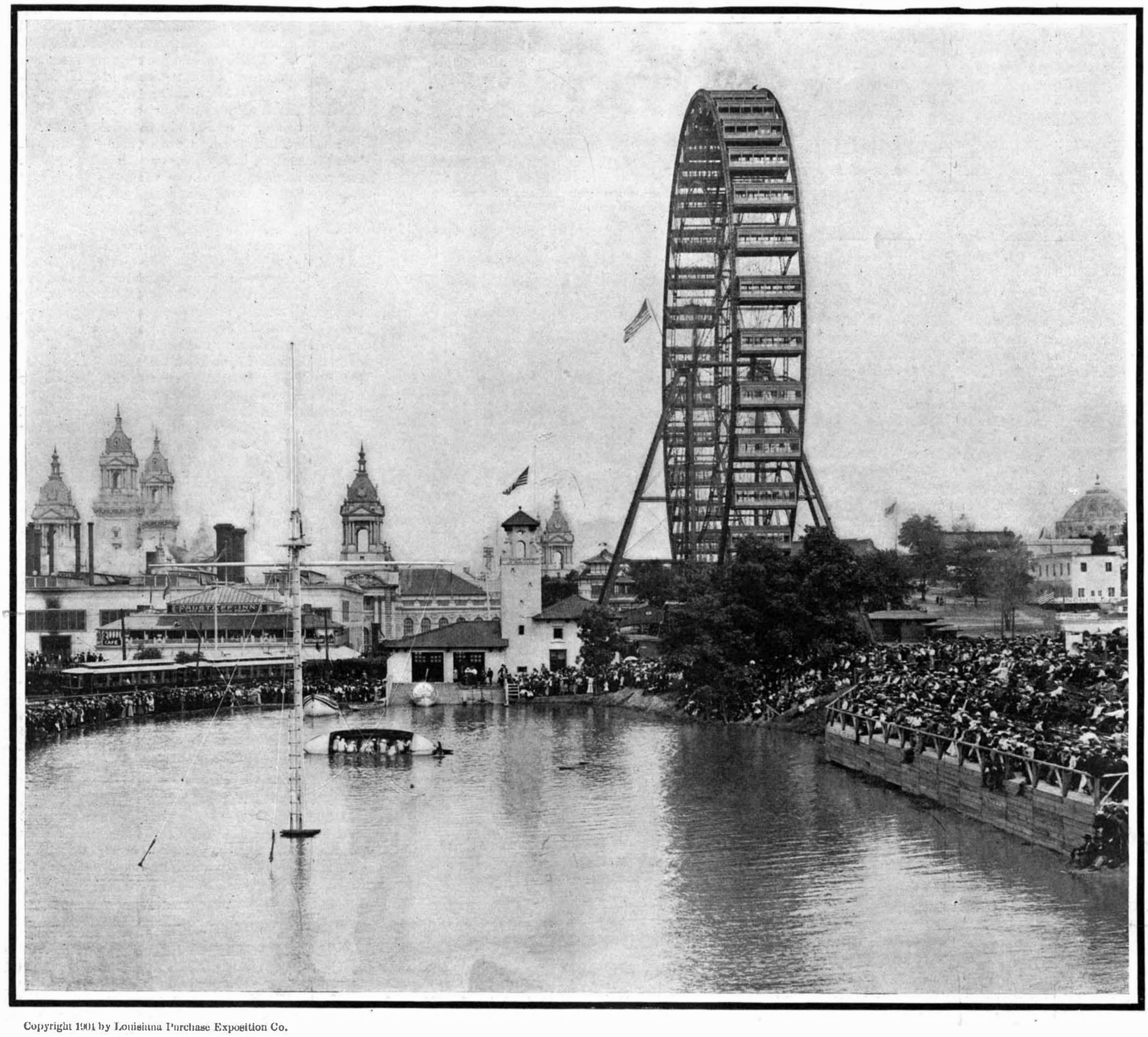
BY THE ST. LOUIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

One of the popular centers of attraction at the fair is a considerable lake of water which the United States government has selected for its most interesting exhibit of the United States Life-Saving Service. The point of view of our illustration is the far end of the lake from the life-saving building, the latter a modest structure consisting of a central tower surmounted by the Stars and Stripes, with a one-story boat house and launching ways to the left of it and a two-story portion to the right for the accommodation of the life-saving crew and their apparatus. Rising from the center of the lake is a mast and yardarm representing the same portions of a stranded ship, which are used in giving exhibitions of life-saving by means of the life buoy. To the left of the lake is seen the tracks of the Intramural Railroad with one of the Intramural trains rounding the curve and about to pass behind the life-saving building. To the right is the large grand stand which has been erected for the use of the public.

There is not in all the fair grounds a more popular exhibit than this, and the large crowds shown in our illustration may be witnessed every day at the fair at the hour of exhibition. The drill includes exhibitions of practically all the more important apparatus used by the life-saving corps. A boat with its full crew aboard is launched down the runway, pulls out to the mast, and lands a couple of sailors who climb to the foretop. The boat returns, a line is shot out by means of the gun, falls across the yard-arm, and is made fast to the mast. A heavier cable is drawn out over the life-line, made fast and hauled taut by the crew ashore. Then the breeches buoy is pulled out over the cable and the ship-wrecked sailors brought ashore. Another and equally interesting exhibit is that when the life-saving crew pull out into the middle of the lake and proceed to upset the life-boat, pulling it over upon themselves and causing it to turn over three or four times in succession, the crew in every case passing under the boat and coming up safely, to climb in again on the other side as she rights herself.

The famous Ferris Wheel, shown to such picturesque advantage above the clump of trees that cluster at its foot, is the same structure that attracted so much attention at the great Chicago Fair in 1893. It has been in practically continuous use ever since. At the time that the Louisiana Exposition was planned it was hoped that some mammoth structure corresponding in size and novelty to the Ferris Wheel would be produced as an attraction of the fair. Nothing, however, was forthcoming, and accordingly arrangements were made to bring the Ferris Wheel to the fair and give it a central location. The problem of moving the wheel from the north side of Chicago, where it had been in service since the Chicago World's Fair, to St. Louis was no small one in itself, for there was 4,200 tons of material, including the 70-ton axle, the engines, boilers, derricks and falsework that had to be transported. It took 175 freight cars to move this material.

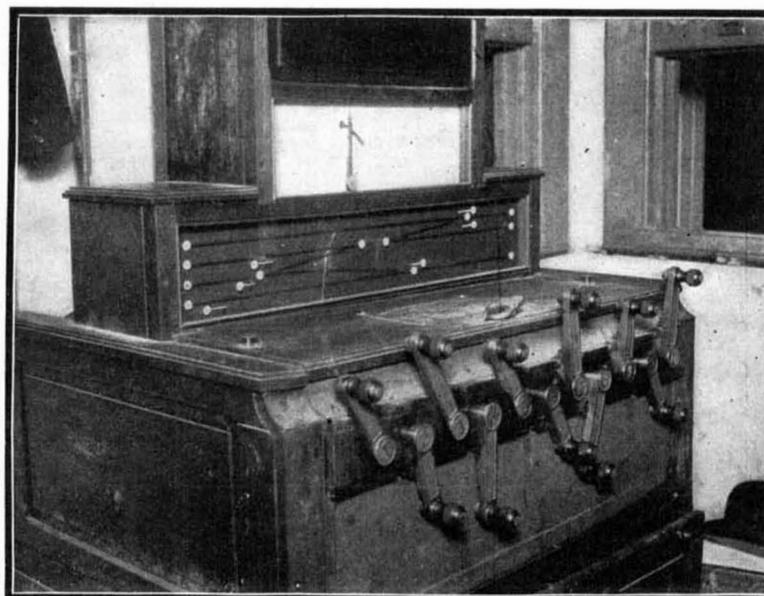
A brief résumé of the dimensions, and some description of the great wheel, may be interesting. It is built upon the bicycle-wheel principle with great tension spokes 2 15-16 inches in diameter, and it consists of two wheels braced together. Between the outer rims of these wheels the 11-ton cars are suspended on pins 6½ inches in diameter and 6 feet long. The cars are 13 feet wide, 26 feet long, 9 feet high and will carry 60 persons each. There are 36 of them in all, so that the total capacity of the wheel is 2,160 persons, and on several occasions in its history the wheel has been filled to its full capacity. The axle on which it turns is a solid steel forging, 32 inches in diameter and 45 feet long. The solid bronze bearings upon which it turns are each 6 feet long and contain nearly two tons of metal. The wheel is run by a double-reversing engine, with cylinders 30 x 48 inches, capable of developing 200 horse-power.



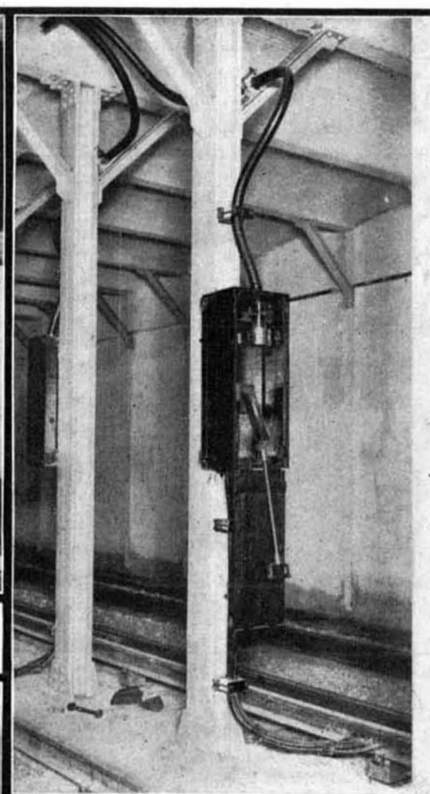
UNITED STATES LIFE-SAVING EXHIBIT WITH FERRIS WHEEL IN BACKGROUND. THE LIFE-SAVING CREW ARE OVERTURNING THE LIFEBOAT TO DEMONSTRATE ITS SELF-RIGHTING ABILITY.

Prof. Pickering's Reported Lunar Changes.

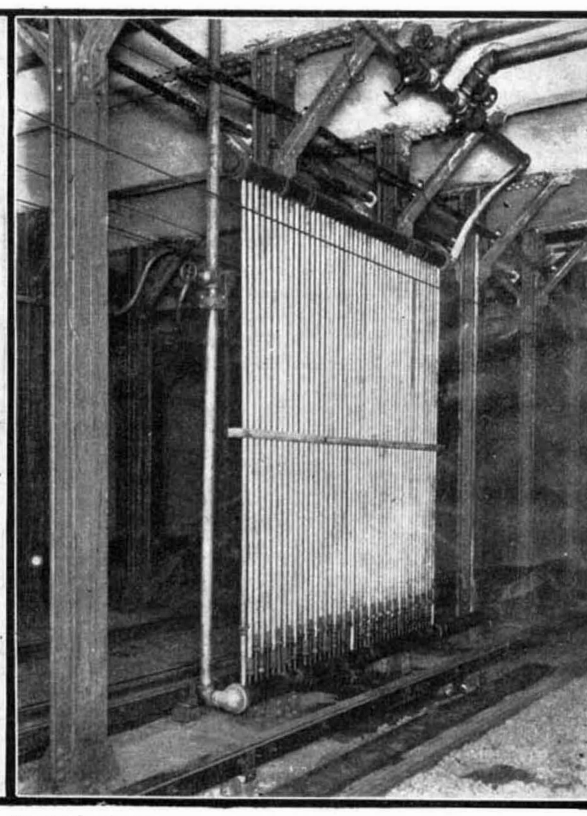
Prof. William H. Pickering, now temporarily located at the Lowe Observatory, Echo Mountain, California, reports that on the night of July 31, 1904, a bright, hazy object 2 sec. in diameter was noticed upon the floor of the lunar crater Plato. Observations made July 21, 22, 23, 26, 27, and 28 had shown nothing unusual at this point. August 2, in place of the bright object a black elliptical shadow was seen. It resembled a crater and measured about two miles in diameter. To the northeast and north extended a large, white area. This was confirmed upon August 3. The object coincides approximately in position with craterlet No. 3, Harvard Annals, XXXII., Plate X. A telegram dated August 22 confirms the reality of a conspicuous change in this region since last month. It states that the existence of the new craterlet is confirmed, that its diameter is three miles, and that the bright area had shifted obviously since August 3. Several other objects not previously mapped have been observed while examining Plato. They consist of two craterlets and a dark spot between two rifts on the southern border of the crater floor, a large craterlet on the northeastern border, and another one 2 sec. southeast of craterlet No. 68. The white area formerly so conspicuous surrounding craterlet No. 54 has now nearly disappeared.



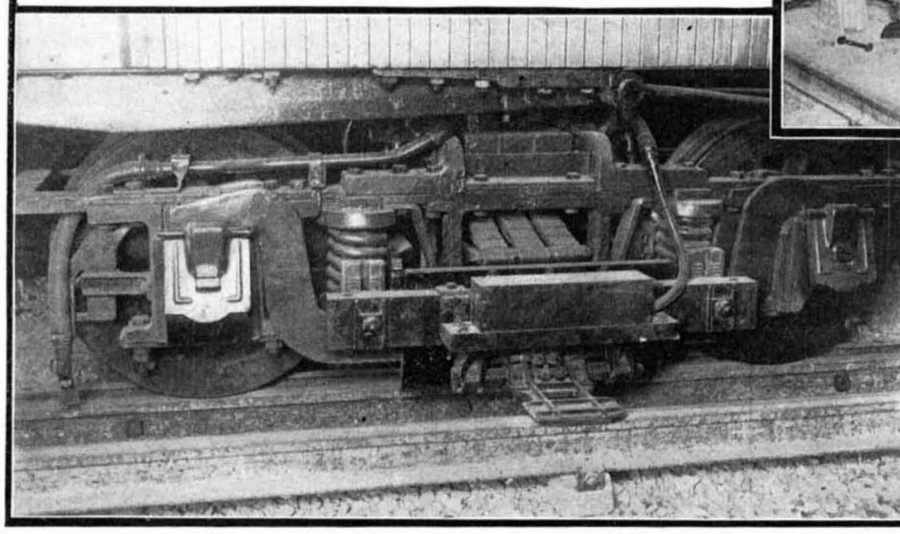
Controlling Box with Models for Showing to Operator Positions of Signals and Switches.



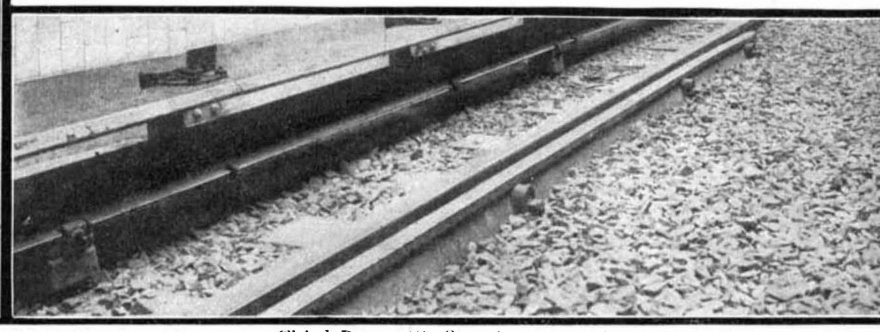
Emergency Cut-out Switch.



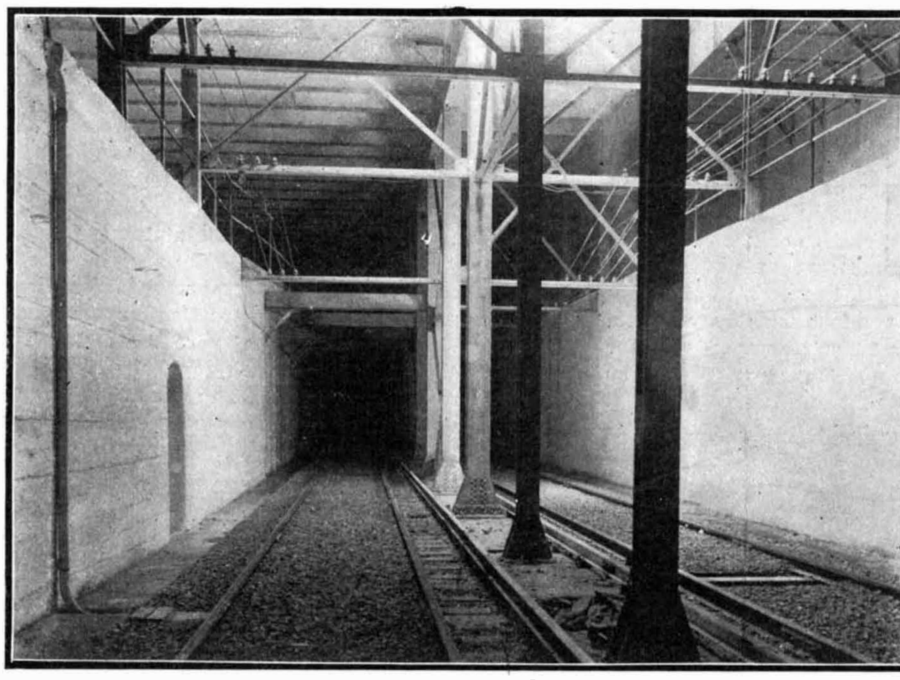
Nest of Pipes for Cooling Air Used in Switch and Signal System.



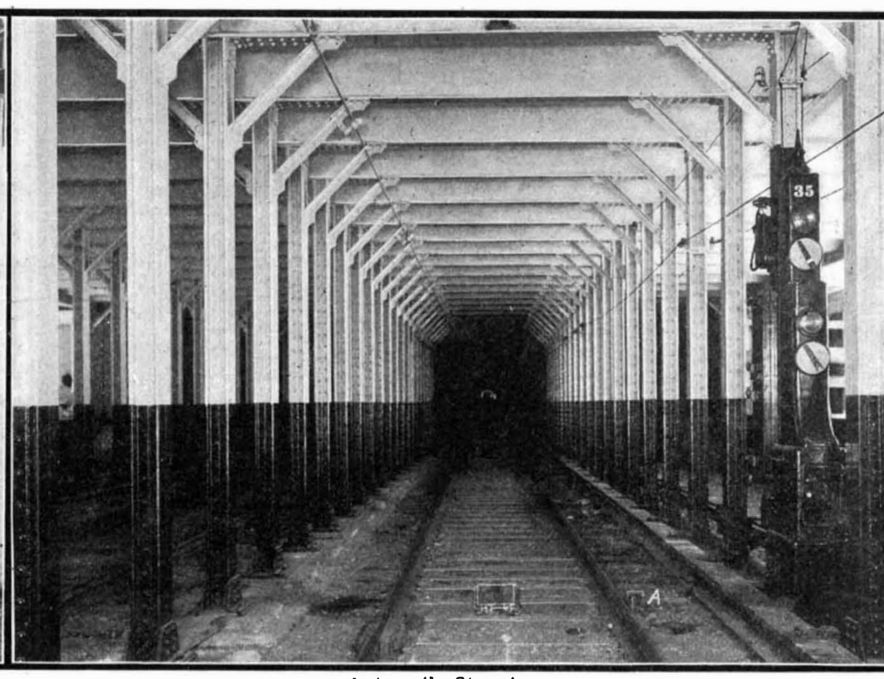
Truck of Motor-Car Showing Third Rail and Contact Shoe.



Section of Third Rail with Covering Board in Place



Tracks at 104th Street Junction.

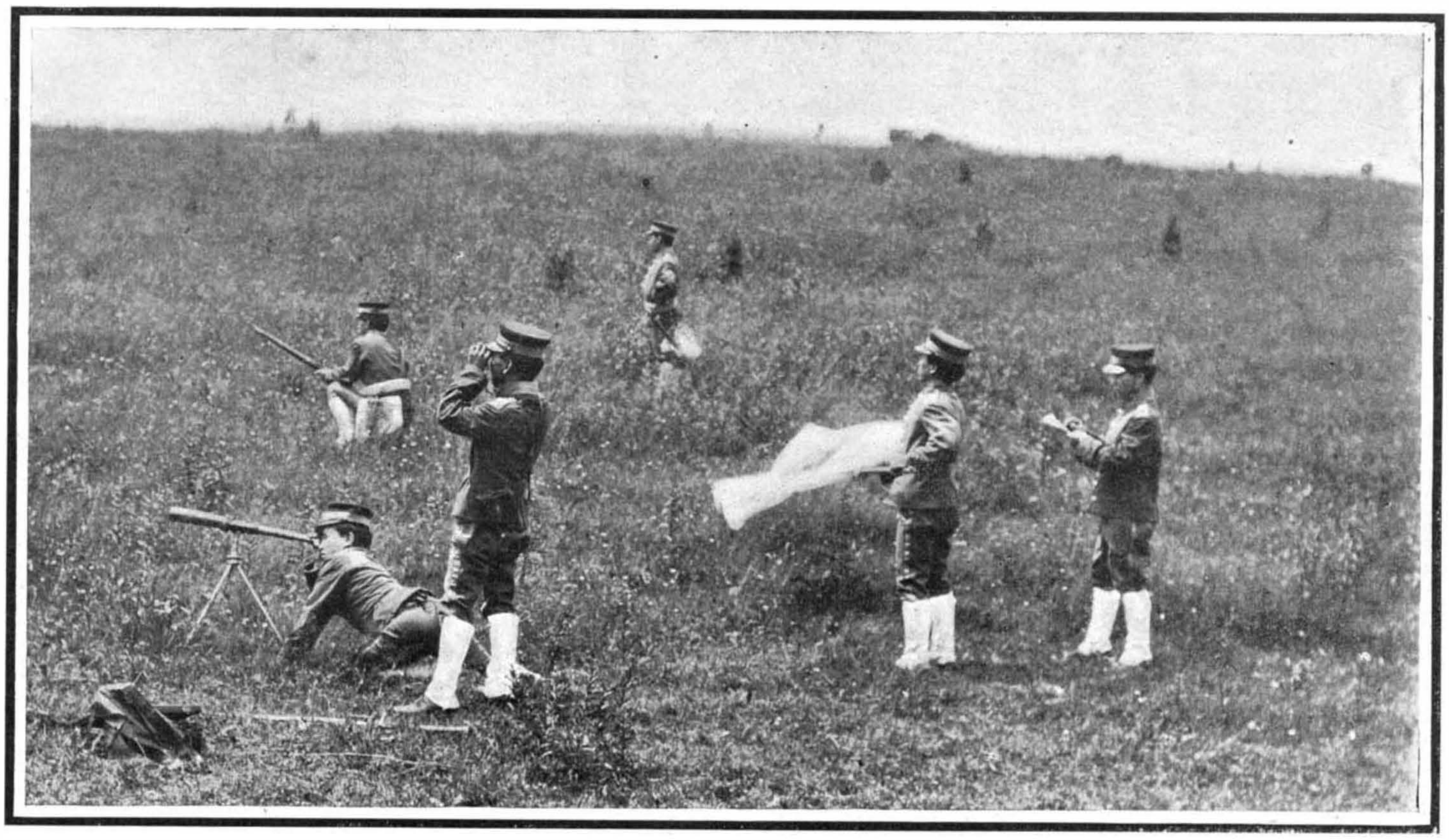


Automatic Stop A.

COMPLETION OF THE NEW YORK RAPID TRANSIT SUBWAY.—[See page 178.]

SIGNAL SERVICE IN MODERN WARFARE.

BY M. C. SULLIVAN.



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"Wig-wagging" Signals to a Distant Point.

The field operations of the Japanese army in the war now in progress in the Far East demonstrate that it possesses a capacity and a precision for extensive co-operation, and above all, for maintaining a successful military secrecy that is, indeed, marvelous.

It has perhaps occurred to some readers that the wonderful successes that have fallen to the lot of the Japanese army in its conflict with Russia, have been due in a great measure to the more intelligent use of modern methods of signaling. This is true, and it is to the successful use of the different means that may be used for transmitting intelligence rapidly on the battle-field that the Japanese generals have been able to make those strategic movements which have won the praise of military experts throughout the world.

It is not alone the superior courage of the Japanese officers and men that is winning victories. The Russians, too, are brave, and in numbers they at least equal the Japanese. The great secret of the superiority of the Japs is their better application of the science of warfare.

While Japan was planning for a war which she well knew was inevitable, she fully understood that her army must have something more than mere physical courage on which to rely for victory.

The world at large has for some time been aware of the ingenuity and resourcefulness which the Japanese have exercised in utilizing the great forces of nature in the building up of their country, but it required the present conflict to show how well they are able to bring these same forces together for the protection of their nation.

On account of the great rapidity with which events culminate and follow each other on the modern battle-field the ability of being able to promptly forward orders and information more than ever before enters into the considerations which influence the final result.

In the previous great wars the line of battle was so contracted that the commander could directly supervise and control the entire field; but now, owing to the murderous fire of modern rifles, the disposition of troops covers an area of many miles and consequently they are less under the direction of the commander-in-chief, and this state of affairs requires great efficiency on the part of the signal service.

The Japanese military engineers made a special study of the effectiveness of the various means of signaling available for battle-field communication used in the last Soudan campaigns by Kitchener, and more recently by the United States army in Cuba, the Philippines, and China, and by the English army in South Africa, such as the flag, torch, heliograph, telegraph, and telephone, and as a result adopted the telephone as the most practical, and have used it more extensively and successfully than has ever been done before on the battle-field.

In flag signaling, commonly called "wig-wagging," there are but three motions. The signalman facing squarely the direction in which it is desired to communicate, waves the flag or other appliance to the right, left, and front. The first two motions are the elements by which the alphabet is constructed; the third being used to signal the ends of words, sentences, or messages. The flags, made of cloth of light and close texture, are square in shape and have a smaller square in the center of a different color from the body of the flag. The colors commonly used are red with white centers, and white with red centers, in sizes two and four feet square; the two-foot flags have 8-inch, and the four-foot flags have 16-inch square blocks for their centers. The color of the flag must contrast as strongly as possible with that of the background. Upon this contrast the legibility of the signals often depends.

Messages can be "wig-wagged" distances of twelve miles, under perfect atmospheric conditions, using powerful telescopes. Under ordinary conditions the range is scarcely more than half as far.

The heliograph is an instrument of great range, and consists of mirrors so arranged that rays of sunlight may be projected in any direction, a shutter being used to interrupt and control the flash. It requires plenty of sunshine, and where nothing intervenes to obstruct the flashes messages can easily be sent distances of fifty miles.

Flash lanterns, having a range of about that of the flag, are used for night signaling.

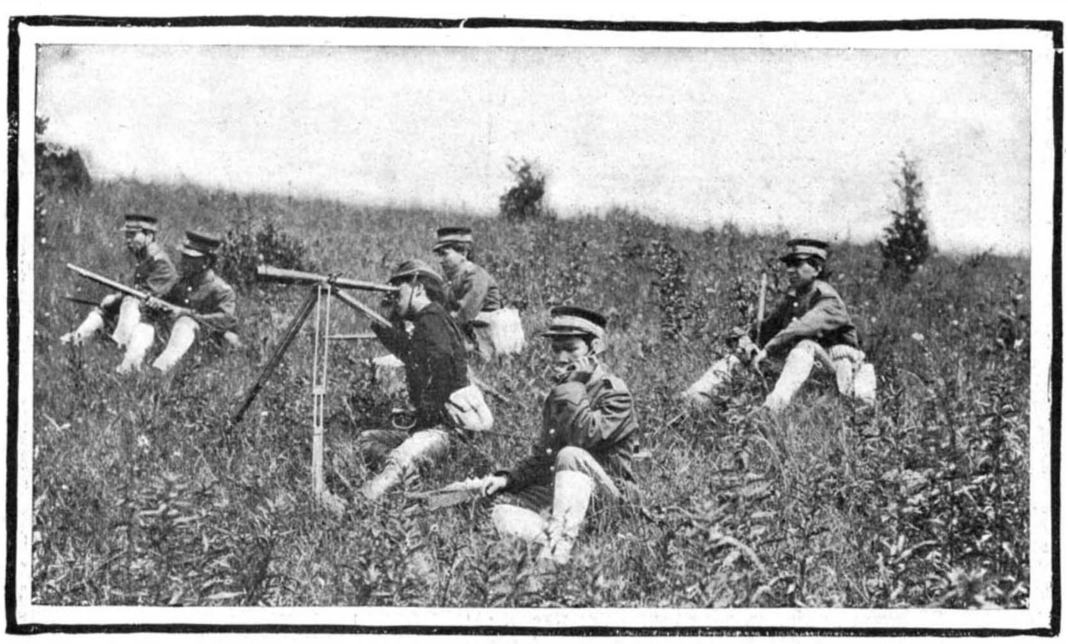
While the visual systems possess the great advantage of mobility and require little skill to operate, they are all at the mercy of the weather, and, having to be worked from elevated points, their presence in the field cannot be successfully concealed from the enemy.

The electric systems, consisting of the telegraph and telephone, when compared with the visual systems are complicated and require a high degree of skill for their successful operation, but they are available at all times, regardless of weather conditions, while concealment from the enemy is complete.

The chain of communication is divided into three parts, the permanent, the semi-permanent, and the temporary or flying lines. For the permanent lines the existing commercial telegraph and telephone lines are used as far as possible. Semi-permanent lines are used to connect the different commanders with the base of supplies located behind the zone of active operations. The temporary or flying lines, used in the zone of active operations, are intended to enable the commander to be in instant communication with every division of his army, as well as with those of the most advanced outposts. It is in this fighting zone that the Japanese are using the telephone to the greatest advantage.

The difficulties incident to maintaining telephone communication on the battle-field are many and varied. The lines are of the most temporary character, no effort being made in their construction for their preservation. Where possible the wire is reeled from wheeled vehicles, like so much rope, across fields, or if roads are followed, it is laid to one side. The telephone department of the Japanese signal corps completes its lines as fast as the troops move, even under forced marching. The wire and instruments are carried on cars whenever possible, but as the army advances into wild country, where roads cease, it is necessary for the coils of wire to be slung over the shoulders of the men and carried great distances by foot. The wire is specially insulated to withstand the hard usage to which it is subjected.

In organizing their signal department the Japanese engineers learned that men who were skilled in elec-



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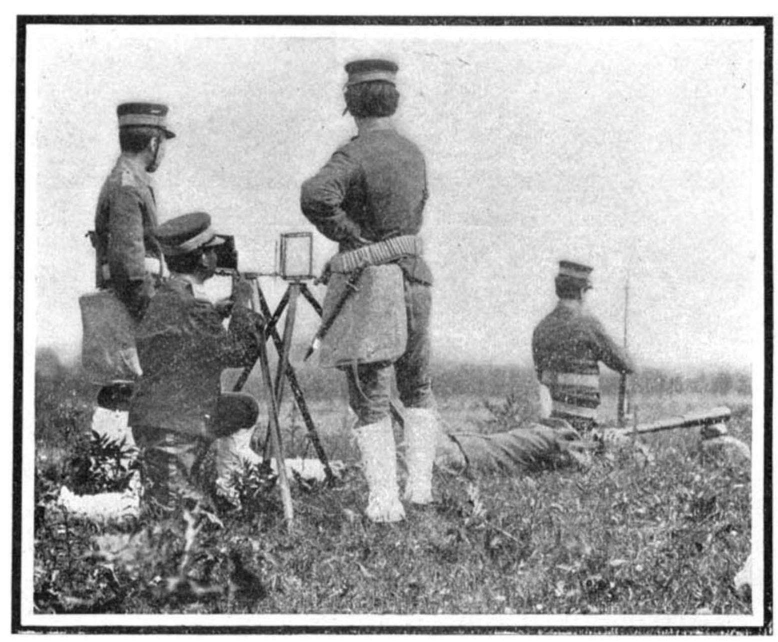
The Field Telephone in Use.



Scouts Studying Enemy's Movements with the Telescope.

SIGNAL SERVICE AS USED BY THE JAPANESE.

tricity could be made acquainted with the details of army work much easier than those who had acquired familiarity with soldiers' duties could be trained into electricians. The plan followed by them has been to utilize the available operators and electricians who, as civilians previous to the war, were engaged in transmitting commercial intelligence by the means of the telegraph and telephone. These electricians, as a result of their experience, knew the telephone, and being skilled in all the details of its construction and operation have in a short space of time accomplished results with it on the battle-field that have established a permanent place for it in modern warfare.

The operations leading up to the battle of the Yalu River, and the battle itself, brought to the front in a forcible manner the advantages to be secured by telephone communication.

Ten days prior to the battle a small Japanese advance guard was patiently forcing back the Russian scouts who were on the Korean side of the Yalu, twenty-five miles north of Wiju.

The Russians, who were strongly intrenching on the Manchurian side around Antung and Kiu Lien, never at any time saw the Japanese in force, not more than a handful of Japanese soldiers being in view at any time, and they moved about in a most unguarded way. The Japanese whom the Russians did see were in telephonic communication with the troops held to the rear of mountain ranges several miles away from the river. Whenever the troops moved it was at night, acting on detailed information which was sent over the hastily-constructed telephone system.

During the battle an incident occurred which demonstrates the value of this instantaneous communication with all parts of the army, particularly during an engagement. When the right and left wings of the Japanese army, after crossing the Yalu, were closing in on the Russian flanks, the Japanese left found itself under fire of its own artillery. With their telephone system it was but the work of a moment to call up headquarters at Wiju, which was in telephonic communication with all of the batteries, and have the direction of fire changed, thus saving many lives and permitting the infantry to continue their advance.

A NOVEL GLIDING MACHINE.

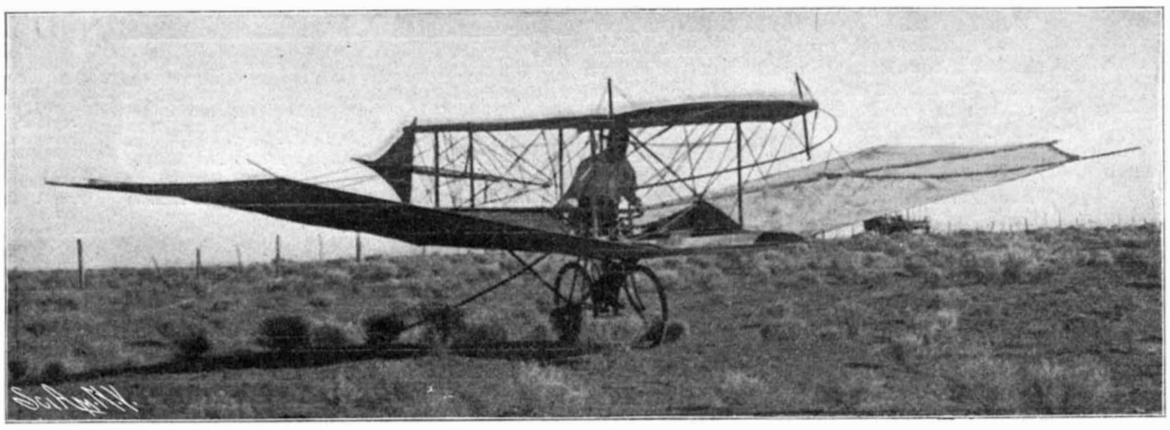
Mr. S. V. Winslow, of Riparia, Wash., sends us the accompanying photograph of a flying machine, which, he assures us, has proven perfectly successful so far as balancing is concerned. The inventor hopes ultimately to use the contrivance as a gliding machine.

In most aeroplanes, as our readers are doubtless aware, the problem of overcoming inertia is that which presents the greatest difficulty. More or less complicated launching devices have been invented which have not always been successful. The most common method, perhaps, of starting an aeroplane is to drive it down an inclined track, allowing it to soar of its own volition after the momentum acquired has overcome the inertia. Lilienthal, it will be remembered, simply held his gliding device with his arms, ran down a hill at a considerable speed, then drew up his feet and soared for a hundred yards or more. Mr. Winslow has adopted a novel method of attaining the same end. His bicycle is certainly as rational a soaring device as Maxim's track or Prof. Langley's complicated launching device of springs. Furthermore, by a very ingenious system of levers, and by connecting his handle bars with the vanes, Mr. Winslow has provided himself with a controlling mechanism that really forms a part of the starting device.

PROF. BOTTS'S FLYING MACHINE

BY J. MAYNE BALTIMORE.

Prof. R. H. Botts, who for nearly twenty years has carefully studied the great problem of aerial navigation, is the inventor and constructor of a new kind of flying machine. His invention represents the results of his long and scientific study, investigations, and experiments.



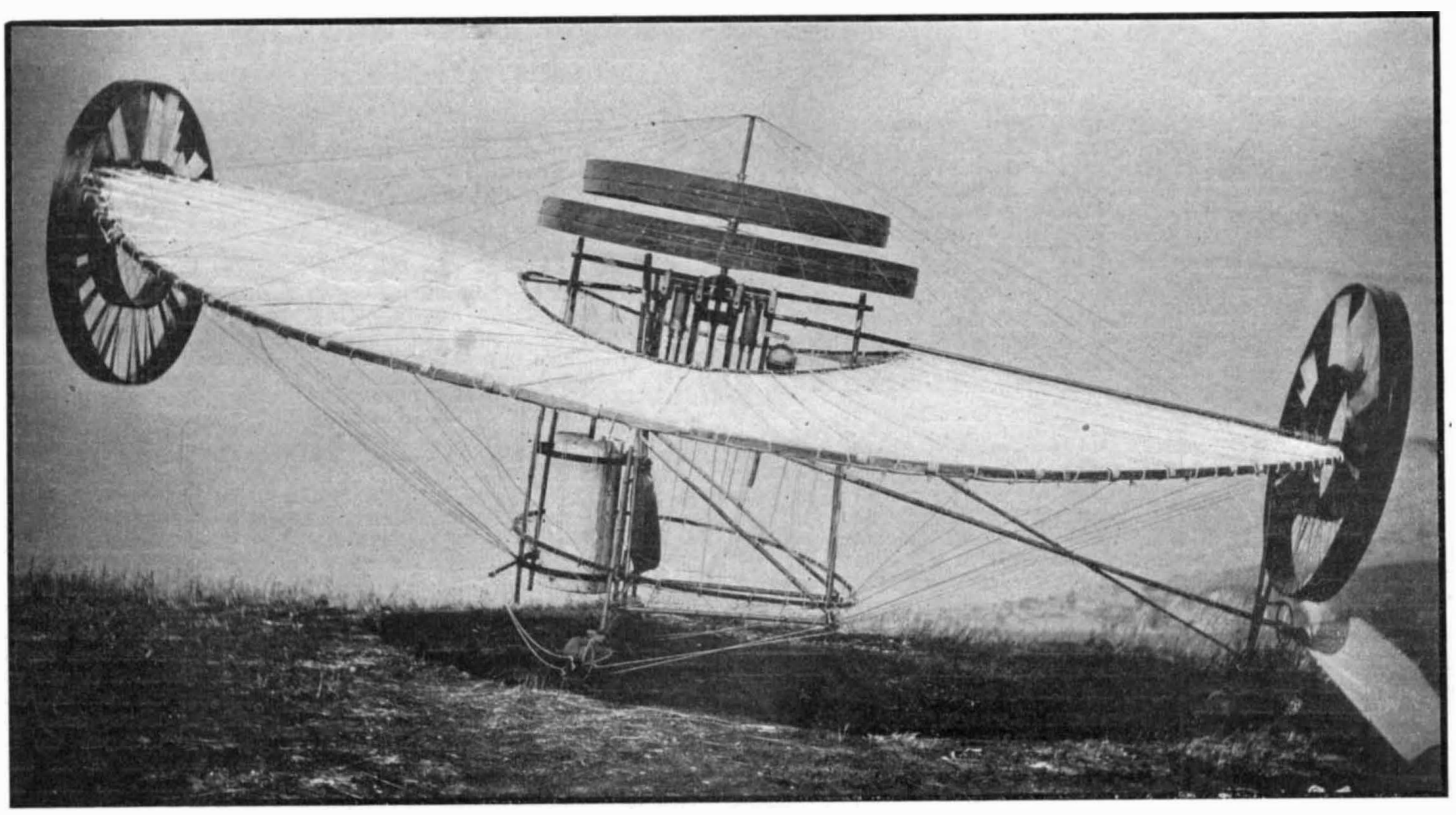
A BICYCLE AEROPLANE.

The Botts plan involves the combination of a perfectly circular-shaped aeroplane together with two propellers that work on a horizontal plane. The aeroplane is 62 feet in circumference—a fraction more than 20 feet in diameter.

There are two hoops to which the aeroplane is attached, an outer one of light, strong steel tubing, and a smaller one of flexible wood. The diameter of the latter is about 6½ feet. The aeroplane is made of parachute cloth—light and very strong. By means of aluminium wire and strong hempen cords, the cloth is stretched as tight as a drumhead.

In the center is placed a circular frame composed of bamboo, wood, and aluminium. This frame composes the car, where the operator sits; also contains the boiler, two engines and the beveled gearing, by means of which the system of propellers is operated. By means of wires and cords, the frame, car, etc., is very securely lashed to the aeroplane and the propellers, shafting, etc.

Above the aeroplane are placed two propellers working horizontally. These two propellers are neutralizing—that is, they run in opposite directions, but the vanes are so placed as to apply the power in one given direction—upward. These two propellers are the "up-lifters," supplementing the aeroplane in ascending or descending.



THE BOTTS FLYING MACHINE.

The upper propeller is smaller—5 feet and 1 inch in diameter. The lower wheel is 6 feet and 2 inches in diameter. Fore and aft are placed a propeller (working vertically at the end of a shaft)—each being 6 feet and 2 inches in diameter. Like the other propellers, they are neutralizing, moving in opposite directions—one pushing and the other pulling. These constitute the driving power—also operating in conjunction with the aeroplane.

Prof. Botts claims that one great advantage of using these neutralizing propellers is that it prevents the entire machine from moving sidewise, or, in a circular direction; that the neutralizing forces hold it on a steady course. He says long study and repeated experimenting has demonstrated this principle.

These propellers are constructed on the bicycle principle, but having an inner and outer rim (wooden) between which are fastened strong aluminium blades or vanes arranged in groups of eight in the larger, and of four in the smaller wheels.

The combined weight of the four propellers is only 43 pounds. By means of the gearing, they are capable of making over 500 revolutions per minute. However, this very high rate of speed will be unnecessary.

The propellers are also placed in linear sections. So when in motion they will cut or pass over different air currents at the same time, thus affording the results of several wheels combined in one.

The aeroplane is so rigged that, like a sail, it may be partly or entirely reefed, in case of very high wind, or for other reasons. It may serve the secondary purpose of a parachute in making descents, or in the event of an accident to the machinery while in flight.

In setting sail, the neutralizing, lifting, and advancing propellers, with the aeroplane tilted upward at a marked angle, enable the machine to glide, or sail through the air, since the latter contains more than one square foot for every pound of weight carried.

In the Botts machine the boiler is placed in front of the operator's seat, affording a complete balancing of the entire machine. It would be almost impossible for it to capsize.

There are two engines each of 6-inch stroke and 3¼-inch cylinder diameter. Total weight of the two engines is 33 pounds. The boiler has 60 feet of fire surface. Steam will be the motive power. The total weight of the machine, including the operator, is about 214 pounds.

The rudder is made of strong cloth—somewhat fin-shaped. It is so pivoted that by moving a lever it can be thrown at any desired angle, vertically or horizontally. The neutralizing propellers avoid the use of a large rudder to prevent the machine from twisting in the air. Prof. Botts has entered for the prize at the World's Fair, and expects soon to start for St. Louis with his invention.

The discovery of important coal deposits in European Russia and Siberia has made it possible to substitute coal for wood on the locomotives of the Trans-Siberian Railroad. Upon 2,000 miles of track the locomotives are now using Siberian coal and in 1903 as high as 500,000 tons of it were consumed. The coal comes for the most part from Tscheremchow and Shudschenka, in the Tomsk region. In the Siberian mines the coal deposit lies at a great depth and generally has but little thickness. It is often penetrated by water. Those of the Tomsk region are nearer the surface and can be easier worked. But the transportation of the coal to great distances is difficult to carry out. Accordingly it is proposed to supply a part of the road from the new mines which have been opened at Kaltschagin.

RECENTLY PATENTED INVENTIONS.

Hardware.

SCREW-DRIVER.—T. W. Fisher, Helena, Mont. Frequent annoyance and inconvenience are experienced in the use of the screw-driver due to accidental unseating of the end from the groove in the screw head, and it often happens that from this cause the surface of a structure or piece of work becomes marred, not infrequently necessitating a new dressing or planing. The present invention has for its principal object to provide a screw-driver having means ("denominated by the inventor a holder or guide") whereby the annoyance may be readily overcome and also whereby the operation of insertion and withdrawal of screws may be effected with ease and facility and without liability to cutting or injuring the hand.

Household Utilities.

SAFETY GAS-VALVE.—P. L. Salemi, New York, N. Y. The invention is peculiarly applicable for domestic use on ordinary gas-jets where there is more or less liability of the gas-jets being tampered with accidentally by unauthorized persons or children. The improvement allows the jet to be opened at will, but not opened so readily as to become dangerous. In other words, the inventor seeks to render it impossible for the jet to be opened except by a person who understands it and who desires to open it.

SCREEN FOR WINDOWS OR DOORS.—E. Christen, Decatur, Ind. The inventor preferably employs a suitable frame for supporting the screen before or within the frame of an ordinary window or door, said screen being of special construction and operating to prevent the rays of the sun from entering a compartment in which it may be located. The screen, however, offers no obstruction to the entrance of light and air therethrough nor to the viewing of outside objects or surroundings from within.

Machines and Mechanical Devices.

BRAKE AND AUTOMATIC STOP DEVICE.—J. C. Smith, Louisville, Ky. In this patent the invention has reference to a combined brake and automatic stop, which is useful in many machines and especially in hoisting-machines, particularly when applied to elevators. The objects are to provide means for automatically stopping a machine, elevator, or the like at predetermined limiting points and at the same time provide means for stopping the same at intermediate points as desired.

TENSION DEVICE FOR WARP-BEAMS.—G. Keller, New York, N. Y. In this instance the invention relates to looms; and Mr. Keller's object is the provision of a new and improved tension device for warp-beams arranged to give a uniform tension to the warp under varying weather conditions to insure the formation of faultless weaves.

WOODWORKING-LATHE.—J. M. Kuebler, Wausau, Wis. The cutter is of the rotary type in the present invention and is driven at a high speed. Both of the turrets are driven by certain peculiar mechanism which imparts to them a slow step-by-step movement, the elements being so arranged that the turrets are at, or practically at, rest during the time that the tool engages the work, the movement of the turrets being independent of the rotation of the work-holders or center-pins, which latter rotation goes on continuously.

COFFEE OR SPICE MILL.—J. W. Kirby, Butte, Mont. In carrying out this improvement the object is to provide a mill which shall be adapted for grinding or pulverizing coffee and spices, the same to be not only simple in construction, but adapted for more thoroughly grinding or pulverizing than is possible with any similar mill known to the inventor.

COIN-CONTROLLED LIQUID-DISPENSING APPARATUS.—A. F. Bradshaw, Bieber, Cal. The intention in view in this case is the provision of a simple mechanism wherein liquid may be drawn from a suitable container on the deposit of a suitable coin or slug, the volume of escaping fluid being regulated automatically by the operation of a suitable knob and the coin being discharged automatically into a suitable receptacle, so that the coin will not subsequently interfere with the proper service of the machine.

NUT-TAPPING MACHINE.—G. F. Zwilling and C. W. Richards, Cleveland, Ohio. In this patent the invention has reference to a machine for automatically threading nuts; and the prime object of the inventors is the production of a machine in which the tapping operations are practically continuous, and thus very greatly increasing the speed of the machine.

Of General Interest.

COPY-HOLDER.—J. L. Rivers, Seattle, Wash. The design in this case is to meet the demands of type-writer operators for a device which will hold a copy so steadily in place that the jar or vibration of the machine will effect it to the least possible extent (when fastened to a solid desk will do away with all vibration) and which may be used in any number of positions on a folding type-writer cabinet, desk, or table in a way to avoid removal or readjustment of the holder when covering the writer with the ordinary cover with which they are provided or when opening or closing a folding writer cabinet or rolling-top desk.

CASING-CLAMPING WRENCH. — J. G. Winger, Grand Valley, Pa. In carrying out the present invention Mr. Winger has particularly in view as an object the provision of a clamp which will securely engage with the exterior surface of the casing-tube and may be used as a wrench to turn the same, the construction of the device being such that the tube will not be bent or crushed under the influence of pressure exerted thereon.

ANIMAL-TRAP. — G. J. Miller, Walla Walla, Wash. The invention is an improvement in that class of traps in which a spring-actuated bow-shaped jaw is adapted to be set and locked in a retracted position and when tripped by the animal snaps down upon his body. It relates particularly to the construction of the locking and tripping device and its connection with the spring-jaws; also to construction of the jaws and their attachment to fixed portions of the stationary frame, which portions constitute their fulcra; also the means for connecting the ends of the wires forming each of the jaws.

PIANO-BACK.—G. H. Jones, Oregon, Ill. In this patent the object is to provide a back which is simple in construction, comparatively light, and arranged to obtain the greatest strength at the point where the greatest strain is exerted by the strings and the metal plate, to increase the volume of tone of the instrument by the elimination of the heavy posts now in use in frames, and to maintain the instrument in proper tune for a considerable length of time.

Pertaining to Vehicles.

WHIFFLETREE-COUPLING.—G. L. Miller, Socialville, Ohio. In this instance the invention is especially useful in couplings for connecting the whiffletree, doubletree, or coupling-pole of a carriage or wagon with the cross-bar. It can be applied to the center of bolsters or axles to receive the coupling-pin or king-bolt or wherever the bore in a wood or soft structure requires protecting lining. As a clamping device it may be used to fasten separate parts together and will constitute a strong brace member for the structure.

Prime Movers and Their Accessories.

PUMP-CONTROLLING MEANS.—W. Small, Sourlake, Texas. Primarily the inventor seeks to provide means for the purposes of a construction which will effectively operate as a governor for a pump in such manner that when pumping oil large quantities usually wasted when a break in the oil-line occurs by reason of excessive pressure or when the supply to the suction becomes too low is saved, whereby pumps equipped with his improvement require less attention, and the service of one or more station attendants dispensed with.

BOILER-FLUE CUTTER.—J. W. Faessler, Moberly, Mo. That class of devices which are employed for cutting the flues or tubes of tubular boilers at a point within the flue-sheet are improved by this invention, and particularly in that class of such cutters in which the body of the tool is provided with a cutter so attached that it may be projected from or retracted within a radial slot in the tool as required for work or when it is being inserted or withdrawn from the tube.

TURBINE.—T. Eastmore and M. M. Freed, Jacksonville, Fla. In this invention, which relates particularly to improvements in turbines the object is to provide a reversible multiple compound expansion-turbine that will be effective in operation with an economical use of motive agent, simple and durable in construction, and easily reversed. The inventors have also made another improvement relating to multiple compound expansion steam-turbines, the object of which is to provide a machine of this character that will be effective in operation, simple and durable in construction, easily reversed, and arranged to utilize the motive agent to the fullest extent.

Railways and Their Accessories.

RAILROAD-SWITCH.—T. A. Bowen, Blackstone, Va. Mr. Bowen's invention is in the nature of an improved automatic railroad-switch designed to be set in operation by the engineer or some other person on the train or switchman along the track, as when freight-trains are being operated over the same. It comprehends certain novel features in the switch mechanism and in the combination, with the same, of a shifting lever with stand, light, and locking devices.

STRAINER ATTACHMENT FOR AUTOMATIC AIR-BRAKES.—S. J. Ballance, A. Uhlich, and G. Uhlich, Lincoln, Neb. The object of the invention is to provide a practical device which may be readily connected with a crossover-pipe between the train-pipe and the triple valve on cars and also between the engineer's brake-valve and the train-pipe on engines, the train-pipe, triple valve, and engineer's brake-valve being parts common to an airpressure-brake system, and when so connected serve to arrest any kind of grit or other impurity that enters the strainer device.

COMBINED RAILWAY-TIE AND RAIL-FASTENING DEVICE.—J. T. Griffin, Watertown, Tenn. Mr. Griffin's invention refers more particularly to metallic ties; and the object of his improvement is the provision of an improved tie of this character of strong and simple construction and improved rail-fastening devices so formed and so arranged relatively to the tie as to effectively secure the rails and prevent them from spreading.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Inquiry No. 5951.—For wax used in manufacture of shoe polish.

Inquiry No. 5952.—For manufacturers of pearl and bone button-making machines.

Inquiry No. 5953.—For manufacturers of coin slot portraiting machines.

Inquiry No. 5954.—For manufacturers of lathes and machines for making wooden bottles.

Inquiry No. 5955.—For manufacturers of pump indicators.

Want to buy receptacles for toilet-room disinfectant. Disinfectant, 794 Broad Street, Newark, N. J.

Inquiry No. 5956.—For address of umbrella handle manufacturers.

Wanted.—Addresses of importers and consumers of bamboo. D. F. Mitchell, Jacksonville, Fla.

Inquiry No. 5957.—For machinery to produce knitted table padding.

Inquiry No. 5958.—For makers of laundry machinery.

Inquiry No. 5959.—For address of drug company dealing in powdered extract of gulf weed.

Inquiry No. 5960.—For manufacturers of rope-making machinery.

Inquiry No. 5961.—For firms or parties using small bottles for putting up samples of medicine and other articles.

Inquiry No. 5962.—For parties making flint glass.

Inquiry No. 5963.—For several second-hand, small electro magnets; also for dealers in amateurs' electrical supplies.

Inquiry No. 5964.—For manufacturers of salve, etc.

Sale.—Adjustable stepladder patented in Canada and United States. Used on stairways. Never placed on market. Joseph A. Jaeger-Rainer, Hull Ave. and So. Scott Ave., Bradford Park, N. Y. C.

Inquiry No. 5965.—For makers of light-weight kerosene engines.

Two patents for sale. Supply tanks for water service, No. 195,662. Valve, a cut-off, for supply tanks, No. 737,941. Can furnish some valves, cut-off, in working order. P. J. Lotthauser, Clarendon, Texas.

Inquiry No. 5966.—For manufacturers of the "Calentador de Camp."

Would you be interested in doing successful business in Mexico? Please write for particulars. We will recommend you a man well known with all business situations in that country. Arturo Andres, Guadalajara, Mexico.

Inquiry No. 5967.—For machinery to saw buttons out of mussel shells.

Inquiry No. 5968.—For importers of tea and coffee.

Inquiry No. 5969.—For manufacturers of stereoscopes.

Inquiry No. 5970.—For loom for weaving wire fence.

Inquiry No. 5971.—For parties making machines used by stamp cutters, etc.

Inquiry No. 5972.—For manufacturers of hard sheet rubber, glassware, brass goods and carbon.

Inquiry No. 5973.—For parties manufacturing machines for making cigarettes.

Inquiry No. 5974.—For manufacturers of sand blast machines.

Inquiry No. 5975.—For parties putting up shingle mill to cut cypress shingles.

Inquiry No. 5976.—For manufacturers of carborundum.

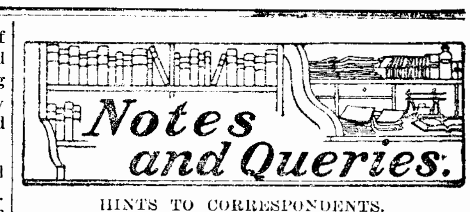
Inquiry No. 5977.—For manufacturers of barber combs.

Inquiry No. 5978.—For dealers in samples of rubber stamps.

Inquiry No. 5979.—For machinery for extracting and cleaning hemp.

Inquiry No. 5980.—For manufacturers of peat and peat goods.

Inquiry No. 5981.—For manufacturers of wall and packing paper.



HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(9454) C. W. W. asks: 1. How does all artificial motion differ from the earth's motion? A. There is no difference, so far as we know, between the earth's motion and other motion. Motion is change of place. It may be that the question has some special sense which we do not detect. 2. Where, in traveling round the world, do you lose a day? A. If one crosses the 180th meridian going from east to west he will skip a day, that is if he crosses on Tuesday, he will immediately change his reckoning to Wednesday, the hours remaining the same. On the other hand, if he crosses going from west to east, he will set his reckoning back a day, that is, if he crosses on Tuesday he will immediately change his reckoning back to Monday. This is not because he loses a day or gains one. He has the same duration as others. It is because on sailing from east to west the days are each more than twenty-four hours long, and in going entirely around the world these minutes in excess of twenty-four hours amount as a total to another twenty-four hours or a day. Similarly in sailing toward the east, one meets the sun earlier by the change he has made in his longitude, four minutes of time for each degree, so that the days are less than twenty-four hours long. In going entirely around the world these deficiencies in the length of the day amount to twenty-four hours or another day, and this the voyager gets by shifting his date backward one day on crossing the 180th meridian. In olden times ships carried their reckoning without change till they had completed the voyage and then made the change on arriving in port. 3. Why will a vessel made of cement hold water and not keep water out? A. A vessel which will not keep water out will not keep water in. It is inconceivable that it should do so. However, a vessel may be porous so that water will leak into it, when it is set into a tank of water, and yet not have water run out of it so as to wet the place where it stands when it contains water. This is explained by the fact that the water which oozes through the pores of the vessel is evaporated as fast as it appears on the outer surface and does not accumulate in sufficient quantities to drop off. Use is made of this peculiarity of porous earthen ware vessels to secure cool water in the tropics. A porous vessel is hung in a draft of air in the shade and the evaporation of the water from the external surface cools the water remaining in the vessel so as to be refreshing to drink. The manufacture of cement blocks as used in architectural work and machines for making them are described and illustrated in Scientific American, No. 9, Vol. 89, also Supplement, Nos. 1148 and 615, 10 cents each. Any maker of brick machinery can make the block-molding machine. We refer you to the American Clay Working Machinery Company, Bucyrus, Ohio; you will also find another address in the copy of Scientific American mentioned above.

(9455) D. L. P. asks: Are the velocities of light and attraction from the moon the same, and if not, why is it that the tides are drawn up when the moon is apparently over them? What is the actual position of the moon as regards the earth, when its observed position is at the zenith? A. The force of gravitation is held by scientists to act instantaneously through space. Light travels with a velocity of 186,300 miles per second in the spaces between the heavenly bodies. The tides produced by the moon are not directly between the moon and the center of the earth, that is, directly under the moon. It requires time to overcome the inertia of the water, and the crest of the tide wave is about one hour behind the moon in the open sea, while near the shore, in bays and rivers it may be much farther than this behind the moon. The position of the moon in the sky differs as seen from any place from its position as seen from the center of the earth. You can draw a diagram for the latitude of your place and see the relative position as seen from your place and from the center of the earth.

(9456) S. F. C. asks: Will you kindly decide the following questions: A claims that it has never been scientifically demonstrated that it is possible to throw a globular sphere or baseball and make it describe a curve on the same plane, i. e., what is commonly termed an in-curve or an out-curve. A also claims that if any curve does take place it is due to the resistance of the air to the ball traveling in one direction but revolving in the opposite, also that said curve will not exceed 4 inches in 60 feet. B claims that a baseball can be thrown 60 feet and made to "break" or deflect at an acute angle when about 58 feet, also that it is possible to throw a ball 60 feet and cause it to curve 3 and 4 feet from the median line. A. There can be no doubt about the curving of pitched baseballs. It is seen every day. Pitchers are chosen for their ability to pitch "curves." We do not, however, know the limits of the distance to which a ball has been or may be curved, and should look with doubt upon the statement that a ball cannot be curved more than 4 inches in 60 feet. The matter has been analyzed by scientists with the conclusion that the curving is the result of a diminished pressure on one side of the revolving ball. The air is rent by the ball as the ball rushes through the air. This is equivalent to an air current past the ball having the same velocity as the ball. The rotation of the ball causes the rarefaction of the air on one side, that toward which the ball is turning, and a pressure is produced toward that side which pushes the ball away from its straight course, as seen by one watching the ball. Any batter can tell you that the balls curve, and for that reason are hard to hit. We do not know what scientific demonstration would satisfy A, but the fact of curving is capable of optical demonstration, and it is the business of science to find the reason for the obvious visible fact.

(9457) E. E. W. asks how the horse power of an electric motor is reckoned. Is it reckoned on what the motor will draw or what it will lift? How many men would it take to run a machine by foot-power that can be run by a 1-horse-power motor? A. The horse-power of an electric motor is reckoned from the amperes and volts which it takes. Multiply together the amperes and volts as determined by the instruments and divide the product by 746, to obtain the horse-power. Eight or ten men may be taken as about equal to 1 horse-power in continuous work, although no definite number can obviously be assigned.

(9458) F. E. W. asks: Has it ever, to your knowledge, been proved by scientific demonstrations, that a ball thrown by the human arm can be curved in the air? Will you kindly inform me in regard to the matter? A. Curved balls are pitched every day on all the baseball grounds in the country. There can be no question about the matter. It has also been made the subject of mathematical investigation. The conclusion is: "The curving of a pitched base ball or a court tennis ball is due to a reduction of air pressure on one side of the rotating ball." You will find a valuable article on the subject of the curved ball in our SUPPLEMENT No. 402, price 10 cents. Other articles are published in the SUPPLEMENT No. 410, 423, 463.

NEW BOOKS, ETC.

HOW TO ILLUSTRATE FOR NEWSPAPERS, MAGAZINES, BOOKS, ETC. By Charles Hope Provost. New York: Brown Publishing Company, 1904. 12mo.; pp. 186. Price, 50 cents.

Mr. Provost's position as a well-known illustrator of the day will give this manual a claim upon popular regard. If criticism may be ventured, it must be to the effect that the writer has tried to cover too much ground, and consequently has been obliged to dispose of such subjects as "perspective," "pictorial composition," and "ornamental design" within the limits of one or two pages. This fact, however, does not detract from the value of the writer's remarks and instructions on other subjects; as in the chapters on "artistic anatomy," for instance, which are remarkably well illustrated by plates showing the articulation of the bony structure, the disposition of the muscles of the body, and the relative proportions of the features of the face and of the members and parts of the body. The list of publishers who buy illustrative work should be of use to beginners ambitious to make money by brush and pen; while an appendix, devoted to the reproductive processes used in book, periodical, and advertising work, contains much that the beginner ought to know.

CHEMICAL ANALYSIS FOR GLASSMAKERS. Containing Methods of Analysis for Clays and Other Silicates which will be found useful for the Pottery Industry. By Edward C. Uhlig, B.S., Chemist for Whitall Tatum Company, Member of the American Society of Chemical Industry. Pittsburg: Kaufmann & Gauding, 1903. 8vo.; pp. 136. Price, $5.

Glassmakers are, as a rule, accustomed to follow certain recipes to produce certain results, without troubling themselves to learn whether the chemical ingredients they use are of the required strength and purity. Mr. Uhlig urges a systematic test of raw materials, and a more careful scrutiny of operations, such as batch-mixing and gas-making, promising that the frequent failures now carelessly attributed to "bad luck" will thus be reduced to a minimum. To this end he endeavors to give, in as simple and non-technical language as possible, such necessary instruction in chemical analysis, in its relation to the manufacture of glass, as will enable the workman to discover beforehand any imperfections in the ingredients, and so avoid failure in the melt.

PRINCIPLES AND PRACTICE OF ARTIFICIAL ICE-MAKING AND REFRIGERATION. Comprising Principles and General Consideration; Practice as Shown by Particular Systems and Apparatus; Insulation of Cold Storage and Ice Houses, Refrigerators, etc.; Useful Information and Tables. By Louis M. Schmidt, Ph.B. Philadelphia: Philadelphia Book Company, 1904. 8vo.; pp. 291; 153 engravings. Price, $2.50.

Ice-making and refrigeration are subjects of great and increasing importance in the economics of civilization. In its application to storage and transportation, refrigeration has extended, and almost revolutionized, trade in food-stuffs and perishable products. Starting with a brief *résumé* of the history of ice-making, from the ancient practice of water-cooling in India to the present time, Mr. Schmidt proceeds to impart a general knowledge of the principles involved. He then brings out the application of these principles in practice, by descriptions of representative apparatus as made by the leading manufacturers. In conclusion he presents some instructive tables, and a chapter on liquid air. The success of this, the second edition of the work, is presaged from the fact that the first edition is entirely exhausted and the demand still unabated.

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ELECTRIC SEWING MACHINE MOTOR.—The instructions and numerous illustrations of details contained in this article will enable any mechanic of average ability to build an efficient motor that will operate a sewing machine. The cost of materials for this machine should not exceed five dollars. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 1210. Price 10 cents by mail, from this office and from all newsdealers.

Trolley, electric car, L. M. McBride 768,674
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Glass, sheet, R. A. B. Walsh 37,111
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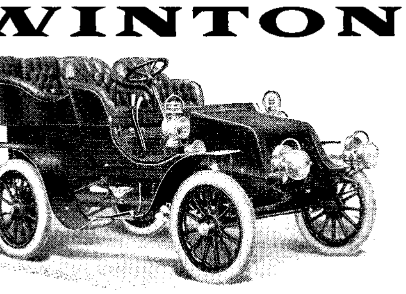

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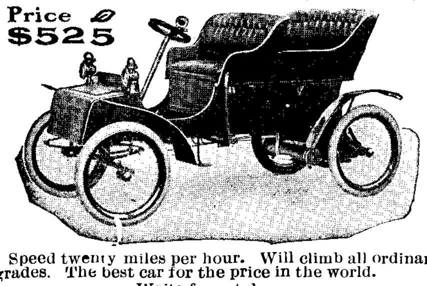

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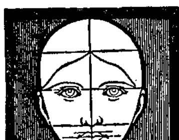

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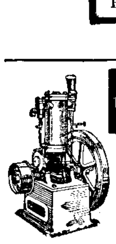

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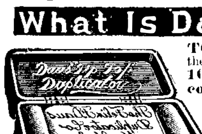

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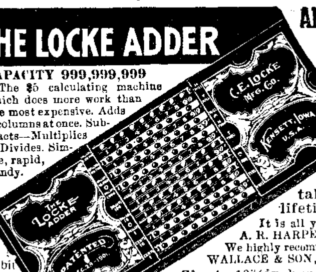

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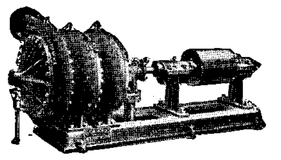

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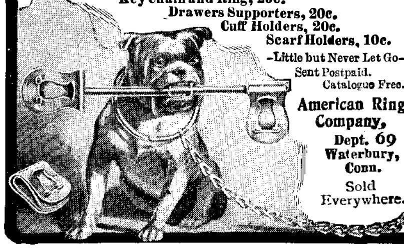

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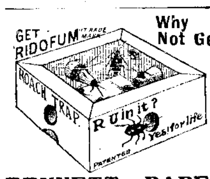

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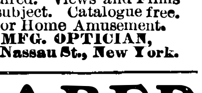

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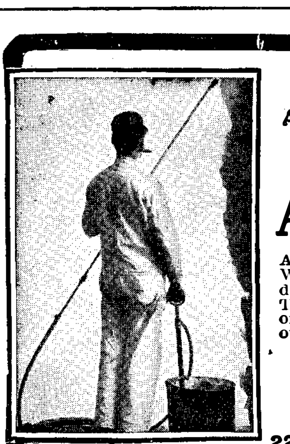

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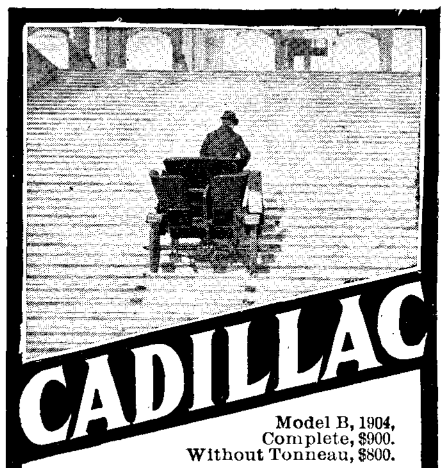

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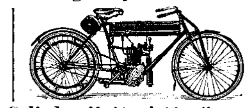

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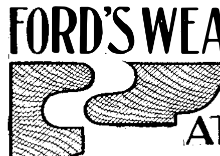

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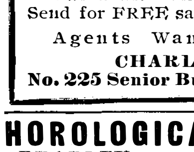

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