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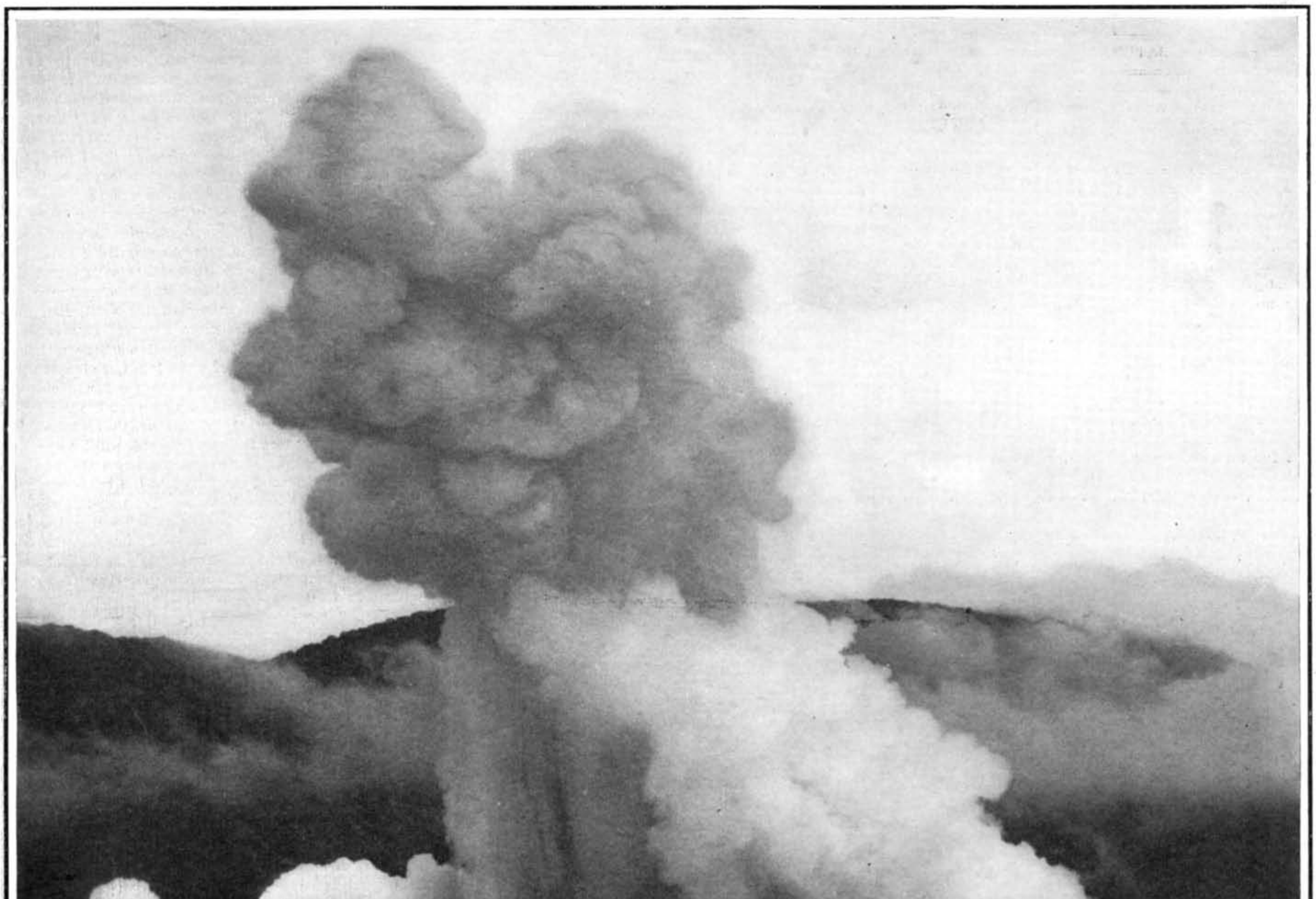

ONE OF THE RECENT GREAT ERUPTIONS OF THE POAS CRATER OF COSTA RICA.—[See page 400.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, NOVEMBER 18, 1905.

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

THE OFFER TO BUILD THE PANAMA CANAL BY CONTRACT.

Among the subjects that will form the subject of discussion by the board of engineers that are now engaged in deciding what type of canal shall be built at Panama, one of the most important is the proposal that was made by Mr. Lindon W. Bates, of this city, to build the whole Panama Canal by contract. We have already referred in previous issues to Mr. Bates's plans for excavating the canal; and it is upon these plans that this engineer is prepared to put in a bid, and give an adequate bond to the government, for the completion of this stupendous work within contract time. The proposal is made in a three-fold form, and it includes plans for three different methods of constructing the canal; one with a 96½-foot level, another with a 62½-foot level, and a third with a 26½-foot level. Mr. Bates's proposal differs radically from any that have yet been proposed, either by the French company or by any of the subsequent commissions and boards that have investigated the problem. Briefly stated, it involves the substitution of large, artificially-formed lakes, rendered navigable by dredging, in place of considerable sections of the canal as originally planned. The two most important of these lakes would be located at the terminals of the canal, and would open directly into the ocean by means of locks. Mr. Bates claims that the formation of these two lakes would greatly improve the sanitary condition of the canal zone, by substituting large bodies of fresh water in place of the existing swamps. A further advantage is claimed from the fact that the character of the dams to be built and their location is conducive to more rapid work than can be done under most of the existing plans, while the speed of transit of vessels through the canal would be greatly increased by the more direct course that can be sailed through the lakes, and the general reduction of curvature. Mr. Bates estimates that the comparative cost and time for completion of the three types of canal would be as follows: For a canal with a 26½-foot level, $135,000,000 and nine years' time; for a canal with a 62½-foot level, $125,000,000 and eight years' time; while for a 96½-foot level canal, seven years would be required and a total expenditure of $111,500,000. These estimates are for the engineering and construction work, pure and simple, and do not include the cost of government administration, sanitation, or policing.

Judging from the great success which has attended the construction of our railroads, and the more costly of our engineering works, there can be little doubt that the canal could be built more expeditiously and more cheaply under the contract system than by any other; and we cannot but think that if any responsible contractor, having a wide range of experience in work of this general character, can be found, who can command the financial backing and give to the government adequate bonds for the completion of the work, it would be best for the interests of the country to let the work by contract, and if possible, in a single contract. We have recently had proof in the city of New York of the excellent results that follow from placing these great engineering works in the hand of one single qualified man. We refer to the successful completion by Mr. McDonald of the $35,000,000 contract for the New York Subway, within the contract date set for completion. We give this opinion without any reference to the particular plan offered by Mr. Bates or any other engineer. The present board will decide once and for all what type of canal shall be built; but when their opinion has been delivered, the next important question will be as to by whom and by what system of management this enormous work shall be put through. We believe that the interests of the country and of the canal would be best served by letting the whole work by contract, in a single contract, if possible, subject to the oversight and final arbitrament of the engineering staff, and leaving the general administration, the sanitation, and the policing of the canal zone in the hands of the government, and preferably of the War Department.

THE SUEZ CANAL EXPLOSION.

Details have come to hand of the methods adopted when the steamship "Chatham," which recently sank in the Suez Canal with a load of dynamite on board, was removed by blowing up the vessel. Some curiosity has been expressed as to the way in which the detonation of this large amount of high explosive was made at once certain and safe, and we are indebted to an Egyptian paper published on the day after the removal of the wreck, for an accurate description of the greatest explosion of dynamite on record. The steamship "Chatham," when it took fire and was scuttled in the Suez Canal, had on board about 100 tons of dynamite, as well as a supply of detonators. The blowing up of the ship was accomplished by means of large mines, each containing 300 pounds of explosive and fitted with the proper electric fuses. One of the mines was placed by divers in the hold in which the cases of dynamite had been loaded, and the other mine was lowered into the hold containing the detonators. Cables were led from the mines to the shore, where they were connected to two of the telephone wires on the banks of the canal. The firing station was located three miles from the sunken wreck, and after the circuits had been tested by sending a small current through electric resistance fuses, the mines were fired. An enormous column of water and debris immediately arose, and ascended continuously for five seconds, the estimated height of the column being over 1,500 feet. The report of the explosion reached the firing point in sixteen seconds after the firing key had been depressed, and it was noted that the report was not particularly loud. The earth tremor, however, was felt almost instantaneously, in fact, while the firing key was still depressed. Although half a minute after the explosion the greater part of the debris had fallen, the air continued for over two minutes to be obscured with what looked like a mist. Although telephone wires were torn from the posts opposite the explosion, the blast was not sufficient to throw down the posts themselves. The water of the canal overflowed the surrounding country for a thousand yards in every direction, and fragments of the ship were distributed over a circle 1,200 yards in diameter. The enormous downward thrust of the explosion was shown when soundings came to be taken over the spot where the ship had lain. Here was found a huge hole, 73 feet in depth. This is the greatest explosion of dynamite ever recorded, the nearest approach to it being the blowing up of Hell Gate in 1876, when 50 tons of high explosive was detonated, and the accidental explosion some years ago of 30 tons of dynamite at the port of Lisbon.

HIGH VELOCITIES AND GUN EROSION.

The biggest problem in the development of war material at the present time, is to overcome the terrific erosion which burns out the inner tube of our modern high-velocity guns. The success of Admiral Togo in defeating the enemy by long-range rifle fire has directed attention more than ever before to the advantage of high velocity and big guns. There are two ways in which the punishing range of the gun can be extended; one is by increasing the velocity of the projectile, and the other is by increasing its weight. The disadvantages of increasing the weight are that less ammunition can be carried per gun, and that the loading of the gun is somewhat slower and its rapidity of fire is reduced. On the other hand, if the muzzle velocity be increased, the same striking energy can be developed at the same range without any increase in the weight of the projectile, and if a powder containing a high percentage of nitroglycerine be employed, there need be no serious increase in the weight of the charge. The United States government prefers to use a powder with less nitroglycerine than is present in the English cordite; but although it has succeeded in obtaining as high, and a little higher velocities at the proving grounds, this result is gained at the cost of using a powder charge that is over twice as heavy, the cordite charge for a 12-inch gun weighing 141 pounds, and our nitrocellulose charge weighing for the same gun, 350 pounds.

Nature, however, demands a heavy toll from those artillerists who seek to secure greater range by higher velocity; for in order to secure high velocity, the powder pressures within the gun must be raised to such a degree that the corresponding temperature plays the Old Harry with the inner tube, the white-hot gases melting it away, just as a block of ice is melted by a stream of boiling water. Up to a certain limit, pressures and temperatures may be raised and velocities increased without serious injury to the lining of the gun; but above that point the inner tube begins to deteriorate, the rifling is burnt out, the projectile fails to rotate on its axis, and begins to tumble end over end in its flight.

We do not hesitate to say that to-day the greatest problem in the development of artillery is the prevention of gun erosion.

There are no great mechanical difficulties to be encountered in getting high velocities. There are to-day at Sandy Hook under test by the Board of Ordnance of the army, two 6-inch wire-wound guns, each of which has shown muzzle velocities far in excess of anything that is used either ashore or afloat to-day. One of these is a design by Gen. Crozier, the present head of the Bureau of Ordnance, and the other is the well-known Brown wire-wound gun, the distinguishing feature of which is its inner core of laminated steel plates. We have before us some of the results that have been obtained during the tests of the latter gun at Sandy Hook. These include sixty-five rounds fired with powder charges of from 32 to 72 pounds, with corresponding muzzle velocities of from 1,913 feet per second to 3,380 feet per second, and with powder pressures ranging from 12,274 pounds per square inch to 43,370 pounds to the square inch. The high velocity of 3,123 feet per second was reached in the fourth round, and in the rounds from that up to the sixty-fifth round the velocities have ranged from 3,200 feet per second up to 3,380 feet per second, and most of them have been over 3,300 feet per second. We understand that structurally the gun has shown no signs of weakness whatever; and the indications are that, were it not for the erosion troubles, the pressures could be carried up to 3,500 feet per second, and the gun would prove to be perfectly well able to carry these velocities in service. Unfortunately, in both this gun and the Crozier gun, which has been tested simultaneously with it, that universal enemy of the artillerist, erosion, is getting in its destructive work. Thus we are once more reminded that the question of the ultimate practicable velocities of our guns is a question for the chemist, the metallurgist, and the powder expert to determine. We are squarely up against the fact that our steel makers cannot provide an inner tube that will endure the terrific heat engendered by modern smokeless powders. Furthermore, our artillerists admit that they do not know what is the exact explanation of erosion, whether the action is mechanical or chemical, or both. This is a field that will well repay investigation. The remedy may be found in the projectile, or in the tube or liner, or in the powder; but probably a careful study of the question of proper obturation will give the quickest solution of the difficulty.

THE ELECTRICAL VALUE OF WIND POWER.

The electrical utilization of wind power has obtained considerable popularity in Europe, and for several years now the Danish government has been conducting a series of experiments with windmills, to ascertain the relative amount of electrical power that can be generated thereby. In this country similar experimental tests have been tried, and although the instances are not numerous and are somewhat isolated, the data furnished indicate a useful future for this form of prime mover. This is particularly true of the agricultural regions of the West, where innumerable windmills have been constructed in the past ten years for irrigating purposes. The question of harnessing these windmills to motors for the generation of electric light, and even power, is likely to receive the attention of the farmers within the next few years.

Probably one of the first experimental efforts made to utilize wind power for generating electricity was that of Dr. Charles F. Brush, the inventor and pioneer in electrical experiments, who installed a windmill plant at his home in Cleveland in 1889, to light his house and laboratory. This windmill generating station is in use to-day, and during its sixteen years of operation, has furnished an excellent example of what may be expected of windmill motors in that section of the country. The fact that the wind power and variation differ considerably in the several States should be taken into consideration, and the value of this form of prime mover may prove more profitable in one section than another. The constant or average wind velocity for the year must be considered, rather than for a month or season.

The simplicity of the windmill generating plant is one of its chief features. In Dr. Brush's plant the dynamo is connected by pulleys, so that fifty revolutions are made to every one of the windmill, and the normal speed of the former is 500 revolutions a minute. In an ordinary wind with a velocity of 8 miles an hour this windmill works the dynamo to its normal speed, developing a load of 12,000 watts. Unfortunately, however, a wind velocity of 8 miles an hour cannot be depended upon steadily in the vicinity of Cleveland, and a storage battery is necessary for equitable operation. The average wind velocity for the United States is given at 8 miles an hour, but in many parts of the country a velocity of only 4 and 5 miles is maintained throughout the summer. The dynamo of the Cleveland plant is arranged to be automatically put into operation at 330 revolutions per minute. The working circuit opens automatically at 70 volts and closes at 75 volts.

In the basement of the house twelve batteries of 34 cells each are installed, and these are charged and discharged in parallel. With each having a capacity of 100 ampere-hours, it is possible to light 100 16-candle-power incandescent lamps. The successful working of this plant for lighting the house and laboratory has demonstrated the value of a windmill generating set for light loads.

The question of the general construction of the windmill itself has been the subject of considerable experiment. In this respect the Danish experts reached the conclusion that a curved wing would develop nearly twice as much power as the plane wing. This is better stated thus in figures: While the maximum power obtained from a curved wing was 108 gramme-meters per second per square meter of surface, the power obtained from a plane wing was only 42 gramme-meters. Grooved wings gave power equal to curved wings, and this form of windmill wing has been used ever since in all of the Danish tests. Four wings make the most convenient form of windmill in use, and a constant proportion between the length and width of the wings gives the highest results. Thus, to secure the most satisfactory surface area, the width of each wing should be from one-fourth to one-fifth the length, and the greatest width should be about three times as great as the narrowest part. The greatest width of the wing is placed in front, so that the wind is caught and carried toward the center, where it finds ready space for its escape. In such a windmill the tip of the wing should develop a speed 2.43 times that of the wind when working. The windmill plant at Wittkeil, in Schleswig, has demonstrated certain facts that carry out the foregoing statements. In this case the windmill has an enormous wind surface. The diameter of the windmill is about 40 feet, and an effective wing space of nearly 1,000 square feet is presented to the wind. The windmill develops 30 horse-power with a normal speed of eleven revolutions per minute. It operates a shunt dynamo that makes 700 revolutions per minute, and develops 160 volts and 120 amperes. This full load is developed when the wind is blowing at the rate of about 8 miles per hour. The windmill furnishes electricity to light the town of Wittkeil, and small motors and lamps are connected to the storage battery, which maintains a voltage of 110. The battery has a capacity of 66,000 watt-hours. This plant has proved so satisfactory that it is being enlarged, and as a permanent lighting station it is likely to prove of unusual importance in the development of modern electricity by windmills.

In the adaptation of the windmill generating plant to commercial purposes in this country, experiments have taken some peculiar forms. In order to eliminate the storage battery, the windmill must be able to store up its energy in some other way. A number of methods to do this have been suggested. At present the extra cost of constructing the storage battery makes the initial cost of the plant more expensive than the first cost of an oil or steam-driven plant. After the first installation the cost of operation is very little, and if it were not for the constant oversight required of the storage battery, the plant would work entirely without any watchman. The storage battery requires the attention more or less of an electrical expert, and the labor question enters into the problem of operation. By eliminating the storage battery, the cost of installation, the repair items, renewals, and the labor item would all be reduced. One patent tested in this country was to utilize a compressed-air plant in connection with the windmill. The dynamo is direct-connected to the air compressor, and the power thus stored up could then be utilized as needed. But in this case the extra amount of mechanism increases the cost of installation even more than the storage battery. The compressor, moreover, requires pretty constant watching, and the windmill generator thus approaches no nearer the self-regulating and operating machine than before.

Another method has been employed, which appears to contain some possibilities for the Western farmers, where windmills are already in use for pumping water for irrigating purposes. By means of storage tanks, the windmill pumps the water to a great height, and then the pressure developed by the falling water is utilized for driving a water turbine or wheel. In this case the dynamo is driven very much like any hydraulic generating plant, and ordinary motors and generating sets could be adapted to the work. The turbo-generating method of utilizing the windmill for electrical development would require nearly as much expense for initial installation as any of the other methods, but once in working order it would prove purely automatic and self-regulating. The great size of the tank required to develop sufficient horse-power to operate the generators is one of the drawbacks to this system. The loss of efficiency would be quite considerable, and the ordinary windmill now in use for electrical generation would have to be increased in size or supplemented by several others. Such a storage tank would, moreover, have to be large enough to hold sufficient water to run the turbo-generators for at least eight or ten hours consecutively. Even then the plant might be put out of work for ten hours or more through the failure of the wind. All would depend upon the average velocity of the wind in the region where the plant was installed. The storage of water by means of windmills in reservoirs on the hillsides has been suggested, thus furnishing an artificial supply of water for hydraulic purposes. In this case a sufficient number of windmills might be installed to pump the water in a huge reservoir that would never be exhausted. The results of such an experiment would certainly prove of interest to engineers, but it is somewhat doubtful if the returns would pay for the heavy outlay of funds for the windmills and the storage reservoir. Yet despite these many serious drawbacks to windmill electrical engineering, it is quite apparent that in the course of time the power of the wind will be used more and more for developing electricity, and with new mechanical methods better results are bound to follow.

ANOTHER NORTH POLE BALLOON EXPEDITION.

According to a notice in the Vossische Zeitung, Marcillac contemplates taking a trip to the North Pole by balloon, similar to that of the unfortunate Andrée. As a safeguard against such accidents as befell the latter, Marcillac intends to carry with him a wireless telegraph apparatus by means of which the balloon will be kept in permanent connection with the starting station.

As regards the technical particulars of the Marcillac scheme, it may be said that the balloon is to be provided with an electromotor capable of evolving driving power during 200 hours, which would be intended either to drive the balloon in the case of weak winds, or to impart to it a course different from the direction of the wind. The balloon is to receive from 5,000 to 5,500 cubic meters of gas, supplied by a novel apparatus in the car. Several instruments have been constructed by Marcillac especially for this expedition—for instance, an amenoscope for investigating the air currents; a velometer for measuring the speed of the balloon; a horn intended to give acoustical signals; and finally, what he calls a "thermogen," viz., a special device for counteracting the influence of the polar cold on the gas of the balloon.

Spitzbergen is to be chosen as starting-point, as in the case of the Andrée expedition. The cost of this trip is estimated at 90,000 francs, while that of the Andrée expedition was about double the above amount.

THE PREVENTION OF "COLDS."

Now that the season for "colds," coughs and neuralgic pains is with us, the careful man is on the lookout for such preventive measures as will guard him against the "eager and nipping air" that may prepare the way for a winter's sickness. It is the proper adaptation to his environment that must settle the question of his immunity against the ever threatening weather ailments.

With the changeable climate of our northern latitudes the task is often a difficult one. Thus a sudden drop in temperature is often followed by a veritable epidemic of catarrhal troubles.

The ordinary phenomenon of a "cold" is explained by a rapid cooling of the surface whereby the superficial circulation is temporarily arrested and internal congestions are produced. The primary effect is generally upon the mucous membranes of the nose, throat, and upper air passages. In consequence of this revulsion chilliness, lassitude, headache, sneezing and cough follow in turn, and the patient becomes generally miserable. Then, when it is too late, he doubts his resisting powers against draughts, cold rooms, undue exposure and the like, and is ready to resign himself to the coddling process for the remainder of the winter. Strange as it may appear, it is this misguided carefulness that explains most of the chronic catarrhs of the season.

First on the list of such causative agencies are our overheated and ill-ventilated apartments. Eminent medical authorities maintain that the sudden change from an overwarmed room to the cold air outside has more to do with the production of "colds" than all other supposed agencies combined. The air passages, after having been dried, and, so to speak, baked in our living rooms, are not only peculiarly sensitive to cold, but are in a condition least liable to resist the influences of the change.

The same principle might apply to overheating the body by too much clothing and enfeebling the skin by confined perspiration. The exact contrary condition results from inurement to low temperature and the creation of a habit of natural resistance. The man who is accustomed to bare his throat to the blast never suffers from tonsilitis, and the one who is used to the cold morning plunge never knows a shiver, even in zero weather. The real moral is to face the cold with a bold front, to conquer rather than to shrink from it and be overcome in the end. The hardened man makes his skin an ever-ready adjuster to all variations of temperature. The feebler one can approach such a state of protection and may in the end equal it.

A like principle applies to exercise. With ordinary garments the well individual never suffers from cold while in motion, but the one who sits or lies in a cold room or in a draught from open door or window is sure to become a victim of his indiscretion.

These are simple enough rules in themselves, but few think of applying them to individual needs until reminded of their lost opportunities.

The worst of all is that a "cold" taken in early winter is apt to linger and thus prepare the system for even more distressing ailments. The very lack of vital resistance that invites the first attack of catarrh is apt to intensify the predisposition to subsequent colds. This in a great measure explains the prevalence of pneumonia during the inclement season. The microbe never attacks a healthy membrane, but lies in wait for the local debilitation which furnishes the soil for the seed.

No more forcible argument could be used in favor of preventive measures against the slightest respiratory trouble that may show itself at this time. Nothing lowers the vital resistance against all winter diseases more than the initiative and apparently insignificant "cold."—N. Y. Herald.

SCIENCE NOTES.

An important item in the extension of the work of the Bureau of Chemistry has been the establishment of inspection for imported food products. As a result food products imported to this country have been greatly improved. In former years the United States was regarded as the dumping ground for the refuse teas of the commerce of the world. Many years ago, in order to overcome this evil, a system of inspection of imported teas was established and has since been maintained. Under the beneficent working of this system Americans are now certain of being able to purchase pure and wholesome tea, since it is almost impossible for spurious and adulterated teas to find their way into this country. Congress has now extended this system of inspection to all foods, beverages, and condiments imported into the United States. There is every reason to believe that when this system is thoroughly established an improved condition comparable to that which has taken place in teas may be anticipated.

The bactericidal effect of wall-paints has been studied ately by Dr. Beaufils (see Revue Générale des Sciences) according to the following method: A layer of paint having been spread out on wooden boards or glass plates, a culture of microbes was placed on this layer after being dried, and the plate thus prepared was kept in the laboratory protected against dust. At regular intervals some microbe colonies were removed and spread out on an appropriate medium or used in inoculating animals. An unpainted check-plate served to ascertain the action exerted by the paint on the vitality and virulence of the microbes, this action being shown generally to be distinctly bactericidal while varying according to the nature of the painting. The colors of enameled porcelain are for instance found to be much more active than oil colors, especially in regard to the bacillus of tuberculosis. The fact that these paints exert a constraining action on the latter bacillus would seem to be the most important practical result of these researches.

When chloride of silver is exposed to sunlight it assumes a violet tint and gives off chlorine. A chemical change thus occurs, and the change of color must be attributed to the formation of a new compound. But there seems to be a great difference of opinion as to the nature of this effect. D. Tommasi, in taking up the question, considers that the chloride of silver, under the influence of the rays, undergoes a partial decomposition which is proportional to the surface, the exposure, and strength of the light. A very small quantity of silver chloride is transformed into Ag_2Cl or Ag_4Cl_3 (this chloride has been directly obtained by Von Bibra) which is finally decomposed into silver and chlorine by a long exposure to the sun, so that the violet chloride of silver contains variable quantities of $Ag\,Cl$ and the two chlorides mentioned above, and also metallic silver. As there are some differences of opinion as to many of the properties of silver chloride, M. Tommasi undertook the study of these properties, and gives the following results. The white chloride of silver when exposed to the sun in a glass-stoppered flask containing water saturated with chlorine, in a short time acquires a slight violet tint which does not become any darker on a long exposure. Here a state of equilibrium is formed between the action of the light upon the white chloride and the action of the chlorine upon the violet chloride, which has the effect of preventing the light from blackening the white chloride, and the chlorine to bleach the violet chloride. Again, dried white chloride in a sealed glass tube becomes violet when exposed to the sun and becomes white again when the tube is placed in the dark. When the dry violet salt is shaken with chlorine water in the dark, it whitens in a short time. He also finds that when the violet chloride is boiled with nitric acid, it is not bleached. Bromide of silver acts in an analogous manner, but the iodide is not affected by exposure to the sun.

THE VISITING BRITISH FLEET.

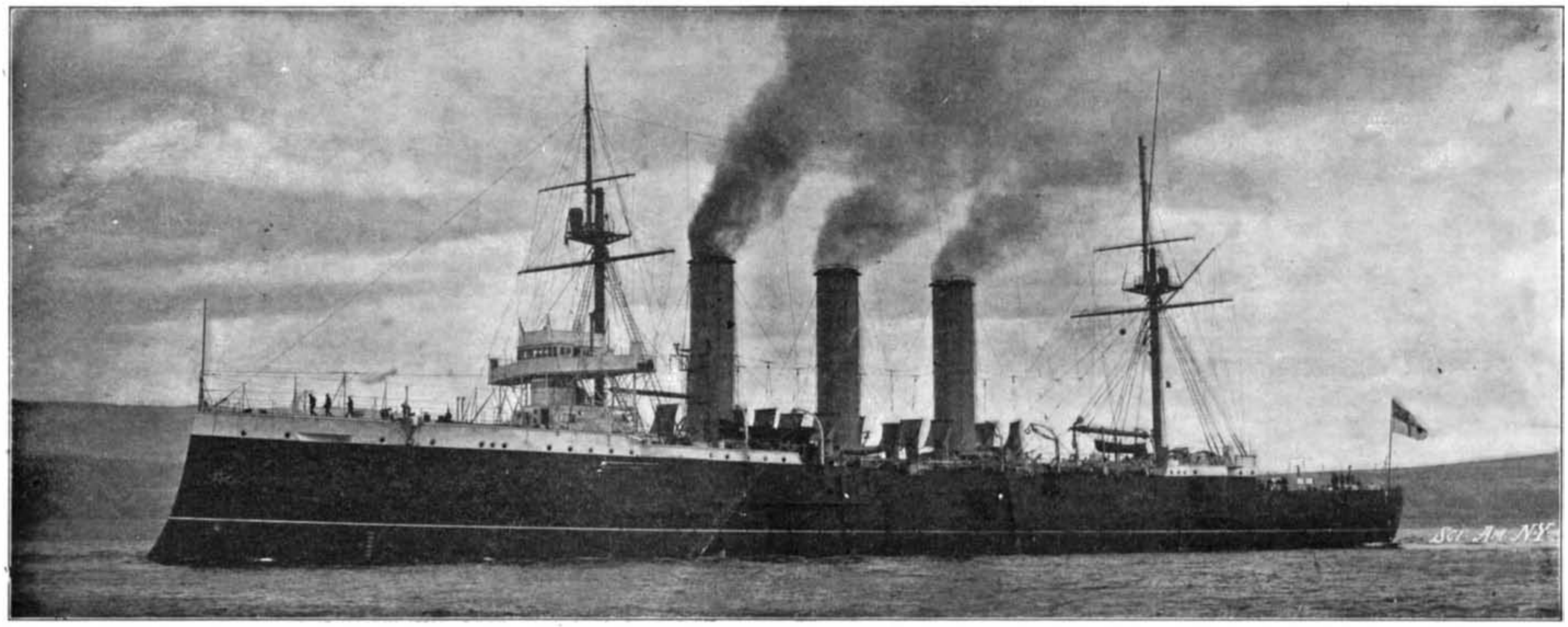
The presence of a British squadron of six armored cruisers in American waters under the command of Prince Louis of Battenberg has been marked by a round of festivities and social functions, that were intended as a national response to the special courtesies extended to the United States warships whenever they are in English ports. Unquestionably, the most striking feature of the visit was the imposing spectacle presented by the presence of this squadron and of the second and fourth divisions of the United States North Atlantic fleet in the North River, where the vessels were anchored in a long line, which stretched from opposite Grant's Tomb to opposite Fifty-second Street, a distance of over two and a half miles. In the line as thus formed were eighteen battleships and armored cruisers, practically all of them of modern construction, and most of them embodying the latest ideas of armament and armor protection that prevailed at the opening of the late Russo-Japanese war. At the head of the American line, opposite Grant's Tomb, were four of the six handsome vessels o[illegible] our latest armored cruiser class, the "Maryland," "Colorado," "Pennsylvania," and "West Virginia." Then followed eight battleships: "Massachusetts," "Iowa," "Illinois," "Alabama," "Kentucky," "Kearsarge," "Missouri," and "Maine," the "Maine" being the flagship of Admiral Robley D. Evans. Immediately astern of the "Maine" was H. M. S. "Drake," the flagship of Prince Louis of Battenberg, and astern of her were five identical armored cruisers of the "County" class, namely, the "Berwick," "Cornwall," "Essex," "Bedford," and "Cumberland."

The ships of the visiting squadron possess particular interest, because of the fact that they represent some of the very latest ships that have been put into commission in the British navy, and for the reason that the flagship invites comparison with our armored cruisers of the "Pennsylvania," class, which were anchored a mile or so further upstream. The "Drake" is one of four armored cruisers built in 1901, the others being the "King Alfred," "Leviathan," and the "Good Hope." All four of the vessels showed excellent speed on their trials, exceeding 23 knots an hour, while the "Drake" itself, after being fitted with new propellers, made for several hours a speed of 24.1 knots an hour, which constitutes her the fastest armored warship afloat to-day. Her dimensions are length 500 feet, 71 feet beam, and 26 feet draft; and as these dimensions are so nearly those of the four United States armored cruisers anchored in the same line, a comparison is of considerable interest. The "Pennsylvania" is 502 feet long by 70 feet broad, with a draft of 26½ feet. The "Drake" displaces 14,100 tons, as against 13,400 tons for the "Pennsylvania." The armor protection of the "[illegible] is superior, as she carries 2,700 tons again[illegible] tons for the "Pennsylvania." The "Penns[illegible] showed 22.4 knots for 27,750 horse-power [illegible]st 24.1 knots for 31,450 horse-power developed on the "Drake." In a comparison of armament the advantage lies somewhat with the "Drake" with two 9.2-inch guns and sixteen 6-inch guns against four 8-inch guns and fourteen 6-inch guns on the "Pennsylvania"; but we prefer the method of protection adopted for the "Pennsylvania," inasmuch as the guns on the gun deck are mounted within a continuous wall of armor, whereas on the "Drake" these guns are protected by isolated casemates.

It is interesting, just here, to compare the armored cruiser classes of later design now under construction for the respective navies. The United States has four vessels of the "Washington" class, which, with practically the same protection as the "Pennsylvania" class, are armed with four 10-inch and sixteen 6-inch guns, the displacement of the ships being 14,500 tons, and the speed 22 knots. These ships may be compared with the British "Warrior" class, of 13,500 tons and 22 knots estimated speed, which are to carry six 9.2-inch guns and four 7.5-inch guns. It is noticeable that the contract horse-power has been reduced from 30,000 in the "Drake" class to 23,500 in the "Warrior" class, the speed and the horse-power being about the same as that called for in our own "Washington" and "Tennessee."

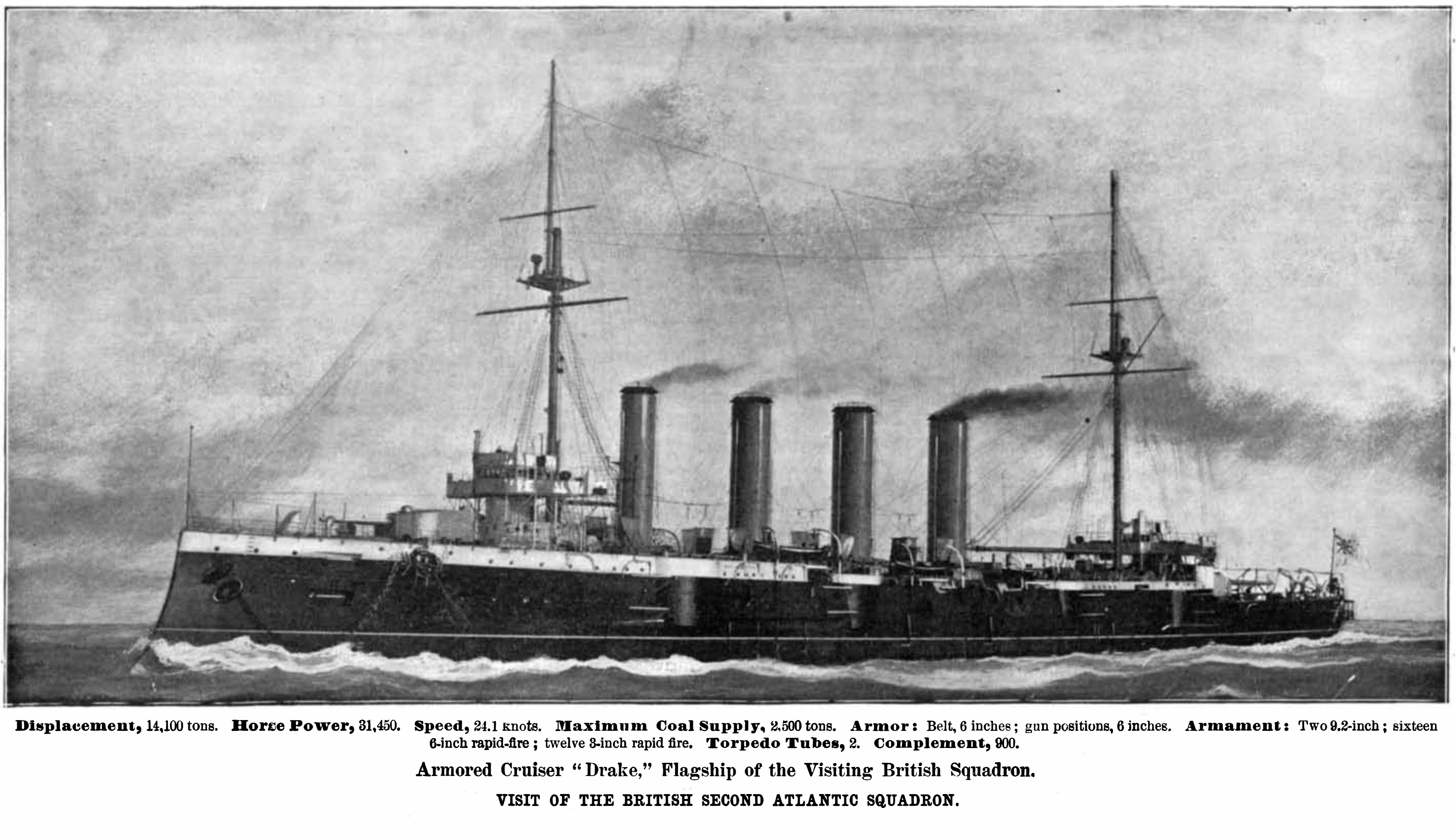
The five cruisers moored astern of the "Drake" belong to a class of ten ships known as the "County" class. The whole ten have been completed, and have had their trials and are now in commission. The vessels with which they are most nearly comparable in our own navy are the semi-armored cruisers "Charleston," "Milwaukee," and "St. Louis," and the reader can compare these vessels for himself by means of the accompanying table. Taking the "Berwick" for her class, her dimensions are length 440 feet, beam 66 feet.

(*Continued on page 399.*)



Displacement, 9,800 tons. **Horse Power,** 22,680. **Speed,** 23.6 knots. **Maximum Coal Supply,** 1,600 tons. **Armor:** Belt, 4 inches; gun positions, 5 inches. **Armament:** Fourteen 6-inch; ten 3-inch; eleven smaller guns. **Torpedo Tubes,** 2 submerged. **Complement,** 678.

Armored Cruiser "Berwick." Also "Cornwall," "Essex," "Bedford," and "Cumberland."



Displacement, 14,100 tons. **Horse Power,** 31,450. **Speed,** 24.1 knots. **Maximum Coal Supply,** 2,500 tons. **Armor:** Belt, 6 inches; gun positions, 6 inches. **Armament:** Two 9.2-inch; sixteen 6-inch rapid-fire; twelve 3-inch rapid fire. **Torpedo Tubes,** 2. **Complement,** 900.

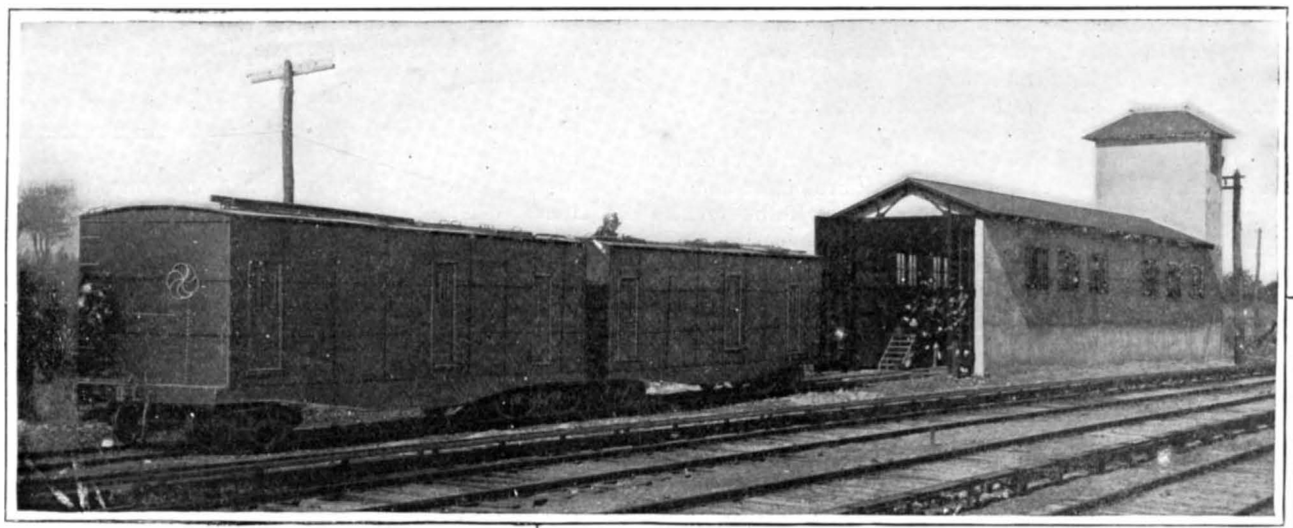
Armored Cruiser "Drake," Flagship of the Visiting British Squadron.

VISIT OF THE BRITISH SECOND ATLANTIC SQUADRON.

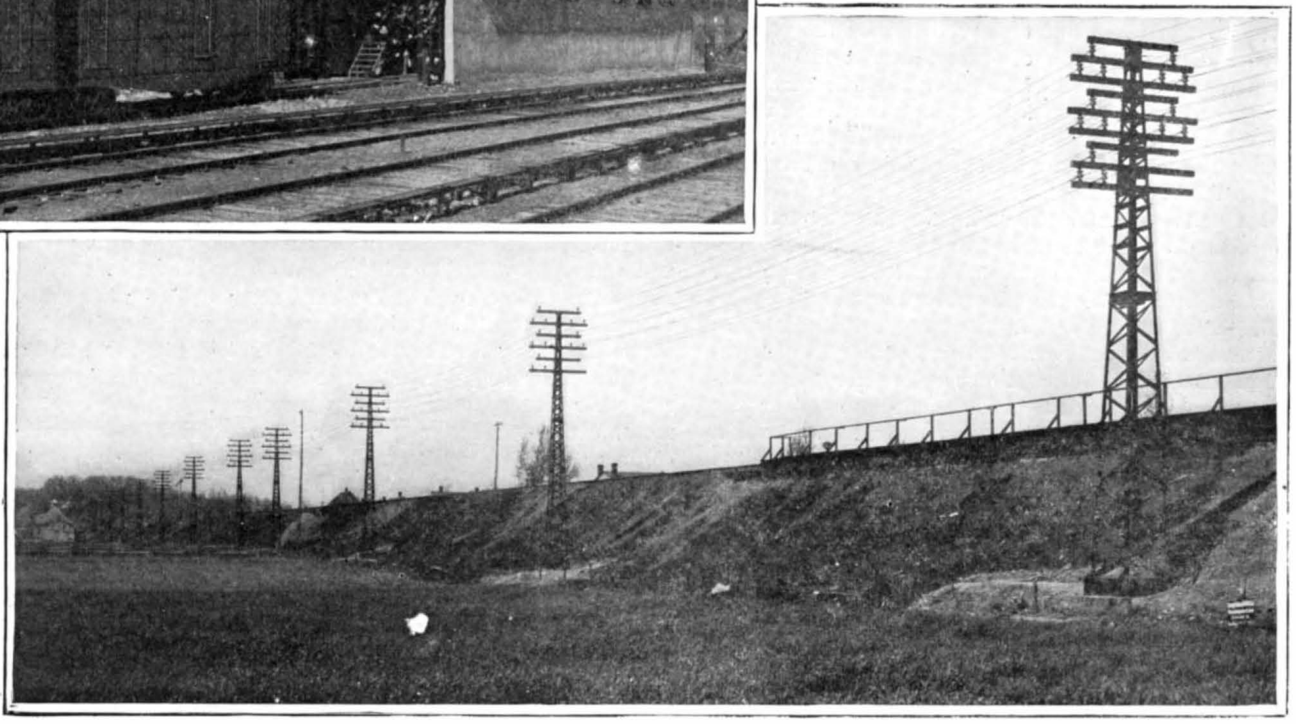
THE LONG ISLAND RAILROAD ELECTRIFIED.

BY A. FREDERICK COLLINS.

The gigantic undertaking of converting the Long Island Railroad from a system using steam to an electrically-operated one marks the beginning of a new era in transportation in this country, for it is the first time in the history of railways and electricity that the feat has been accomplished. Quite true it is that the New York Central will exceed it in magnitude, but it will be at least two years before the work now going on will be completed, while the steam locomotive has already given way to the electric motor car on a large section of the first-named railroad, the inauguration having just taken place.



Two Portable Sub-Stations and Shelter House for Same.

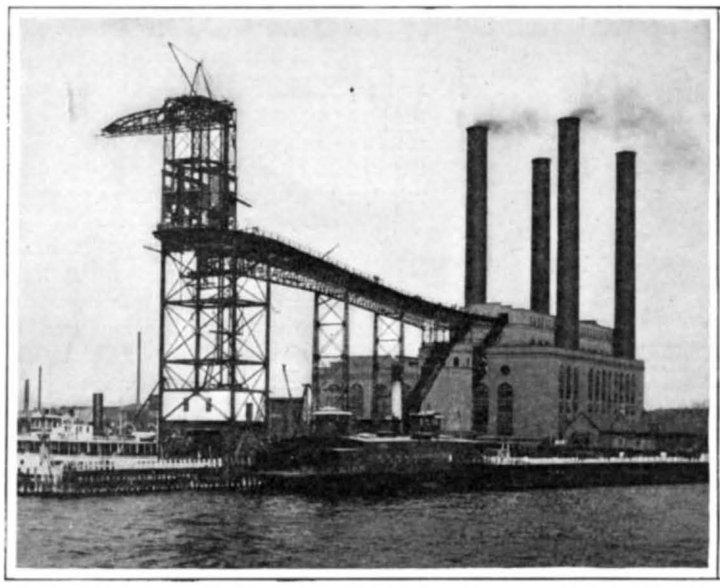


View of Trunk Transmission Line Between Long Island City and Woodhaven Junction, Showing Latticed Steel Poles.

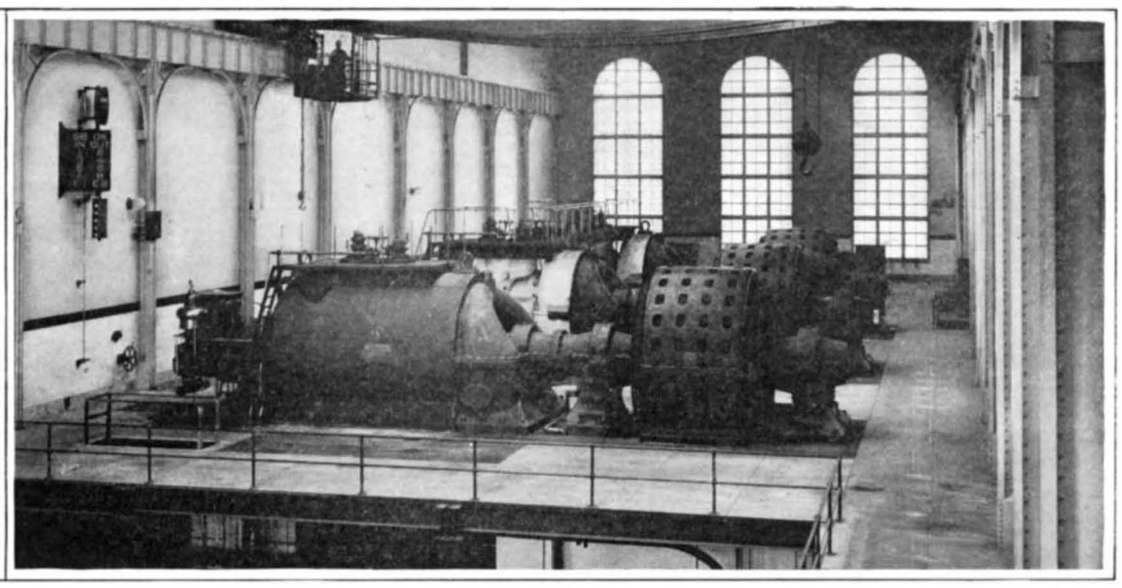
At the present time there is in operation a total mileage, when reduced to a single-track basis, of 97.5, and this is divided among the routes between Flatbush Avenue, Brooklyn, and the Belmont race track; between Ozone Park and Rockaway Park, and between Jamaica and Springfield Junction. During the next few months other portions of the road, or specifically, from Hammel to Springfield Junction, will be similarly electrified, while the line from Long Island City to Port Washington, and a short feeder from Whitestone Landing to Whitestone Junction, will be ready within a year and a half.

The progress and extensions of the electrification of the Long Island Railroad may be seen by referring to the map shown on page 398, and its inspection will serve to indicate in a measure the complicated nature of the traffic involved; thus there are two important terminals in the Borough of Brooklyn, and the roads leading from these form a network of lines over which there is conducted a heavy through as well as a suburban service. The Flatbush terminal connects directly with the Brooklyn Rapid Transit elevated lines, and these in turn lead to the Brooklyn Bridge and the Broadway Ferry. When the subway and tunnels are completed by the Interborough Rapid Transit Company, under the East River from the Battery in the Borough of Manhattan to Flatbush and Atlantic Avenues, Brooklyn, the new electric road will also connect with them, so that passengers arriving at the Flatbush Avenue terminal from points on Long Island will be favored with a short and quick route to the heart of Manhattan's financial district.

The extent of the service may be in a measure judged, when it is stated that on the Atlantic

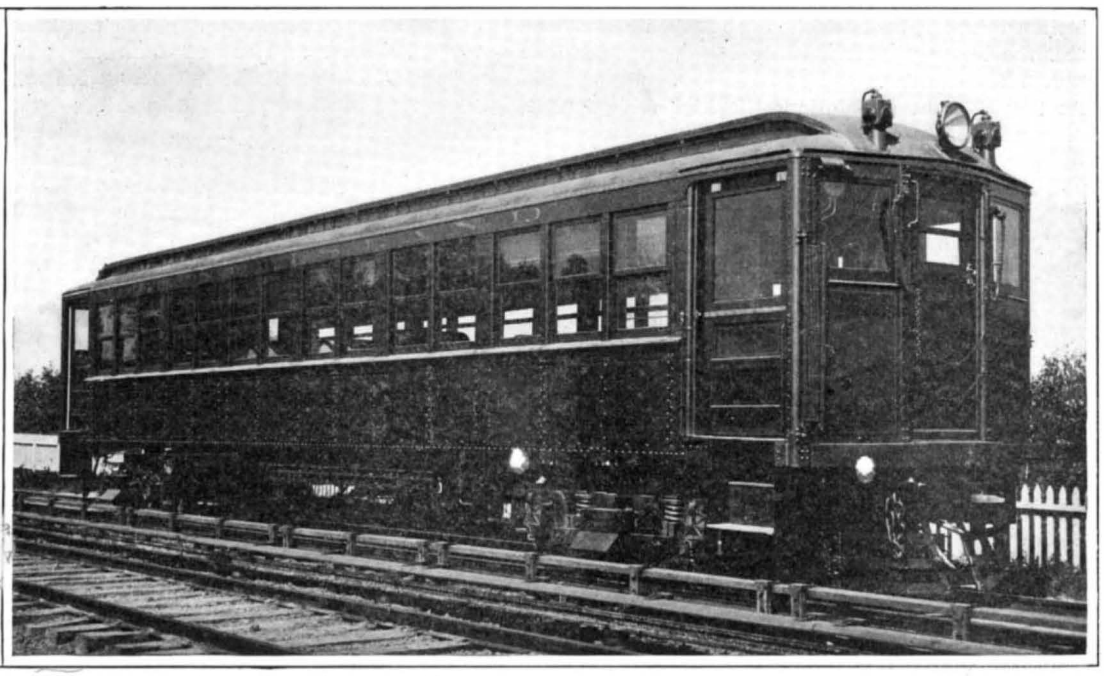


Long Island City Power Station and Huge Gantry Crane for Loading Coal from Barges.



View of Engine Room Floor, Showing 7,500-Horse-Power Steam Turbines Direct Connected to 5,500-Kilowatt Generators.

Steel and Concrete House for Housing Two Portable Sub-Stations.



One of the New All-Steel Motor Cars.

ELECTRIFYING OF THE LONG ISLAND RAILROAD.

Avenue line trains are not only run from the suburban towns on either shore of Long Island, but a large local business is also done in carrying passengers from Flatbush Avenue to Jamaica, besides a heavy excursion traffic to Rockaway Beach and to the race courses at Aqueduct, Metropolitan, and Belmont tracks. When the Pennsylvania Railroad Company completes its elaborate plans, another extension of the electric service will probably be found necessary; but with the Long Island's great project finished, it will be an easy matter, compared with the present change from steam to electricity, to equip as much of the remaining road as may seem desirable.

The current for operating the trains of the entire system is generated at the new power house on the water side at Long Island City, consequently it is located at a point on what may be termed the circumference of the network of lines which it is to feed; however, it is intended that power shall be furnished from the central station for operating the trains under the East and North Rivers when the Pennsylvania terminal and tunnels are done, and this will bring the power house a little nearer the geographical center of the entire combination of lines as contemplated in the present scheme of these two great railways, while from the standpoint of the distribution of its energy, it will approximate very closely its center.

The chief feature of the power house installation is a double tier of thirty-two boilers, each of which develops 520 horse-power, while space is reserved for sixteen more of the same size. Immediately over the boiler room are the coal bunkers, and these have a capacity of 7,000 tons; coal is brought up alongside the building on barges, when it is conveyed 110 feet to the top by a large gantry crane carrying an automatic scoop bucket holding 3,000 pounds. The coal is then automatically broken, cleansed, and weighed, when it is ready for the boilers, to which it is conveyed and fed by automatic stokers. In the engine room there are three Westinghouse-Parsons steam turbines, having a capacity of 5,500 kilowatts, while ample room is provided for increasing the number of units when the entire system is electrified. The turbines are direct connected to three-phase alternating-current generators, and these deliver the electrical energy to the transmission lines at 11,000 volts. From the high-tension lines the current is distributed to the sub-stations, of which there are five located at convenient places. The transmission cables are carried throughout the system in three different ways. They are either carried underground in conduits, or they are suspended on steel poles, while on other routes the distribution is by the third rail.

Starting at the power house, the high-voltage lines are laid in conduits, and by this means are taken underground through Long Island City until the yards of the railroad are reached, when they are permitted to emerge, and from this point on, north to south, that is to Woodhaven Junction and thence beyond to Beach Channel, they are strung overhead on latticed steel poles, as shown in the illustrations. At Woodhaven Junction there is located a sub-station, and from this point the transmission lines radiate to the east and west, running in the first instance to Flatbush Avenue terminal, and in the last to Dunton; in this case the cables are laid in conduits, as are those from Beach Channel to Hammel. The high-tension lines from Dunton to Belmont race track and from Rockaway Junction to Springfield Junction are suspended on steel poles, the latter wherever utilized being mounted on concrete foundations.

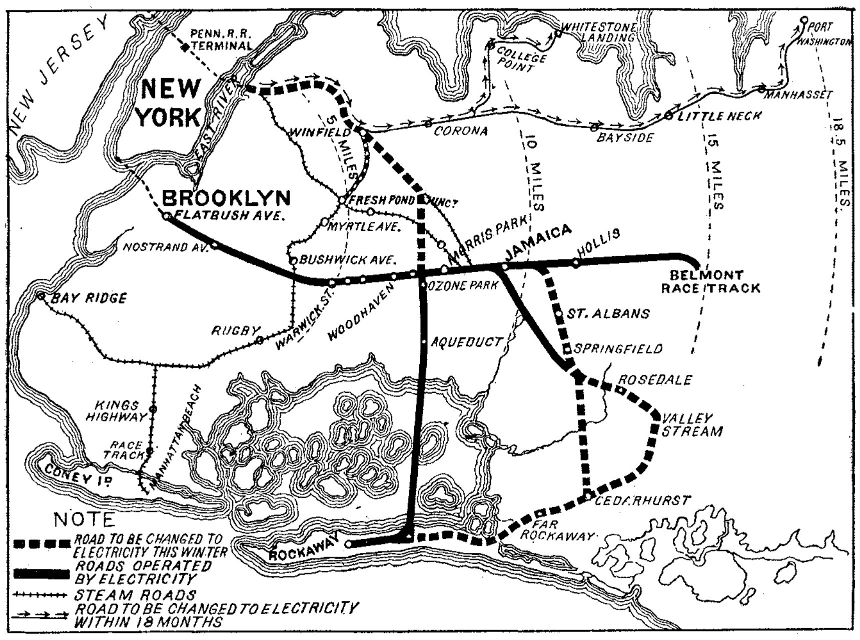
At the different sub-stations the high-voltage alternating current is converted into a direct current of 600 volts by static transformers and rotary converters. It will not be necessary to enter into the details of the sub-station equipments; suffice it to say that they represent the most advanced construction.

A novel feature of much importance is the introduction of portable sub-stations; each of these comprises a steel car of the usual design fitted with three static or alternating-current transformers and a 1,000-kilowatt rotary converter. These movable units have several uses, the principal ones being to augment the capacity of the stationary sub-stations, and to maintain the potential at any point where the traffic might become spasmodically heavy, as it often does at the different race tracks.

The railway equipment is of standard third-rail construction, the rolling stock being similar to and capable of being interchanged with those of existing elevated and subway lines, as well as the Pennsylvania surface and tunnel lines now under construction. Since the Long Island Railway is a third-rail system, and at the same time a surface road, it is obvious that the feeder rail must be well protected, so that pedestrians can not by any possible chance come in contact with it. The third rail is laid 27 inches from the gage line of the track to its center line, the top of the rail projecting 3.5 inches above the top of the track, this arrangement being standard with the roads previously mentioned. At given intervals sleepers extend beyond the track, and the rail is sustained in its position by vitrified clay insulators.

The rail is covered its entire length, except where it passes over grade crossings and in front of stations, by a wooden plank that is supported about 4 inches above it by wooden uprights that are placed outside the rail. At the crossings, but well within the line of protecting fences which inclose the entire right of way, the third rail terminates in a broad sloping shoe, the electrical connection being kept intact by a heavy insulated wire carried under the street or road, as the case may be, in a conduit, making connection with the third rail on either side.

At the present writing the rolling equipment consists of 150 motor cars, built entirely of steel, and these are operated in trains of five cars each. It is the intention of the officials, however, to make up the trains of motor and trail or ordinary cars, that is, a five-car train will have three motor cars and two trail cars, while an eight-car train will consist of five motor cars and three trail cars. All the cars are provided with the pneumatic multiple unit system of control, and each car is fitted with two motors of 200 horse-power each, both the latter being placed on one of the trucks, while the other and opposite truck is motorless. The steel motor cars were designed by Mr. George Gibbs, chief engineer of Electric Traction for the Pennsylvania, New York and Long Island railroads.



MAP SHOWING THE ELECTRIFIED LINES OF THE LONG ISLAND RAILROAD.

Since the cars were designed to be interchangeable with those of Manhattan subway and other New York and Brooklyn roads, and were yet required to run on the surface over the Long Island route, it was necessary to provide a special combination platform that would be flush with the floor of the car as in the subway, and to enter or alight at rail level, as over the route for which they are primarily intended. Each of the motor cars weighs 83,000 pounds, and can easily maintain a speed of 55 miles per hour if required, or at the rate of 25 miles per hour they can keep a schedule which includes stops of 1.6 miles apart.

Provision has been made by which the current is cut off and the air brakes applied the instant the motorman's hand is removed from the controller, and this device is an important safety factor, for should illness or death overtake him while in charge of a train, it would simply stop. To keep the heart of the railroad, that is, the power house, in constant touch with all its various ramifications, an elaborate system of telephony has been installed; the telephones are similar in design to those employed by the police of New York, and boxes are located at intervals of 2,000 feet along the line. Besides these precautions against accident, a comprehensive installation of the most efficient type of block signals has been put in. To facilitate the work of inspecting the railway and its various subsidiary appliances, two gasoline track automobiles are used; these are capable of carrying four men, together with all necessary tools and supplies. They are powerful enough to make 30 miles per hour, and light enough to be lifted from the track by two men.

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To meet the effects of sea-water on cast-iron piles, and for other reasons, it is a common and good practice to make the lower lengths of greater thickness—say, ⅜ inch more—than that sufficient for the upper. Occasionally, also, the bottom lengths are filled with concrete, which no doubt adds to the length of time during which they may be relied upon.

Motor Cars in Hungary.

So far, the trade in motor cars has not acquired any great degree of development in Hungary, although within quite recent dates a marked upward movement has been noted. Hungarian industry is still too immature to enable it to supply the public with cars that would in any way be capable of competing with foreign builds. Recently a cart and wagon factory at Gyor opened an automobile section, and is reported to have made an arrangement with a large French firm for the supply of all the necessary parts. In addition to this, Mr. Rokk Gstvan, an important Hungarian industrial, has recently secured an order for the supply of light cars to the Hungarian postal authorities. Be this as it may, many years will still have to elapse ere the means (tools, plant, etc.) at the disposal of national industry will be such as to admit of the inauguration of a "motor car industry" worthy of the name.

Hitherto, French cars have been most used by the Hungarian public; this is due to the fact that the leading firms (Peugeot, Delaunay-Belleville, Dietrich, Panhard-Levassor, Darracq, Bayard-Clément, and Dion-Bouton) are all well represented at Budapest.

England, Austria, Germany, Italy, and America, are also making great endeavors to create a market in Hungary for their cars. An Italian (Turin) firm has lately succeeded in placing some of its builds, while Germany is doing fairly well with Mercedes cars, due to the push and energy of the firm's representative at Budapest, viz., Mr. Arnold Spitz, who has also a branch at Vienna. Smart advertising in trade papers has had much to do with the popularity of the German Mercedes cars.

A motor exhibition was held at Budapest last month, and exhibits were made by the following firms: French, Dion-Bouton; German, Appel-Darracq; and American, Oldsmobile. Altogether eighty-eight cars were shown, and thirty-seven of these were sold. In spite of the bad weather which prevailed the total of paying visitors amounted to 40,000 persons, and there were many others who had press, advertising, and other free tickets; from this it will be seen that the Hungarian public is taking much interest in up-to-date means of locomotion. The bad state of the roads is one great drawback to motoring in Hungary, but that can easily be overcome. All those who are wise will keep their eyes on this market; judicious advertising in papers devoted to cars that find their way to Hungary, would bring the enterprising speculator just as good results as have been secured by Mr. Spitz and other smart men who don't mind spending a few dollars.

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Neuchatel Steam Turbine Plant.

Neuchatel is an example of a large town having a combined steam and hydraulic plant for delivering current. The hydraulic station at Pré aux Clées became overcharged, and as no more power could be had from the river, it was decided to erect a steam plant in the city, on the border of the lake. After considering the question of gas engines, it was finally decided to employ steam turbines. The boilers are of the water-tube pattern, coming from the Guillaume Works at Neustadt, and provided with superheaters. The boilers have 250 square yards heating surface and the superheaters 70 square yards, the latter being placed under the steam dome. A system of gates allows the flame to pass through the superheaters, or simply through the tubes. Brown-Boveri steam turbines of the well-known Swiss make are used here. The first one which has been installed has some 300 horse-power and makes about 3,000 revolutions per minute. The speed can be varied ten per cent on each side. The dynamo is mounted upon the same base and is direct-coupled to the turbine. It is of very compact shape, carrying two field coils. The condenser pump is worked by an independent electric motor. The steam turbine can be started and set running inside of ten minutes. As to the steam consumption, it is estimated at twenty-five pounds of steam, dry and saturated at eleven atmospheres per kilowatt at full load. The Neuchatel station also contains the dynamos which receive the current from the hydraulic plant at 3,800 volts and transform it to low tension current for the tramway lines.

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Blowing wells, sometimes known as breathing wells, are now being investigated by the United States Geological Survey. The best-known examples of this type of well are found throughout Nebraska. The force of the air current in one of the Louisiana wells is sufficient to keep a man's hat suspended above it. The cause of such phenomena is mainly due to changes in atmospheric pressure.

THE VISITING BRITISH FLEET.

(Continued from page 396.)

COMPARISON OF ARMORED CRUISERS.

	Drake.	Pennsylvania.	Berwick.	Charleston.
Length......	500 ft.	502 ft.	440 ft.	423 ft.
Beam........	71 ft.	70 ft.	66 ft.	65½ ft.
Draft........	26 ft.	26½ ft.	24½ ft.	23¼ ft.
Displacem't.	14,100 tons	13,400 tons	9800 tons	9700 tons
Horsepower	31,450	27,750	22,680	21,000
Speed........	24.1 knots	22.4 knots	23.6 knots	21.5 knots
Coal	2500 tons	2000 tons	1600 tons	1500 tons
Belt..........	6 to 3 ins.	6 to 3½ ins.	4 to 2 ins.	4-in. partial
Gun position	6 to 5 ins.	6½ to 5 ins.	5 to 4 ins.	4 ins.
Total weight of armor..	2700 tons	2219 tons	1800 tons	854 tons
Guns.......	2 9.2-in. 16 6-in. 15 small	8 8-in. 14 6-in. 46 small	14 6-in. 10 3-in. 8 small	14 6-in. 18 3-in. 34 small
Torpedo tu's	2 submerged	2 submerged	2 submerged	—
Complement	900	882	678	564

and draft 24½ feet, the displacement being 9,800 tons. She carries a belt which extends from the bow to the wake of the after barbette, and ranges in thickness from 2 inches to 4 inches. Her armored deck is 2 inches thick, and she has 4 inches of side plating on the lower deck amidships, which decreases to 2 inches at the bow. The armament of fourteen 6-inch guns is carried in two two-gun turrets, one forward and one aft, and in ten armored casemates. These vessels have all easily maintained 23 knots an hour on trial, and they carry a good coal supply. As compared with our own "Charleston," they are better protected, carrying about 1,800 tons of armor as against 850 tons, and they have a higher speed by about a knot and a half. The armament in both cases is about the same, but in each case it is not as powerful as it should have been, the Japanese armored cruisers like the "Asama," of the same displacement, carrying four 8-inch guns and fourteen 6-inch, being greatly superior in gun power. The British have remedied this weakness in the six later ships of the "Devonshire" class, by mounting an armament of four 7.5-inch guns and six 6-inch guns, besides increasing the protection at the water line from four to six inches.

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Analysis of Fertilizers.

The methods recommended by the International Commission are similar to those in use for the determination of phosphoric acid and potash. According to the Zeitschrift für Angewandte Chemie, the commission proposes for nitrogen the Kjedahl-Jodlbacier or Schloesing-Grandear methods as to nitrates; the distillation with magnesia for ammonia, and the Jodlbacier process for total nitrogen in presence of nitrates, and for organic nitrogen in the absence of nitrates. In the latter case the operation may be also conducted by combustion with soda lime. Fodder is to be cut up, broken, sifted, and the following determinations made: Water: Desiccation at 100 deg. C. during three hours for 5 grammes. Crude protein: The percentage in nitrogen is to be multiplied by 6.25, the Kjedahl method. Assimilable nitrogenized principles: The method of Kuhn is to be applied; the gastric juice may be replaced with commercial pepsin. Fats: Exhaustion of 3 grammes of dried matter at 95 deg. C. in the stove by means of ether, and weight of the residue after evaporation of the solvent. When the operation is on the seed-cakes of siccative oils, the desiccation is to take place in a current of hydrogen or of lighting gas. In case molasses is present, it is necessary to first exhaust the water, then dry, and finally estimate the fat. Extractive nitrogenized principles: These are to be estimated by difference. Ligneous principles: Three grammes of substance free from grease are to be boiled successively with 200 cubic centimeters of sulphuric acid (1.25 per cent) and 200 cubic centimeters soda lye (1.25 per cent). Each boiling, continued for half an hour, is to be followed by washing with boiling water. Ash: Five grammes of matter are to be incinerated, the ash analyzed, with a determination of the silica, if the percentage appears abnormal.

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The Current Supplement.

The current Supplement, No. 1559, opens with an article on the peat industry of the United States by A. Frederick Collins. Charles H. Stevenson writes on otter furs. A most thorough discussion of modern turbine pumps is presented. The paper on the perception of the force of gravity by plants is concluded. J. H. Morrison presents another installment of his historical review of the iron and steel hull steam vessels of the United States, selecting as his subject steel shipbuilding. One of the most notable papers read before the South African meeting of the British Association for the Advancement of Science was a paper by Prof. W. E. Ayrton on the distribution of power. This is abstracted in the current Supplement. A. Rigaut presents a lucid explanation of Catalysis. The stature of man at various epochs is considered by A. Dastre in a thoughtful article.

Correspondence.

A Letter from the Inventor of the Hargrave Kite.

To the Editor of the Scientific American:

The untiring efforts of Prof. Langley and his staff in their work on the flying machine cannot be overestimated. No doubt every scrap of experience is safe in the archives of the Smithsonian Institution.

The difficulties encountered are in no way exaggerated, and must steel the hearts of those who can foresee the results that shall certainly ensue.

Plank the dollars, and wire in again while the men are around who helped to amass our present stock of knowledge.

Do not worry and be jealous about what particular spot on the globe the first machine jumps off. Japan or the Argentine is just as likely as Washington, D. C.

Law. Hargrave.

Woollahra Point, Sydney, N. S. W., September 29, 1905.

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A Teacher of Physics on "Teaching Physics."

To the Editor of the Scientific American:

In reply to Mr. Perkins's article on teaching physics, printed in your issue of October 21, I should like to speak on behalf of the pupils and the teachers.

Mr. Perkins says that he "set an examination in physics based upon a well-known college textbook, with questions of a fundamental character, and no more difficult than those asked of freshmen who have completed the first year's college course," and that the results were most discouraging. I infer from the article that these questions were for pupils who had taken physics in our ordinary secondary schools. If so, why should the questions be based upon a college textbook when such pupils have studied only high-school textbooks? And why should they be such as are asked of freshmen, when the average high-school pupil is two years younger? A number of the subjects mentioned, such as angular velocity, susceptibility, and diffraction gratings, are ordinarily not taught at all to high-school pupils, and are not even mentioned in many of the textbooks used; while, for good reasons, many of the other subjects are merely glanced at in passing. At the same time, physics is ordinarily taught in the third year in the high schools, and the difference between a pupil ready for the fourth year in the high school and one ready for the second year in college depends not only upon the two years difference in age and maturity, but upon the fact that the college pupil has had two years more of vigorous school training; that one of those years has been perhaps his most ambitious year, the freshman year in college; that he has been thrown among older persons instead of younger; and that physics has occupied one-third of his attention instead of one-fourth, as in the high school. Furthermore, the freshman taking his closing examination is among familiar surroundings, is usually answering questions set by one who has been his instructor in the subject, and he has just finished the course; while the applicant for college admission is among strangers, under distracting influences, the style of the questions may be unfamiliar, the subjects emphasized may have been slighted by his own teacher, and his course was finished over a year before.

It may be said that the teacher is at fault, at least in not presenting all the subjects mentioned, or in presenting them poorly. I am of the opinion that neither the average pupil nor the average teacher is at fault; but that the fault, if there is one, lies in expecting more than nature is ready to give. And I am also of the opinion that to demand more than nature is ready to give is more grievous than to demand less; the injury is fully as great and the expense is far greater. For some years I have had occasion to read and mark thousands of physics examination papers, written as a rule by pupils at the end of their physics courses, from high schools, parochial schools, and preparatory schools. I have written the questions myself, and have varied them not only to suit the general needs, but as well to test various phases of physics teaching; and have also continuously tested my own pupils, not only as classes but as individuals. From all this the conclusion has been persistently forced upon me that the average teacher asks too much of his pupils in physics; attempts to cover too many subjects or to pursue them too deeply. There is scarcely a subject mentioned in Mr. Perkins's article upon which I should expect in these examinations to get an entirely satisfactory discussion. Can it be that these thousands of pupils and the twoscore or more of teachers are all inefficient? Many of the subjects mentioned are fundamental, yet they are abstruse and beyond the clear conception of the pupils, and have little practical value. The opinion is slowly gaining that it is better to teach that potatoes in boiling water will not cook quicker by turning on more gas than to teach the exact meaning of moment of inertia. The one sticks, and is used through life; the other is evanescent, and is used only by the specialist.

As to the charge of incompetency, I think we must all plead guilty. Not because we have devoted less time or energy to preparation than the Latin teacher has; but because the subject demands more preparation both before and while teaching. The theoretical side of the subject is as broad as Latin, and is constantly changing, while Latin is at rest. At the same time the practical side requires the training of a machinist, a tinsmith, and an electrician, if no others. A thoroughly competent physics teacher should be able to do work in any of these lines as well as the most competent tradesman, because his work is constantly under the inspection of his pupils. For these reasons we are incompetent. If I were to select a year's work to aid me most in teaching, it would be at some trade, although I have had an aggregate of four or five years of practical work as a machinist, a tinsmith, a stationary engineer, an electrical engineer, and a blacksmith.

But, though in this sense incompetent, yet I think the average teacher of physics gives more for his salary than the average man in other professions or trades, not only because of the preparation required, but because of the work actually performed. In Chicago, the physics teacher receives about the same pay as the stone mason. I have worked in armature winding departments where some of the winders received more than I have ever earned as a teacher, although they had no technical knowledge whatever, and I found the work much less tiresome than teaching. That greater competency should not be expected of the ordinary physics teacher under present conditions is shown by the fact that many of them can and do receive more pay at other work for which they are not so well equipped. For some years before teaching I earned more than I ever expect to earn as a teacher, and that at work which, while it is of great value to me as a teacher, yet required no college training, and at work to which I could return at any time.

Therefore, on behalf of the teachers as well as the pupils, to the indictment as a whole I plead not guilty.

So far as the school authorities are concerned, I cannot speak from experience; I can only surmise, as a college teacher can only surmise in reference to the conditions of high-school teaching. Without venturing an opinion as to whether the fault lies with the school officials or with the people behind them, I feel that improvement would result if teachers were placed upon a merit system, and not a time-serving system, as fully as in commercial corporations, without a maximum salary limit; so that there would be tangible inducement for constant exertion and for remaining in the ranks. And this should extend to a consideration of work done outside of schools and colleges. Again referring to myself (for I feel that one's own experience is about all that is of value in such a discussion as this) the work which I have done on the farm, in stores, offices, and courts of law, has been fully as valuable to me as a teacher of physics as the work which I have done in schools and colleges. Other things being equal, one who has spent his life within the walls of schools and colleges as pupil and teacher is surely not as competent to train children to fight the battles of life as he who carries the scars of the warfare.

Finally, I do not think that "a disproportionate stress is put on the laboratory end." The mere fact that the average pupil pursues three other studies which are book studies only is sufficient warrant for homeopathic doses of such study in physics. But, if space would permit, there are many reasons which might be mentioned why laboratory work should not be lessened, even though the apparatus, the conditions, or the teacher may not be perfect.

E. J. Andrews,

Teacher of Physics, Waller High School,

Chicago, Ill., October 21, 1905.

A New Safety Lamp.

A new form of safety incandescent lamp for use in mines has been devised by M. Tommasi. It is intended to be used in mines where fire-damp occurs, also in powder works and localities which contain inflammable dust. Incandescent lamps do not always give a complete security in such cases. When the globe breaks, the filament burns in the air and may throw off glowing particles and also cause sparks which are sufficient to give an explosion. The new lamp avoids all contact of the filament with the air. The incandescent lamp is inclosed in a glass cylinder. The lower part of the cylinder is closed by the lamp-socket, while the upper part has a cap which contains a small stop-cock. The lamp-socket contains a small bellows which, when filled out, causes two contacts to press together. The filling is done by blowing through the stop-cock from a rubber ball. Should the cylinder break, the air escapes and the bellows contracts, breaking the electric contact. When the lamp alone breaks, the partial vacuum produced within the cylinder also causes the bellows to collapse. In either case the current is cut off from the lamp and no damage can be done.

A VISIT TO THE VOLCANO POAS.

BY ALBERT RUDIN.

About twenty-five miles to the northwest of the city of San José, the capital of Costa Rica, is the remarkable volcano of Poas. This is one of the numerous volcanic mountains of the Central Chain, and while not the highest among them, is beyond question one of the most interesting, picturesque, and easily accessible. The degree of activity of the volcano varies from time to time, but since last April the frequency and violence of the eruptions have largely increased, and numbers of them have been clearly observed in San José. Although the writer had visited Poas on several previous occasions, the recent extreme activity of the mountain induced him to make the expedition upon which the accompanying photographs were taken.

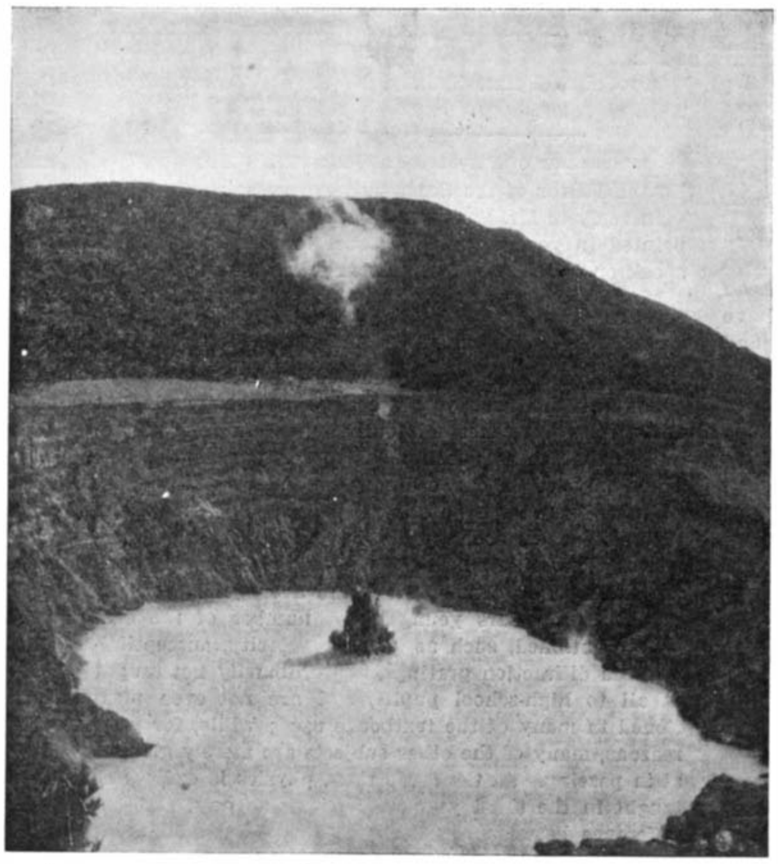
The journey, starting from Alajuela, can be made on foot or on horseback. While the first method is much the better thoroughly to enjoy the trip, it will be found very trying to those unaccustomed to long jaunts of this character, as the way is neither short nor easy. In fact, it takes about ten hours to climb the mountain. For several hours the path to the crater leads through cultivated fields, and when the end of these is reached a further journey of about an hour and a half through a forest brings the traveler to the *potrero*, a large clearing in a hollow, 8,160 feet above sea level. This is in all probability an old crater, which in the course of time has gradually become filled in. A small stream of water possessing a slightly sulphurous taste issues from a chain of ponds and takes a course to the south through the forest. The quantity of sulphur in the water, which is quite harmless as a beverage, is not too great for the existence of animal life, and a species of small toad is often found in it.

After crossing the *potrero* toward the north, the road traverses a second section of the forest. In this the humidity is excessive and constant the year around, and it contains a great number of muddy pools from which a considerable quantity of sulphureted hydrogen gas (H_2S) is constantly rising. It is a peculiar fact that the presence of this gas is limited exclusively to the described locality, and at no other place, not even in the crater itself, has its unmistakable odor been noted. At an altitude of 8,360 feet, a second *potrero* is crossed, and this is succeeded by a short ascent through underbrush. At the end of this short, comparatively open climb, the traveler suddenly and quite unexpectedly reaches the lip of the crater, and with an indefinable sensation of awe and wonder finds himself at the very brink of a vast perpendicular-sided pit of seemingly recent origin, at the bottom of which lies a motionless pool of yellowish water. The sense of deadly stillness and desolation is undisturbed by any indication of life. The almost vertical walls are devoid of even a vestige of plant creation; not a bird wings its way through the air; the surface of the pool is without a ripple, and even the human voice sounds strange and incongruous. Suddenly the silence is broken by a great and startling underground rumbling, and a huge column of a dark-colored liquid is thrown to a vast height from a spot near the center of the lake. The column ordinarily rises to a height varying from 250 to 500 feet. Almost instantly a vast cloud of vapor is evolved which surrounds the column and rises to an immense height.

The crater, which is conical in form, has an extreme altitude of 8,500 feet above sea level. Its upper diameter is about 3,200 feet, and its depth about 1,000, while the diameter of the lake approximates 1,600. From time to time small columns of vapor curl upward from various points of its surface, and sometimes the frequency of these is so great that the entire lake resembles a boiling caldron. The walls of the crater are less steep at the south side, the point at which the traveler has approached it, and only from here is the descent to the bottom possible. Even from this point the undertaking is difficult and even hazardous, and should not be attempted without a guide. By a strange optical illusion, the distance to the lake from the rim of the crater appears vastly less than it in reality is, and a full hour of fairly rapid scrambling is required to make the descent. The scarcely defined path is at times dangerous, running around boulders and along overhanging precipices, and frequently offering the poorest kind of foothold because of its covering of loose and slippery volcanic ash. About half way down is the *"juro del macho,"* a small stream of delicious sweet water.

When the bottom is attained the traveler will find it to his advantage to move about with the exercise of considerable care because of numerous concealed holes filled with a slimy substance, consisting mainly of sulphate of lime with a large excess of sulphuric acid. This hardens in a few moments when exposed to the air, and consequently the pits are covered with a slight shell that renders it almost impossible to distinguish between them and solid ground. If a foot goes through this thin crust, aside from the resulting inconvenience at the moment, it will be found that in a few days the shoe will be destroyed, as the seams cannot resist the acid action.

The lake at closer view is found to be covered with clouds of vapor and it is impossible to see for any distance. Among other gases, sulphur dioxide (SO_2) is present in considerable quantities, and at times the smell becomes almost unbearable. Sulphur is found in numbers of places and the "sand" of the beach is composed almost entirely of rounded bits of this substance. At close range the water is grayish in color, and it is so acid that it almost burns the tongue when tasted. Any dark cloth moistened with the liquid instantly becomes red, and is ultimately destroyed. Chemical analysis of the water reveals large percentages of sulphurous and sulphuric acids, sulphate of lime, and other substances, and it contains besides a considerable deposit of volcanic ash. The temperature at the shore, while varying considerably, ranges around 115 deg. F. During his last visit the writer witnessed some of the largest eruptions ever recorded. During one of these the tremendous column of dark liquid rose to an estimated height of 2,000 feet, and was about 300 feet in diameter. The waves produced on the lake by such an outburst are formidable, and long after the eruption has ceased the roar as they break against the rocky sides of the crater is plainly heard from the edge above. Provided care is taken to select a spot beyond reach of the incoming waves, there is little danger in viewing an eruption from below, and the sight is one that the observer, thrilled with fear and excitement, will never forget.

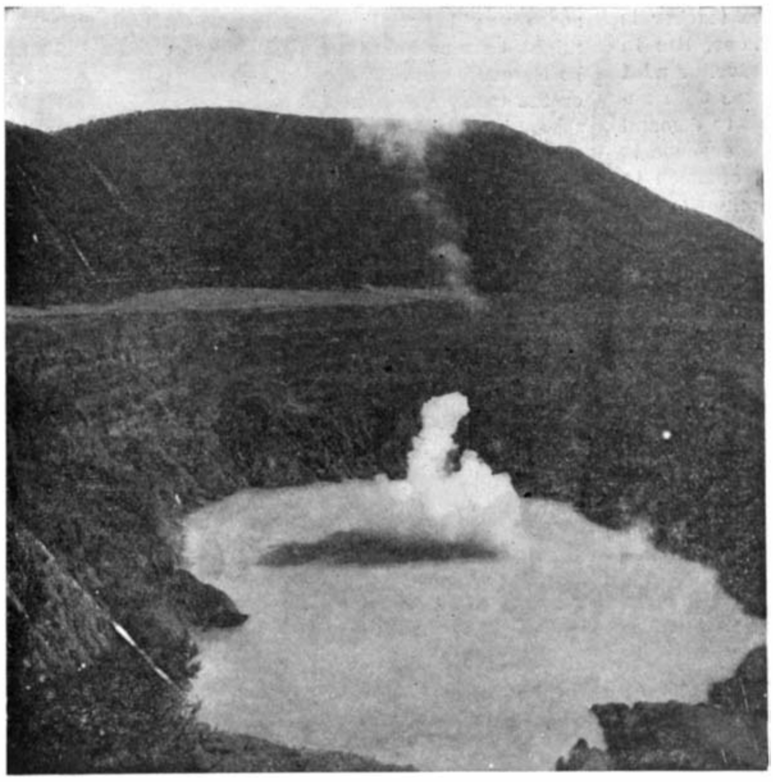


The Column of Black Liquid Begins to Make Its Way Upward.

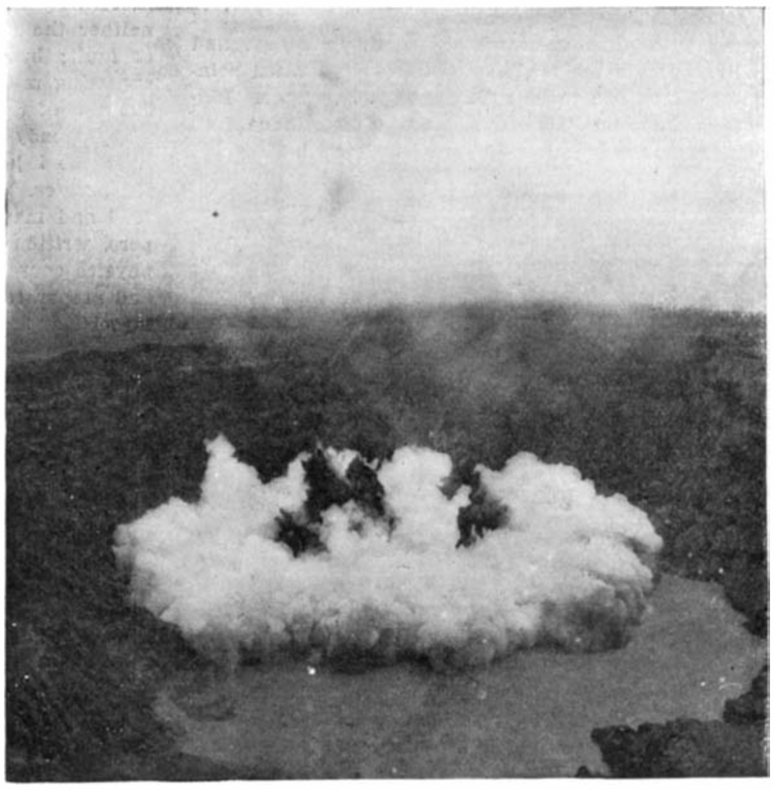
The eruptions do not succeed one another at regular intervals. Sometimes the outburst does not take place for several hours, while at others as many as three or four will occur within an hour. To the writer it appears that the more violent eruptions take place in the early morning, even before sunrise, and that the intensity of the convulsion decreases as the day advances. There is a popular belief that any unusual noise produced in the vicinity of the crater will cause an eruption, but tests with the combined voices of a number of persons, and the discharge of firearms, carried out by the writer's party, usually proved futile.

Considerable difference of opinion has arisen as to the manner in which the volcanic ashes which sometimes fall on the surrounding cone are thrown from the crater. Various observers believe that there are openings on the east side of the giant pit, and that the ashes are ejected from these. On the last expedition, the writer's party observed a fall of ash after every large eruption, and this seemed to come directly from the puff of steam or vapor. A possible explanation is that a large quantity of the water comes out during an eruption at a temperature much above the boiling point, evaporates, and leaves dry the ashes which it contained, to be scattered by the wind.

At a distance of some hundreds of yards from the edge of the crater, and separated from it by a small elevation, is found a natural curiosity in the shape of a most charming little blue lake which, with its luxuriantly green shores, presents a remarkable contrast to the scene of desolation the observer has just left. This lake, 8,600 feet above sea level, is about 1,200 feet in diameter.



The Rise of the Vapor Which Accompanies the Column.



A Curious Form of Eruption.

A VISIT TO THE VOLCANO POAS.

AN AUTOMOBILE ECONOMY TEST.

In order to give a demonstration of the efficiency of the American gasoline automobile, the New York Motor Club recently carried out an economy test, which, although having only nine competitors, was nevertheless a successful affair and put all the machines that took part to an excellent long-distance test. The first two days of the week were given up to a trip to Philadelphia and return—a total distance of 204 miles; Wednesday and Thursday the cars went to Albany and back—a distance of about 320 miles; and the last two days of the week, 200 miles more to Southampton, L. I., and return.

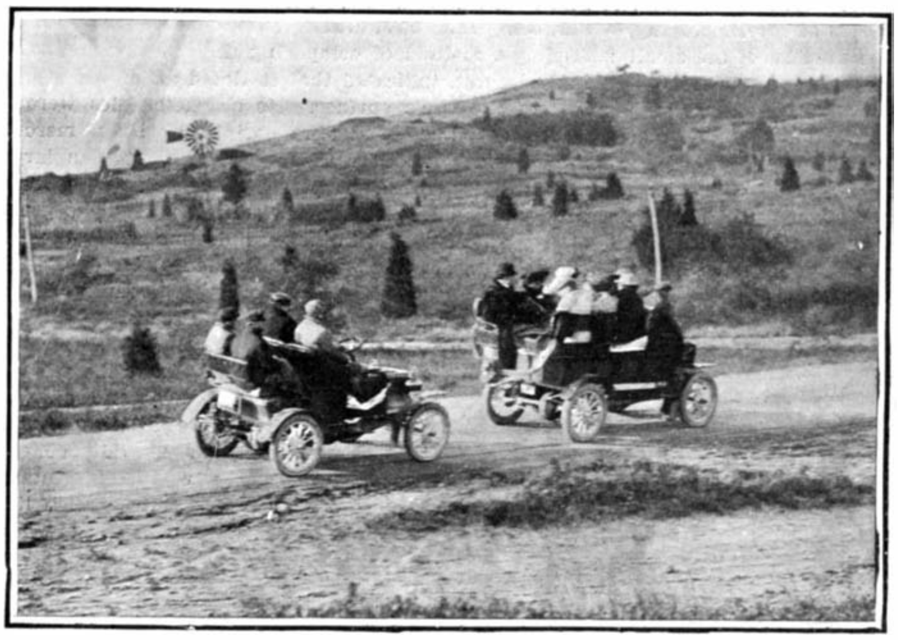
The competing cars, although few in number, consisted of distinctively American types. There were two low-priced runabouts, both originally the outcome of one man's inventive genius—the Reo and the Oldsmobile. The former, which is the latest design for a single-cylinder light car, had the box behind the individual front seats arranged to open and form a second seat facing forward and capable of carrying two more persons. The latter, of the well-known curved-dash type, with tiller steer, carried only two, although sufficient ballast was taken along to make up for two more people, who could have been carried on the dos-a-dos seat. In the run to Southampton this car also picked up and carried for eight miles a member of the editorial staff of this journal and his bicycle, which had a punctured tire. This was an additional weight of 154 pounds, while 150 pounds was allowed for each passenger.

It will be well to state here that the results of the test were figured on the total cost per passenger in comparison with the railroad fare, and that definite charges were made for oil, gasoline, tire, and all other repairs, said charges being in excess, if anything, of current prices. Gasoline, for example, was charged for at the rate of 25 cents per gallon, whereas 20 cents is the regular price in the East at all garages. The railroad fare charged was for a total mileage of 660, while the machines actually covered over 725 miles.

Continuing the mention of the other cars in the test, which, with one exception, were all touring cars, these were as follows: A Wayne two-cylinder touring car; three Compound three-cylinder touring cars; Marmon and Frayer-Miller four-cylinder, air-cooled touring cars; and a Reo ten-passenger bus, which was simply the standard 16-horse-power two-cylinder Reo touring car chassis, geared to 25 miles an hour instead of 35, and fitted with an open bus body. The performance of this machine, which has a horizontal double-opposed engine of 4¾ inches bore by 6 inches stroke, was remarkable; for not only did it spin along at an average speed of 20 miles an hour on the good roads, but it also climbed some very steep and sandy pitches on the river road 10 miles below Albany, without shedding any of its passengers. The total weight of bus and load was over a ton and a half. This mass propelled itself to and from Albany with a gasoline consumption of only 12 gallons each way, or at an actual fuel cost of 1½ cents a mile. With all charges included, the total cost of running it 682 miles was found to be $29.30, or $2.93 per passenger. The Reo runabout was second with a total cost of $13.54, or $3.38½ per passenger. One of the three-cylinder Compound cars was third (the third cylinder of this car is a low-pressure one and receives the exhaust of the other two) with a total cost of $18.62 and a cost per passenger of $3.72½. The remaining four cars to complete the test were charged as follows for the total distance: Wayne, $19.815 total, $3.963 per passenger; Oldsmobile, $15.86 total, $3.965 per passenger; Compound, $17.185 total, $4.296 per passenger; and Marmon, $22.915 total, $4.583 per passenger.

The Frayer-Miller car, which has a novel air-cooled system consisting of air jackets and a powerful blower, had the misfortune to strip its gears when leaving New York on the trip to Albany. It lost two days as a consequence, and was out of the test, though it made the last two runs satisfactorily. Its showing, both before and after the accident, was one of the best. Representatives of the Scientific American rode on this car the first and the last two days of the test, and they found the car to be both fast and reliable, while the motor showed no signs of overheating, and ran as perfectly as any water-cooled motor. This and the Marmon engine, the cylinders of which are 4 x 4 inches, were the sole representatives of the air-cooled type, and they demonstrated well the feasibility of cooling a four-cylinder touring-car motor of 24 horse-power entirely by air. Another fact worthy of notice is that the four-cylinder, air-cooled Marmon used only $1.40 worth of oil, while the three- and two-cylinder, water-cooled cars used $2.12 and $2.10 worth respectively. The Frayer-Miller engine used very little oil, also. Both these cars are fitted with mechanical lubricators. The engines are shown in the accompanying illustrations. On the other hand, while the air-cooled motor is theoretically more economical of fuel, the two entered in this test did not show superiority in this respect, as they averaged only about 16 and 11½ miles per gallon respectively. The Reo runabout made quite the best showing as it averaged 21 miles per gallon. With this small car a careful driver should easily average 20 miles to the gallon of gasoline when the car is fully loaded. Less than half a gallon of lubricating oil was used by this machine throughout the entire run. The approximate running cost (gasoline and oil) per ton-mile was, for the runabout, $0.016, and for the omnibus, $0.019. The only breakdowns were the stripping of the gears and breaking of an axle on one of the Compounds, the breaking of a spring on another, and the ditching of one of them due to turning out for a team and the failure of the brakes to hold. These, with the accident to the Frayer-Miller car, were the only breakdowns of any consequence in a 725-mile run, which certainly speaks well for the reliability of the American car over good, bad, and indifferent roads. The trip to Albany was the longest and hardest of the test, and some very trying stretches of road were traversed before it was reached.

The rules followed in conducting this test, although good in the main, will receive some minor changes which a practical test showed them to need.

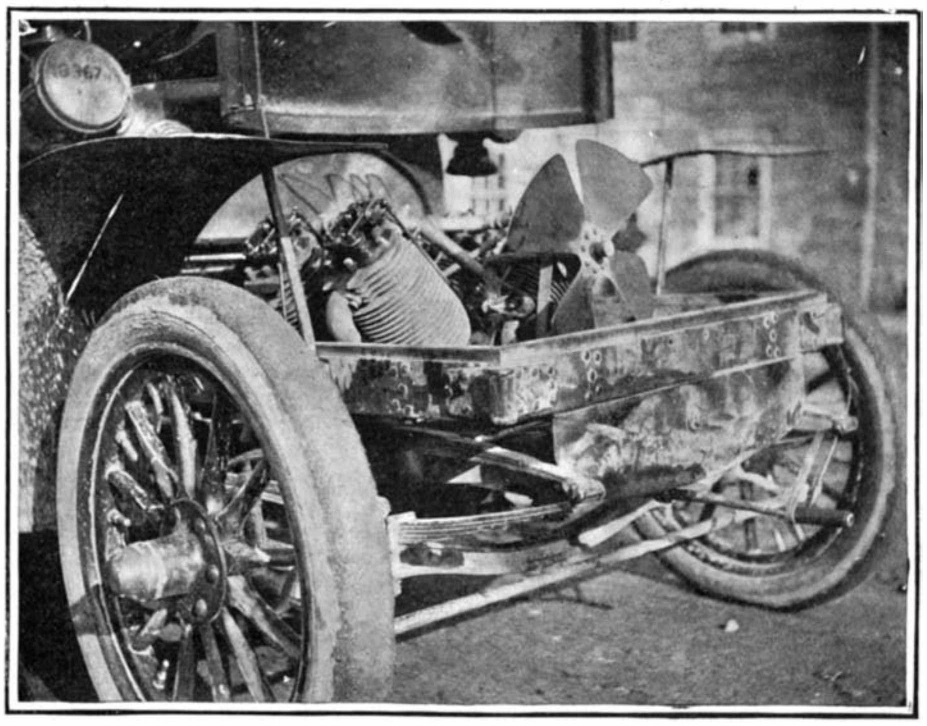


The Reo Bus and Runabout Among the Shinnecock Hills of Long Island.

The bus carried ten people and the runabout four. These machines were first and second respectively.

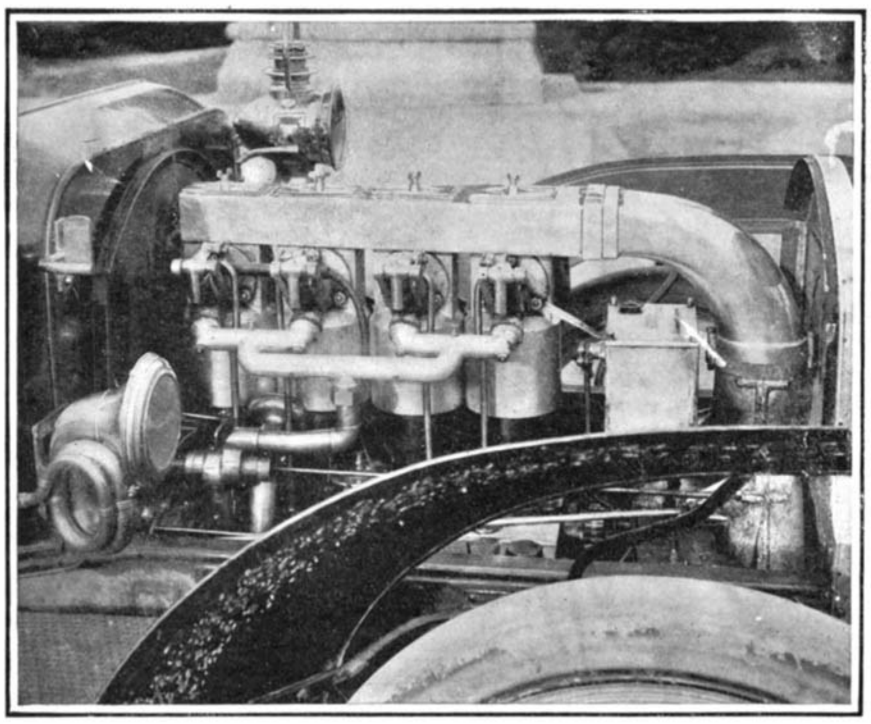
The 15-Horse-Power Compound Car Which Was Third.

This car has two 4 x 4 high-pressure cylinders and a third 7 x 4 low-pressure cylinder between them.



The 20-Horse-Power Air-Cooled Motor of the Marmon Car.

This engine has four 4 x 4 cylinders placed in pairs at an angle of 90 degrees.



The 24-Horse-Power Air-Cooled Frayer-Miller Engine.

This engine has a blower in front for supplying a powerful air current to the aluminium air jackets. The cylinders are $4\frac{1}{16}$ x $5\frac{1}{8}$ inches.

THE WINNING AUTOMOBILES IN THE NEW YORK MOTOR CLUB'S ECONOMY TEST.

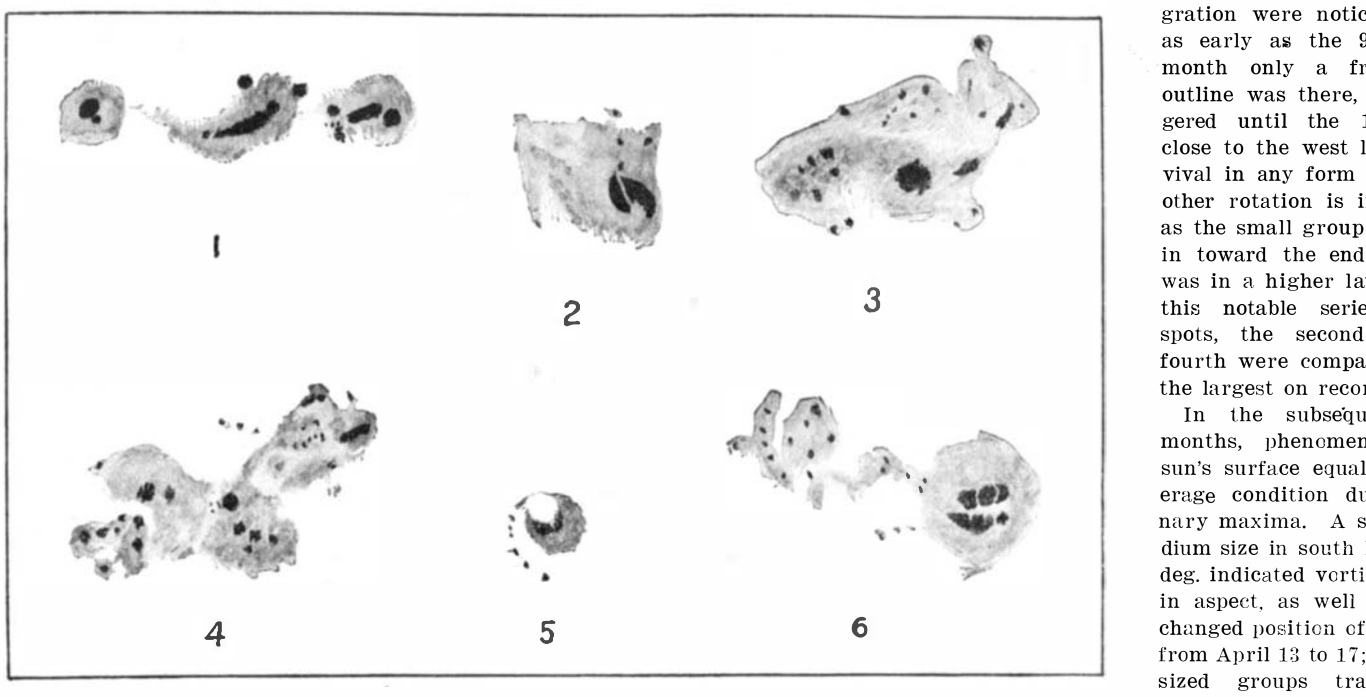
THE MAXIMUM OF THE PRESENT SOLAR CYCLE.

BY ROSE O'HALLORAN.

When last winter's sun shone forth between the rainclouds, it needed no magnifying power to discover that unwonted storms heaved its surface, and that the range of spottedness familiar to observers of recent solar cycles had been far surpassed. A dimmed area on December 8, a black streak in the middle of January, a rhomboidal discoloration in the beginning of February, an oval one in the end of that month, and another oval area in March, these were the successive signs of a sunspot maximum of unusual intensity. Two or three black markings distributed over as many years seem to be the amount of disturbance generally visible during maxima to the normal eye without magnifying power, but four giant spots within a period of two months is probably unparalleled in the memory of the present generation of observers.

The stage of departing minimum and approaching maximum ended with the appearance of the enormous spot of October 5, 1903, and though the succeeding fifteen months brought to view some large groups, they had not the size, motions, nor duration that challenge special interest. In 339 days of observation with a 4-inch lens, on only four was the disk unspotted.

A quadrangle of rapidly changing spots inclosing a tract of photospheric calmness, 70,000 miles across, extended from north heliographic latitude 10 to 20 deg. between the 7th and 16th of December, 1904. Too far apart to be classed as one group, they were suggestive of adjacent though separate causes. By the rotation of the sun on its axis, and meanwhile the motion of the earth in its orbit, each segment of the spot-zones is in view of the earth thirteen and a half days, and then unseen for an equal time; while our atmosphere, the inevitable night hours, solar vapors, and the effects of foreshortening also concur in hindering a prolonged view of the sun's features. Still, a coincidence as to time, position, and form often renders the identification of a disturbed area that has traversed the unseen side and come round again reasonably certain; but the quadrangular eruption had partly faded before it crossed the disk, and left no trace in the following rotation.



1. Sunspot of January 16, 1905, 10:40 A. M. 2. Sunspot of January 30, 1905, 11 A. M. 3. Sunspot of February 5, 1905, 9:40 A. M. 4. Sunspot of March 7, 1905, 9 A. M. 5. Cyclonic sunspot, April 17, 1905, 9:45 A. M. 6. Sunspot of July 15, 1905, noon.

SUNSPOT STUDIES.

On the 2d, 3d, and 4th of January, 1905, the only group visible on the disk was a pair of enlarging spots in the southwest quadrant. The 5th of the month was cloudy, but on the 6th a small spot and several smaller companions were noticeable in the southeast quadrant. This was probably the first appearance of the stupendous eruption visible from January 28 to February 10. At the same time, the northeastern zones were also tracts of latent possibilities, though there was nothing unusual to indicate the fact. A curving line of four unpretentious spots appeared there on the 7th, and when near the west limb developed an oval section 14,000 miles in length which seems to have returned on February 4, and again, for the third time, as the giant spot of March. When the curving line of four spots had passed toward the center on January 10, another small group, also teeming with possibilities, was inside the northeast limb, and in two days included two spots 17,000 miles in length connected by a struggling penumbral line. Before the 16th, this insignificant filament had become the main section of the enlarging group, which, like a long black streak one-seventh of the sun's diameter, was visible to the naked eye for several days. It extended 123,000 miles in north latitude 11 deg., and over the penumbral tracts, 30,000 miles wide in parts, ten umbræ were distributed. On the 19th, decrease was evident throughout, and the rapid central development, being especially transient, was reduced to one-half. The group was still visible on the 23d, but when due on the east limb on February 6, no allowance for unusual length or drift could, consistently with Carrington's law, identify it with any of the markings in the northeast quadrant of that date. On January 28, five days after its disappearance over the west limb, what was evidently another eruption of prodigious extent was well inside the southeast limb at 11 A. M., Pacific standard time. If the two were in existence during the previous five days on the invisible hemisphere they were not much more than a hundred degrees of the circumference apart. The newcomer was in south latitude 15 deg., and owing to width combined with length was found by measures taken at Greenwich to have no equal in dimensions during the last thirty-three years. In the foreshortened view of the 30th at 11 A. M. it was chiefly penumbral, rhomboidal in form, with two large umbræ divided by a slender photospheric streak. At the same hour on the following morning this bridge had changed direction nearly ninety degrees, the cyclonic tendency being shared by a small adjacent umbra. At this stage the disturbance seems to have had its greatest extent when allowance is made for the effect of foreshortening. Between clouds on February 2 and 3 it was distinctly visible without magnifying power, and on the 4th, when central in south latitude 15 deg. was more than 100,000 miles in length and 60,000 in width. The slender bridge was gone and the two vortical sections formed one oval umbra 18,000 miles in diameter, while numerous small umbræ were scattered round.

On the morning of the 5th an immense breach in a north-and-south direction had divided the western part of the penumbra, development or a greater velocity had noticeably advanced the lower part of the fragment and many changes were also evident in the minor umbræ. Notwithstanding the effects of foreshortening, a decrease in the size and in the number of the small nucleii, it was visible to the naked eye on the 6th, and telescopically until the 10th, when it passed from view. As Carrington in the middle of the last century devoted many years to a vigilant study of returning spots and their individual periods, his laws seem the best general index to latitudinal difference in solar rotation. Fifteen degrees from the equator, the mean position of this latter spot, is accredited with a rate somewhat less than twenty-five and a half days.

On January 28, 11 A. M., a screen image of the sun was arranged to measure one foot in diameter and the spot was then one-eighth of an inch inside the east limb. If centrally situated, this photospheric tract would be 9,000 miles across, but in the position of extreme foreshortening represented about half a day's journey. Allowing two days for the earth's advance onward, the spot was overdue on the morning of the 24th, as its size should have hastened a reappearance, but it was looked for in vain. Early on the 25th, a large spot was well inside the limb and, when less foreshortened, bore a general resemblance to the expected marking in its decline. It also proved to be in the same latitude, 15 deg. south. Flecks of sea-foam sinking from crest to hollow of the rolling billows are not more elusive as to identity than these signals of solar disturbance. It may have been a new spot in an adjoining tract. If the same, it was no exemplar of Carrington's law. Though of lesser dimensions than during its supposed previous transit it was visible without magnifying power for several days when central on the disk, and was close to the west limb on March 10. Again in accordance with a rotation period of four weeks, and in the selfsame latitude, a spot was within the east limb on the morning of March 25. In one respect it was remarkable. Having enlarged to medium size, six small umbræ were formed, and in two days faded out, though what may be called pores became discernible in the same tract, while a triangular area of the adjoining surface on the eastern side assumed a dimmed aspect. Forty thousand miles in length and more than half that in width, it was too faint to be classed as penumbra, too distinct to be overlooked. When near the center of the disk it was oblong in form, and the disappearance of pores on the border and the development of minute spots throughout the area was an interesting stage of transition. As the formation of umbræ became more evident, the middle of the dimmed area cleared, leaving only a porous border, which soon was undiscernible in the general decrease and foreshortening that followed. These belated rotations, if such they were, end the history of one of the largest solar eruptions that have ever been measured, according to some estimates, surpassing all, even the historic spot of September, 1858. In April there was no marking in the same zones that could be classed as a fourth return.

Perhaps the strangest fact is that, in March, solar activity was far from being exhausted by the unusual displays of the previous months. On March 1, when marveling at the succession of sun scenes already presented, another portentous gap broke the symmetry of the eastern limb.

As before intimated, a small group occupied its place in January and again in February, while the periods of return were in good accordance with the law of Carrington for ten degrees of latitude. Extending between 8 to 16 deg. north from March 1 to 13, it measured 117,000 miles in length, and was in fact longer than the compact eruption of January 28, but, being somewhat cruciform, covered a smaller area. A simple method of comparing the areas when seemingly largest, indicated that it tinted about one-fourth less of the sun's surface.' Its characteristics were a rather deep-hued penumbra sprinkled with numerous small umbræ, and the absence throughout of a large umbra. Seldom has such an interesting sun picture been presented as on March 4, when a previous great storm drifted westward toward decline while the incoming leviathan surged onward with foreshortened coils giving promise of vast length. Seemingly one-fourth of the disk apart, both were discernible without magnifying power.

When this later discoloration was past the center, decrease in tint and disintegration were noticeable, and as early as the 9th of the month only a fragmentary outline was there, which lingered until the 13th when close to the west limb. Survival in any form during another rotation is improbable, as the small group that came in toward the end of March was in a higher latitude. Of this notable series of sun spots, the second and the fourth were comparable with the largest on record.

In the subsequent three months, phenomena of the sun's surface equaled the average condition during ordinary maxima. A spot of medium size in south latitude 20 deg. indicated vertical motion in aspect, as well as by the changed position of its umbra from April 13 to 17; two good-sized groups transited in May; and on the 23d and 24th of that month the visible photosphere as seen in a 4-inch telescope was entirely unspotted. But the mysterious source of discoloration was not yet on the wane. After a month of moderate activity another series of leviathans came into view. The first was 96,000 miles in length, and when central a few degrees north of the equator, on June 26, 70 degrees of vortical motion was noticeable in its bridged umbra. The elongated group still discernible inside the west limb on July 1 was followed in five days by another 73,000 miles long. This latter would have been scarcely visible to the unaided eye but that a large umbra developed on July 8 and was perceptible on the south side of the disk for some days. When still central, a stupendous umbra encircled by a wide penumbra emerged into view at the east limb. This foremost section of an incoming group measured 45,000 miles across and was visible to the naked eye on July 13, three days before it was central. A serpentine appendage in the rear brought the entire length to 118,000 miles. It was eight degrees north of the equator and changed little in transit. A suggestive incident in its career as it neared the western limb was the outbreak of a spot about fourteen degrees behind it which, in the much foreshortened view, measured 62,000 miles. Such a repetition of activity in the rear is frequent, may be more than accidental, and would account for seemingly belated returns. Two rapidly changing groups between 30,000 and 40,000 miles in length were the chief features of the August sun; and widely scattered disturbances of lesser size in September indicated that subsidence of activity was slow and gradual.

A brief summary dating back to the beginning of October, 1903, when the intermediate stage from minimum to maximum was clearly passed, shows that activity has been pretty evenly distributed between the northern and southern spot-zones in these two years. In deducing results the term "spot" is used to denote a discoloration whether single or in parts, provided the components are sufficiently near to indicate a common origin. As the largest eruptions are rarely spread beyond an area twenty degrees in diameter, a group scattered over that extent of surface is classed as one disturbance or spot. According to this classification, in 613 days when observations were obtainable, 263 spots appeared on the disk, 118 being in the northern hemisphere, 108 in the southern, while the positions of 37 were unascertained. On only six days was the disk unspotted in a four-inch lens. Of these 263 spots, 115 appeared from January 1 to September 30 of the present year (1905). This denotes an increase in the average number as well as in size during these tempestuous months. The proportion in the hemispheres was nearly preserved, 53 being north of the solar equator, 47 south, and 15 unlocated. As explained in the foregoing account, the northern tracts also had the larger share of the seven stupendous eruptions described. A comparison of those of lesser size—neither vast nor faint—shows that during this same critical period about 18 appeared north and 15 south of the equator, from latitudes 5 to 20 being the chief zones of activity.

When the great spot of October, 1903, heralded the beginning of maximum, widespread magnetic disturbance encompassed our globe, but it is a circumstance of much interest that during the past nine months, when tempest-tossed areas of still greater extent faced earthward again and again, neither auroras nor electrical phenomena were in notable co-operation with this climax of maximum spottedness.

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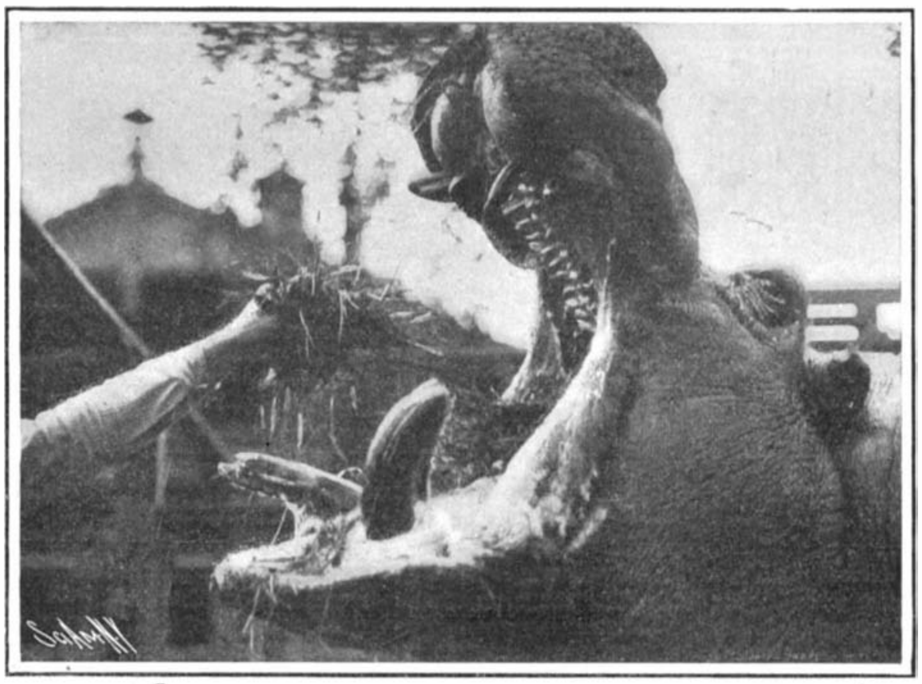
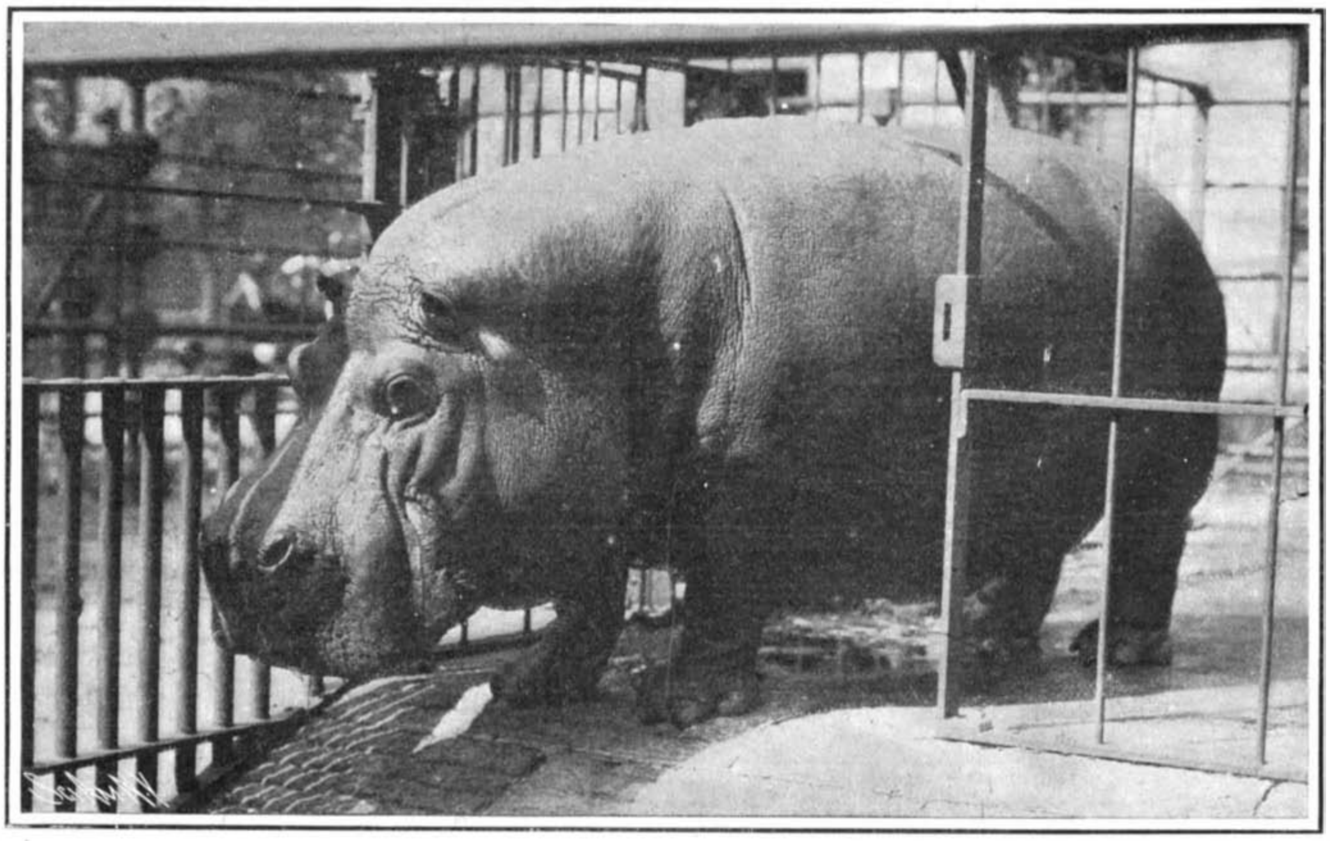
CAPTIVE HIPPOPOTAMI.

While few menageries or zoological gardens include hippopotami among the members of the animal world which they contain, the general public is nevertheless quite familiar with the appearance and characteristics of the great ungulates. They have been described in word and picture by innumerable naturalists, historians, and writers, even of the earliest times. We find unmistakable reference to them in the records of the ancient Egyptians, and to-day there is little doubt that the behemoth of the Bible was identical with the hippopotamus. The Central Park Zoo, of New York city, is particularly fortunate in the possession of three splendid specimens, a pair of older animals and a young one. The pair, Caliph and Miss Murphy, are well known, not only to those directly interested in these matters, but also to the reading public, for the huge brutes have been repeatedly described and pictured in various publications.

Caliph, the great male which is the subject of the accompanying interesting engravings, has been in the Central Park Zoo since 1889, while his mate, Miss Murphy, has been included in the collection for a somewhat shorter period. These two have proven remarkably prolific, and have presented an admiring public with eight healthy offspring, and these, with the exception of the young one at present in the Park, have been sold to other menageries. This is not an exceptional case, for strangely enough these curious beasts thrive well in captivity, and breed not infrequently. Were it not for the difficulty formerly experienced in securing original pairs, they would to-day be far more common in zoological parks. Needless to say, it is very difficult to capture the hippopotamus in a wild state and transport the animal uninjured to civilization, though if this be accomplished successfully, he takes kindly to captivity, and often lives contentedly for many years. In fact, a single specimen existed in the Zoological Park in London for over twenty-eight years.



Feeding Time.



"Caliph," the Giant Hippopotamus of the Central Park Menagerie, New York City.

"Caliph" Musing

CAPTIVE HIPPOPOTAMI.

Hippopotami in captivity do not require the excessive care and attention which are usually necessary for the well-being of tropical animals. One factor which is of considerable advantage in this respect is the fact that the animals lack the restlessness and nervousness so commonly found in wild creatures. Though terrible fighters if aroused, they are even-tempered and fairly intelligent, and learn to obey the word of command of their keepers. They appear to appreciate kindness, and seldom if ever require punishment.

Hippopotami are purely herbivorous, and in the wild state feed upon grasses, various water plants, rice, millet, maize, and similar growths. This diet is approximated as nearly as possible in captivity. They are fed every day, usually early in the afternoon, on fresh grass or hay, various vegetables, and bread. They have very healthy appetites, and we can imagine the quantity of food that a "hippo" can consume, when we consider that the stomach of a large specimen will measure as much as eleven feet in length.

The hippopotamus is heir to few troubles. Mutual attrition keeps his teeth, which grow throughout his lifetime, within proper bounds. One of the accompanying illustrations clearly portrays the molar characteristics of the animal. As he not only spends most of his waking hours in the water, but often sleeps there also, the frequent immersions keep his thick skin in a healthy condition. The water must have a temperature of not less than fifty-five degrees, and must be maintained at this point the year around. With the exception of the usual attention regarding the cleanliness of the habitation, other necessary care includes merely the proper preparation of his food and the regulation of the temperature.

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A large gas company of Paris has lately bought three patents for the commercial manufacture of a gas which is rich in methane, and this will allow the gas works to utilize the gas-carbon which is not easy to dispose of. Methane has a high calorific power and when used in connection with the incandescent gas mantles it gives a better light than is obtained with ordinary coal-gas. One of the patents provides for suppressing the carbon monoxide which may remain in the gas, so that it can be employed generally and will not meet with the opposition which water-gas encounters in France and which prevents its extensive use. The principle of the process consists in making hydrogen react in a catalytic manner on oxide of carbon in the presence of nickel. To produce the right quantity of methane, CH_4, we need a greater amount of hydrogen than ordinary water-gas contains, so that the new method seems to be summed up in the production first of water-gas, then of an excess of hydrogen, and the two gases are put in the presence of the catalytic agent in the right proportion. As yet the process is in the experimental stage. Tests made at Lyons show that the reactions on which it is based occur as was predicted, and it now remains to operate it on a large scale and find whether it has all the superiority that is claimed for it.

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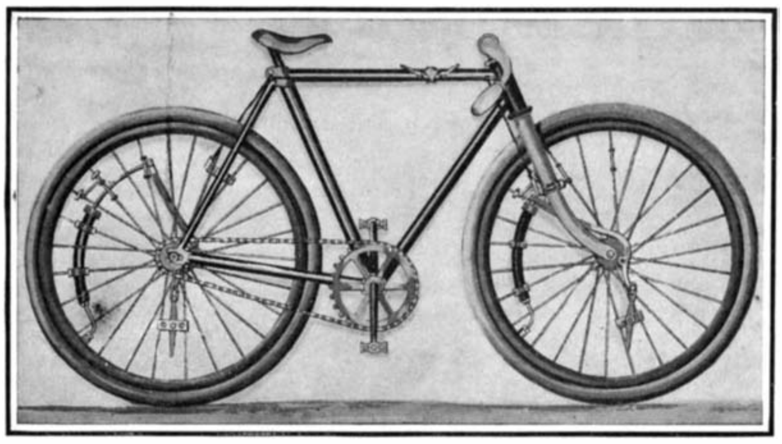
The use of tantalum as a filament for electric lamps is deprecated on account of its tendency to soften.

AN AUTOMATIC BICYCLE PUMP.

In the accompanying engraving we illustrate a novel bicycle pump, which is designed to be attached directly to the bicycle wheel, and which will operate automatically to inflate the pneumatic tire of the wheel as the wheel rotates. The controlling levers which set the pumps in action are conveniently located on the upper cross-bar of the bicycle frame, so that the rider may readily set in action either the pump on the front wheel or that on the rear wheel, or both, as desired. The pumps are not of ordinary form, but are curved as indicated in the illustration, so as to lie parallel with the rims of the wheels, to the spokes of which they are attached. Flexible tubes connect the pumps with the inflating nipples of the tires. The curved piston rod of each pump is provided at its outer end with a crosshead to which a lever is attached. This lever is fulcrumed to the hub of the wheel, and at its opposite end carries a pin which engages a slot in the head of a short trip lever. The latter is pivoted on a clip attached to the spokes of the wheel. Each pump is operated by an arm pivoted to the forks of its respective wheel. This arm lies in the path of the crosshead on the piston rod, so that as the wheel rotates, the piston is forced into the pump cylinder. Fastened to the spokes just above the pump cylinder is an inclined metal plate which, when the piston has been forced home, engages the operating arm and lifts it clear of the crosshead. As the wheel continues to revolve, the operating arm engages the trip lever, drawing the piston out again. This action continues as long as the operating arm lies in the path of the lever and crosshead. Normally, the operating arm is lifted, against the action of a spring, by the controlling lever, to which it is connected by means of a wire. Mr. Patrick J. McGinn, of Salisbury P. O., Rhodesia, South Africa, is the inventor of this improved bicycle pump.

Though we have shown this pump applied to a bicycle, it is obvious that it could be used, as well, on an automobile or any other vehicle equipped with pneumatic tires.



AN AUTOMATIC BICYCLE PUMP.

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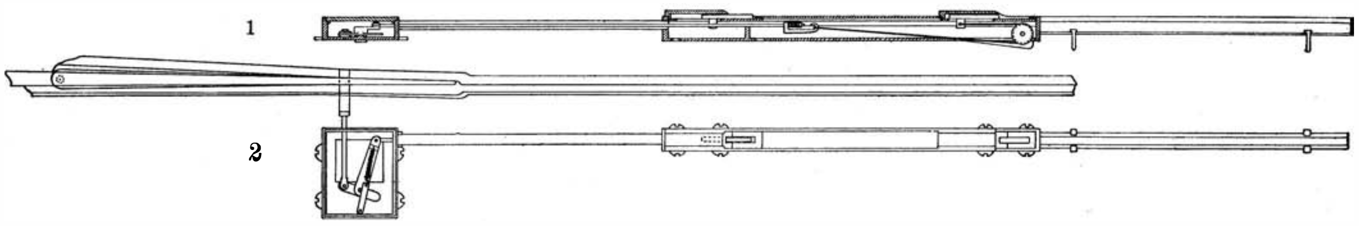
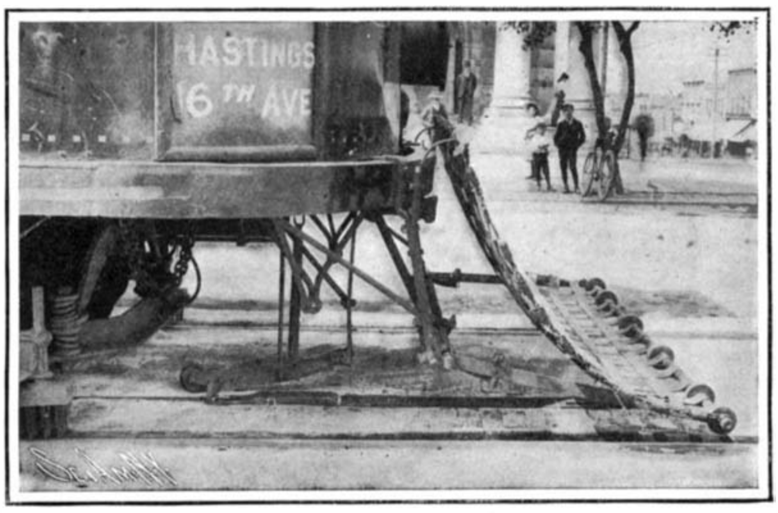
AUTOMATIC SWITCH THROWER FOR STREET RAILWAYS.

Our present methods of tending switches of street railways are very primitive. At busy junctions a man is posted to operate the switches, but at all other points the motorman must bring his car to a stop and throw the switch himself. Inventors have long been endeavoring to remedy these conditions by devising some simple mechanism for automatically controlling street railway switches. In many cases these efforts have failed, owing to the fact that the mechanisms were too expensive or complicated, or because they offered treacherous obstructions to the ordinary travel of the street. In the accompanying engraving we illustrate one of the successful inventions which has overcome these objectionable features and has proved its value in practice. This automatic switch thrower has been used for two years on the systems of the British Columbia Electric Railway Company in Vancouver, Victoria, and New Westminster, giving entire satisfaction. The operation of the switch is clearly shown in the detail views, of which one is a side elevation of the switch thrower with the casing partly broken away, and the other is a plan view of the same. Fitted to the switch tongue is a dog, which is connected by a rod to an angle lever. The latter is protected by a cast-iron box, within which it is fulcrumed. A wrought-iron pipe connects this box with a long cast-iron casing in which the triggers are mounted to slide. Within the cast-iron pipe is a connecting rod attached at one end to the angle lever and near the opposite end to the forward trigger. The rear trigger is connected to a rod by means of a chain, which passes over a pulley at the rear of the trigger casing. By this arrangement, it will be evident that when the rear trigger is pushed forward the connecting rod will be drawn back, throwing the switch tongue to the right, while if the other trigger is operated the rod will be pushed forward, throwing the switch to the left. The triggers are mere blocks of metal, which project above the face of the trigger casing. They are operated by means of a lever fulcrumed below the front platform of the car. The rear end of the lever is provided with a lug adapted to engage the triggers, and a roller adapted to hold the lug at proper level to strike the triggers. A short rail is spiked down, just back of the trigger casing, for the roller to travel on. A spring holds the lever normally clear of the triggers, but the motorman can at any time lower the lever by depressing a push-bar with his foot. When in this position the lug will strike the trigger, pushing it forward into a hood which is formed on the casing, and the lug, in the meantime, will ride up the inclined side walls of the hood, and thus pass on over the trigger. In use, when it is desired to close the switch for the main line, the motorman depresses the push-bar just as the first trigger disappears under the fender, and holds it down until he sees that the switch is thrown. To throw for a branch line the push-bar is depressed as the forward trigger disappears under the fender. It is not necessary to stop the car when operating the switch, though the speed should be reduced to about two miles an hour.



DETAIL VIEWS OF THE AUTOMATIC SWITCH THROWER.



POSITION OF THE SWITCH THROWER AS IT IS OPERATED BY THE MOTORMAN ON THE CAR.

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A New Road-paving Material.

Great interest is being manifested among British surveyors and municipal authorities in a new road-making material called "tarmac." As the name signifies, this process comprises the utilization of a tar and macadam. The raw material consists of ironstone slag rejections, hitherto a practically wasted product, immersed in tar. The refuse is used immediately upon its withdrawal from the furnaces in a white-hot condition. It is allowed to cool somewhat, and is then broken to a requisite gage, varying according to whether it is for bottoming or finishing purposes. After crushing, and while still hot, the slag is placed in a cylindrical mixer, where it is incorporated with a mixture of tar, creosote, and one or two other ingredients. This process insures the complete saturation of the hard, tough slag with the oils of tar. Upon withdrawal from the mixer, the material is ready for use.

In making up a road with tarmac no elaborate and expensive preparations are necessary so long as the thoroughfare possesses a solid, strong bottom. No concrete foundation, such as is essential for asphalt, is necessary. It is only required to see that the road surface is smooth and that all loose stones have been removed. If the operations are carried out during the season when the weather is uncertain it is advisable to wash the road with tar, so that no interference with the work be caused through rain. Any inequalities or holes that are present in the surface of the road are cut out, tarred and then patched with a fine grade of tarmac well rammed down with a hand rammer.

The road is first covered with a layer of coarse tarmac to a depth of about 2¼ inches in thickness, though the proportion of this layer depends to a great extent upon the strength of the road, and the extent of the traffic which passes over it. Care must be observed to see that every stone touches its neighbor, so that the layer may be homogeneous and solid. The material is then rolled down carefully with a roller of medium weight, and any shaping that is necessary to the road is carried out at this stage.

When the first layer has been thoroughly consolidated it is allowed to stand for two days. A second finishing strata of tarmac of 1½ gage is then applied and similarly rolled. The result of this operation is to fill the interstices in the surface of the first layer, and to present a level, even face to the traffic. A final thin layer of slag dust is then carefully spread over the surface, completely filling any minute interstices in the road surface, and when the superfluous dust is removed a day or two later, a road surface as smooth as asphalt results.

The road by this treatment is provided with a solid coating about 3½ inches in thickness, absolutely watertight, since no water can possibly percolate through, owing to the method of construction, to the foundations beneath. Nor can the road surface be disintegrated either by the sucking action of automobile pneumatic tires, heavy wheels, or animal traffic. Another conspicuous advantage is that the roadway never becomes dusty or muddy according to the nature of the weather, as inevitably results with ordinary macadam, nor does the surface become slippery during rain, as is the case with asphalt and wood pavings. Furthermore, the expense of cleansing and sweeping is appreciably reduced, and, owing to the nature of the material, it is very durable, requires scarcely any attention, and when once laid will last for years.

Tarmac is considerably cheaper than granite macadam, and, unlike tarred granite and similar road metaling materials, as it wears it always presents a gripping surface. Owing to the fact that the heated slag during manufacture absorbs a large proportion of the tar and other mixing ingredients the life of the material is greatly enhanced.

A stretch of road in a London suburb has been treated with this material for a distance of 1,950 feet by 22 feet 6 inches wide. This highway is subjected to heavy traffic, and although the roadway was paved over eighteen months ago, no signs of wear are yet observable. The cost of treating this section was about $2,125 as compared with $1,480 for making it up with granite.

The difference in the initial expenditure, however, has been more than counterbalanced by the greater economy effected in the question of maintenance. Any ordinary macadam roadway in dry weather requires constant watering to alleviate the dust nuisance. On the other hand, the tarmac road did not require watering for three months. With the latter road cleansing and sweeping was greatly facilitated and expedited. Consequently, when considered from all points of view, the tarmac road has proved considerably cheaper in the long run, and whereas the granite macadam requires remaking every three years, the tarmac road will last at least six years. With regard to ease and comfort in traveling over the two materials there is no comparison, since the tarmac roadway always affords a level, even surface.

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The advantage of the tantalum lamp is its high efficiency. It takes only half the current of an ordinary carbon-filament lamp of the same voltage and candle-power; consuming at the beginning of its life about 1.7 to 1.93 watts per candle-power, as against 3.5 to 4 watts per candle power.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

INTERNAL-COMBUSTION-ENGINE REGULATOR.—A. N. HATHERELL, Appleton, Wis. This invention relates to means for automatically regulating the speed of internal-combustion engines. The regulator consists principally in a swinging contact member actuated by centrifugal force through the revolution imparted to the regular member in time with the operation of the engine, said contact member being combined with conducting devices in such a manner as to short-circuit the electrical igniting apparatus, thus stopping the ignition of the charge of fuel when the speed of the engine becomes too great.

Of Interest to Farmers.

WIRE-FENCE LOCK.—J. W. DRUMMOND, Chillicothe, Ohio. The object of the improvement is to provide a simple, cheap, and easily-applied lock for connecting the horizontal strands of a wire fence to the vertical cross members or stays in such manner that the lock will be a strong and rigid connection of the two members and will not slip on either of them.

PLOW.—J. COLLINS, Dockery, Miss. The plow is especially adapted for opening new ground, but may be successfully employed in all work adapated to the plow. Adjusting mediums are provided for a knife-colter whereby said colter may be given vertical adjustment to or from the point of the share, which mediums can be quickly and conveniently operated and are of such construction that a guide is provided for the colter between its ends and the colter is held at the side of the beam, the colter's adjustment being made by sliding the mediums to and from the heel of the beam.

TRACTION-ENGINE.—R. REED, Logansport, Ind. The engine is capable of general use, but is especially adapted for agricultural purposes and to which many kinds of farm implements may be applied. The device will operate any kind of a farm implement that can be drawn by horses or a motor. Means are provided whereby the power can be transmitted to all of the wheels upon which it operates. Also for turning the vehicle about sharp corners by operation of the motor itself, and for additional manually-operated steering means. Power may be applied at will to rear and front wheels or either alone for changing speed and direction of motion.

LEVELING AND RAISING DEVICE.—G. H. TENPAS, Sherman, N. Y. The aim of this inventor is to provide a leveling and raising device which forms a permanent part of a portable machine, such as a grain-separator or the like, and which is arranged to permit convenient leveling of the body of the machine or raising the same, if necessary.

INSECT-DESTROYER.—L. TANNER, Cheneyville, La. This insect-destroyer is especially designed for destroying boll-weevils, cotton caterpillar-moths, boll worm-moths, sharpshooters, and other insects injurious to the cotton-plant and other growing plants. It can also be used on insects in gardens and orchards.

Of General Interest.

SCRAPER.—I. W. EVERY, Athens, N. Y. In its preferred embodiment the invention comprises a carriage formed of two runners with rigid connection between them. On the runners is arranged a movable draft-bar, and to this bar is connected a scraper proper, which is normally held rigid with the carriage, but which upon the release of a latch is drawn to the bar into dumping position. Operation is entirely automatic except for manual operation of the latch. The scraper removes snow from ice or other surfaces, but is useful in connection with other materials.

STEAM-TRAP.—E. J. RYAN, Danville, Ill. The object of the invention is the provision of a new and improved steam-trap arranged to periodically and automatically insure a complete discharge of the water of condensation without danger of leakage of steam. The device is composed of comparatively few parts, not liable to easily get out of order.

IMITATION EMBROIDERY.—N. NOËL, St. Chamond, Loire, France. The present invention relates to letters of the alphabet, figures, and other embroidered signs the characteristic feature whereof resides in the fact that the letters and signs are made with a cord having swollen portions. These letters applied on paper are sewed upon all kinds of tissue. They are made of thread or cord having some parts thicker than others, corresponding to the calligraphic outline of a previously-made design.

SHIRT AND GARMENT SUPPORT.—S. LONDON, New York, N. Y. The improvement has reference to shirts or shirt-waists, such as worn by small boys. The object of the invention is to provide a garment of this kind with means for supporting the trousers in a resilient or elastic manner without recourse to suspenders.

GIRDER-CARRIER. — C. L. KETCHAM, Springfield, Mo. This device handles heavy bridge-girders and deposits them in place upon the structure to which they belong. It is of especial use where desirable to avoid delaying traffic by blocking up the main line over the bridge. It also effects economy in construction, both as to the number of men employed and the time required for accomplishing the placing of the girders.

Pertaining to Vehicles.

HORSE-COLLAR.—J. S. HULL, Manly, near Sydney, New South Wales, Australia. This pneumatic horse-collar comprises an outer casing and a pair of inner independent inflatable pads and having the lower ends thereof closed and overlapping one another, each pad being provided with an inflating-valve and provided at its lower end with an opening for a cord for introducing the pad within the casing.

VEHICLE-WHEEL.—J. M. CARPENTER, Millersburg, Ohio. In this case the invention pertains to improvements in wheels for vehicles, particularly automobiles, the object being to provide a wheel with hard metal or steel teeth on its periphery to prevent slipping on ice or frozen ground, the parts being so arranged as to not interfere generally with the spring-yielding of the wheel.

Designs.

DESIGN FOR A TOILET-POWDER RECEPTACLE.—W. A. BRADLEY, New York, N. Y. Mr. Bradley has invented a new and original design for toilet-powder receptacles. The body of this receptacle is nearly round, being slightly flattened in its broadest part. It is flat bottomed. The head tapers from neck portion up to the orifices at the top and the whole constitutes a very graceful and ornamental toilet article.

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. 7496.—For manufacturers of iron baking ovens and bakers' supplies.

Inquiry No. 7497.—For makers of pin machines.

Inquiry No. 7498.—For makers of luminous paint.

Inquiry No. 7499.—For machinery for manufacturing steel pens, nibs and holders.

Inquiry No. 7500.—For manufacturers of hot air pumps.

Inquiry No. 7501.—Wanted, a machine for automatically affixing postage stamps to letters.

WANTED.—Patented specialties of merit, to manufacture and market. Power Specialty Co., Detroit, Mich.

Inquiry No. 7502.—Wanted, a machine for stamping letters on metal disks.

Inquiry No. 7503.—Wanted, a machine for manufacturing corkscrews.

WANTED.—Young man experienced in drafting and designing textile machinery " New England." Machinery, Box 773, New York.

Inquiry No. 7504.—For makers of paper bottles, for milk delivery, also of machines for corking the same.

WANTED.—Ideas regarding patentable device for water well paste or mucilage bottle. Address Adhesive, P. O. Box 773, New York.

Inquiry No. 7505.—Wanted, a machine for projecting opaque pictures or objects.

FOR SALE.—Paying up-to-date metal working plant. Best location; good building. $75,000, or will sell large interest to right man. Chance, Box 773, New York.

Inquiry No. 7506.—For the manufacturer of the explosive Rack-a-rock.

Inquiry No. 7507.—Wanted, woodworking machines for sash and door factory.

WANTED.—An experienced master mechanic, who has received not less than $2,500 per year, to take charge of a large manufacturing plant in New England. References required. Plant, Box 773 N. Y.

Inquiry No. 7508.—For makers of portable houses.

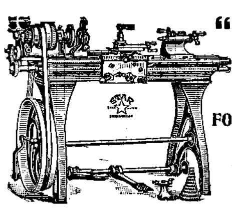
Inquiry No. 7509.—Wanted, a small ice machine of about 50 to 100 pounds a day.

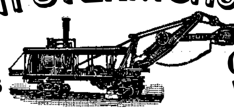
Inquiry No. 7510.—For the makers of the Garden City Rotary Air Compresser.

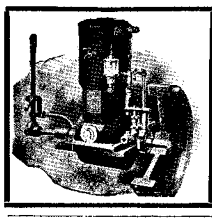
INVENTIONS WANTED.—Undersigned will consider one or two good patented or patentable inventions to manufacture on royalty. Something in popular demand preferred. Honest treatment guaranteed. F. Raniville Company, Grand Rapids, Mich.

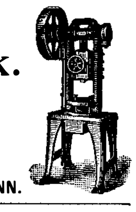
Inquiry No. 7511.—Wanted, the makers of a novelty called the Tumbler, being a blue capsule with a buck shot in it, and small American flag around it; the capsule to hold about 1 ounce.

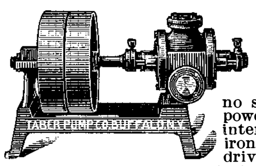
WANTED.—Competent man who has knowledge of Mechanical Engineering, to take a position as traveling salesman for the selling of construction material used in Insulating Refrigerating Plants. Apply by mail to the Bruening Cork Company, Oakdale, All'y Co., Pa.

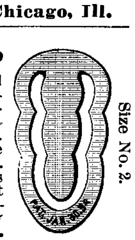


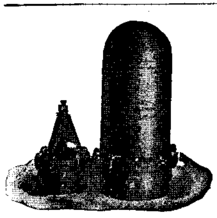


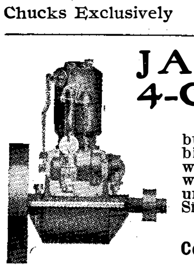


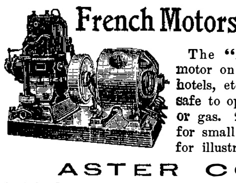


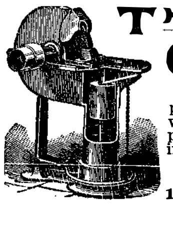


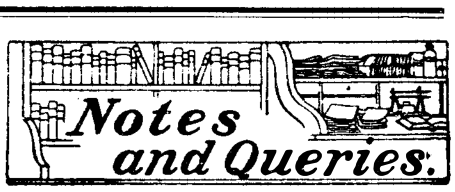












Notes and Queries.

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.

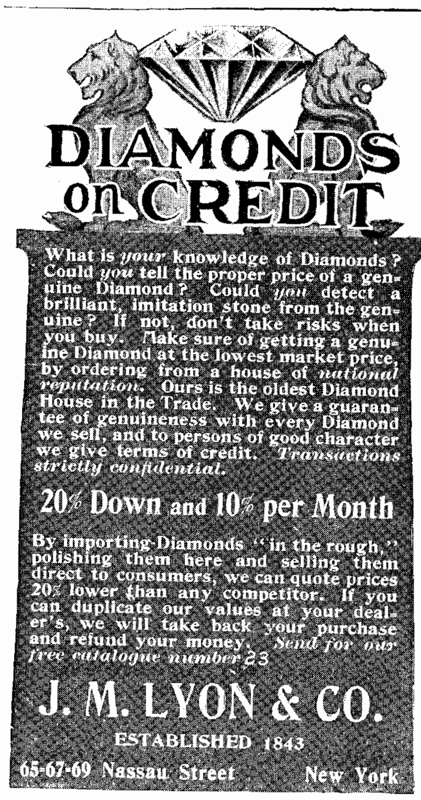
Minerals sent for examination should be distinctly marked or labeled.

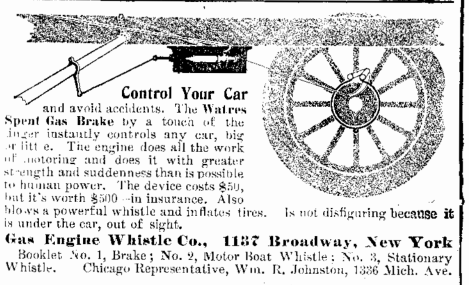
(9840) J. F. writes: In regard to the answer to question 9697, SCIENTIFIC AMERICAN, July 15, 1905, I doubt that the lead ball should strike the ground earlier than the one of cork. Supposing the balls to fall in a vacuum from the same height and at the same instant, the only force acting on them will be the force of gravity. This force produces a constant accelerating velocity of 32.16 feet per second on any freely falling body, disregarding weight or shape. Therefore both balls will receive the same velocity and consequently strike the ground at the same time, when falling in a vacuum. In the case of bodies falling in the atmosphere, the only difference from the former case consists in the introduction of the resistance of the air, retarding the velocity produced by the force of gravity, and whose effect on the falling body depends only upon the amount of surface the latter presents to the air. The shape of the balls being the same, the resistance of the air will be the same for each. The resulting velocity, or velocity produced by the force of gravity minus the amount of velocity neutralized by the resistance of the air, is the same for each ball, the two terms of the expression being the same for each, they reaching the ground, therefore, the same instant also when falling in the atmosphere.

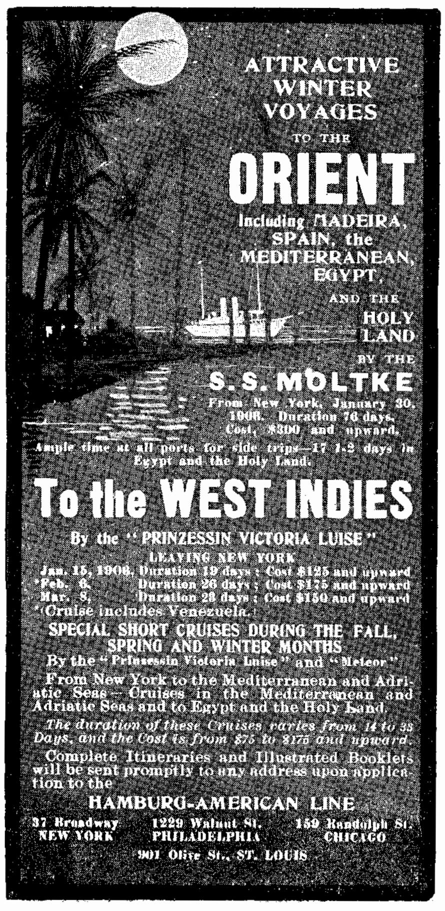
(9841) C. V. asks: Please give formula for "frosting" incandescent lamps (electric); also for dyeing same in either three following colors: scarlet, blue, and green. How long should they remain in frosting or dyeing fluid for good, permanent frost or dye? A. The colors used for dipping incandescent lamp bulbs are generally aniline dyes dissolved in varnish. A transparent varnish should be used, and made quite thin. It is better to make several dippings of a thin color than to attempt to reach the depth desired by one dipping. The bulbs must be perfectly clean and dry when dipped. They may be washed in soap and water, dried, and wiped with alcohol just before dipping. The hands should not touch them after the washing. A good method for doing the same thing by means of photographer's collodion is given in SCIENTIFIC AMERICAN, Vol. 74, No. 10, answer to query 6751, which we send for ten cents. Another good article upon the subject may be found in SUPPLEMENT No. 948, price ten cents.

(9842) J. R. D. asks: If agreeable, will you kindly advise what metal has the most expansive property when subjected to heat, and also state to what extent quicksilver or mercury will expand by heat, and whether or not quicksilver expands more by heat than does water? A. We give you the rates of expansion of several of the metals which expand most rapidly by heating: Potassium 0.000249, sodium 0.000218, mercury 0.000182, indium, 0.00014, cadmium 0.000094, lead 0.000088, aluminium 0.000070. Mercury expands more than water does for the same change of temperature near the freezing point. The rate of expansion of water as given in the "Physico-Chemical Tables" of Castell-Evans is 0.0000644. All the figures we have given above are from the same tables, which are of the highest authority.

(9843) J. F. W. asks: 1. In a series or current transformer, will the E. M. F. of the secondary vary as the current in the primary increases or decreases, the E. M. F. of the primary remaining constant? A. In a transformer the voltage in the secondary varies with the ampere turns of the primary. Hence a change in the amperes in the primary would make a corresponding change in the E. M. F. in the secondary. 2. In the boosting transformer when the primary winding is connected across the mains and the secondary in series with the circuit, the E. M. F. of the secondary is added to that of the circuit. If both windings be connected in series with the circuit and with each other, as in the following diagram, what, if any, effect will take place in the E. M. F. of the circuit? A. If both primary and secondary were connected in series with the line, they would simply act as any other inductive resistance would act, and would retard the current. They would simply constitute a part of the load of the dynamo.







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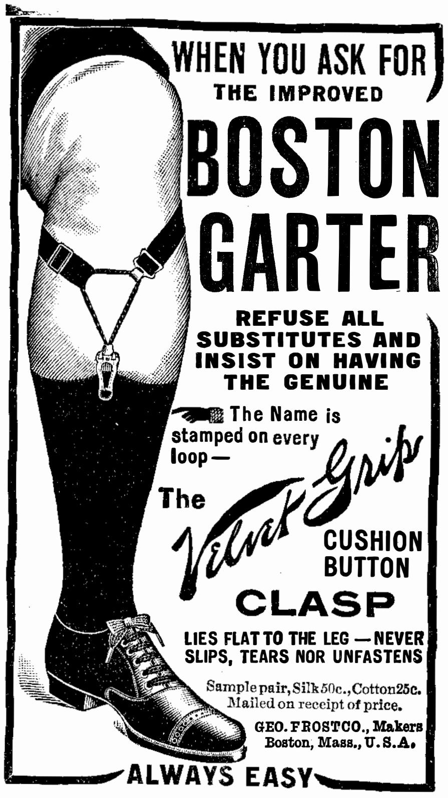

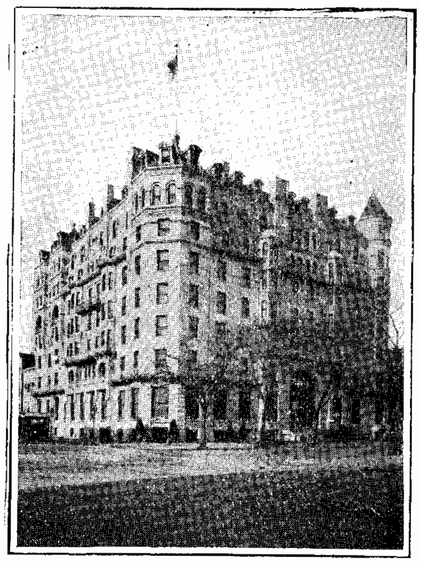

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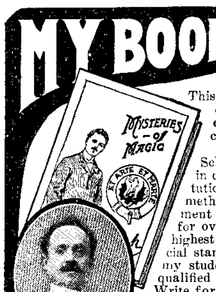

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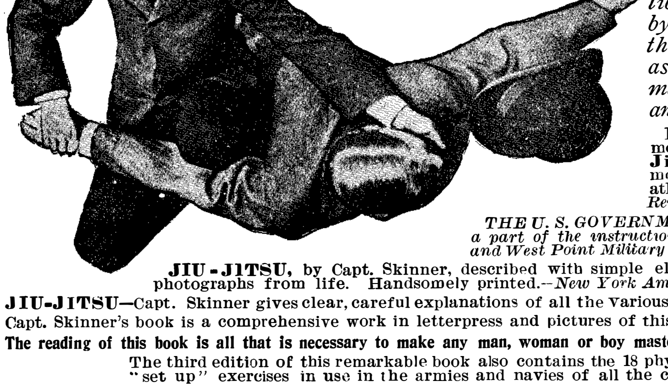

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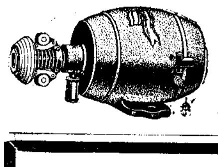

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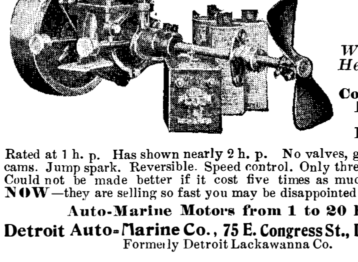

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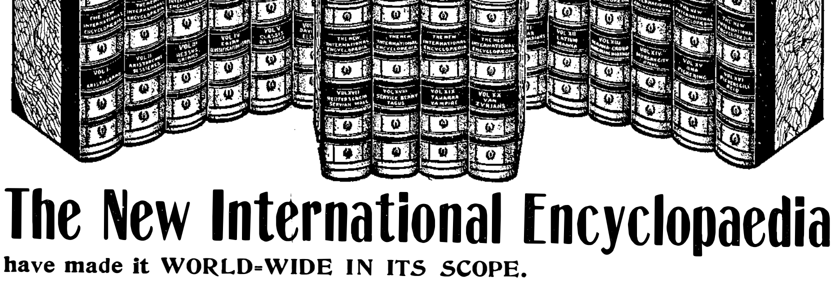

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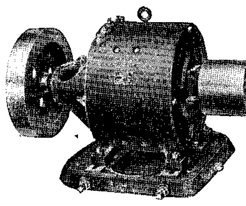

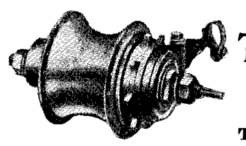

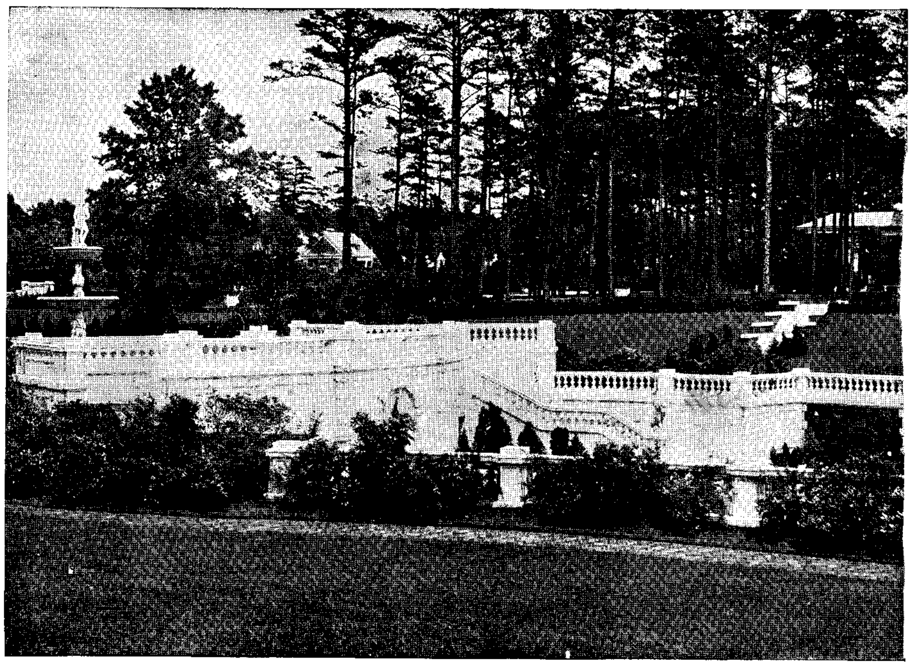

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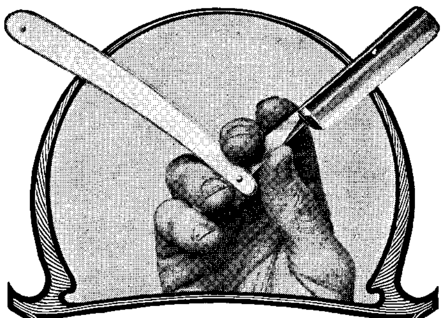

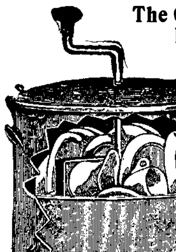

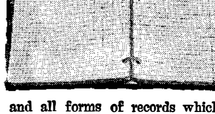

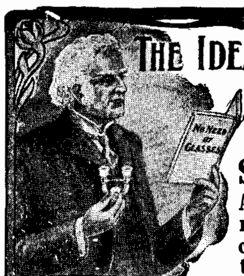

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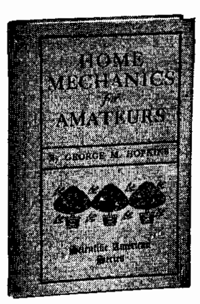

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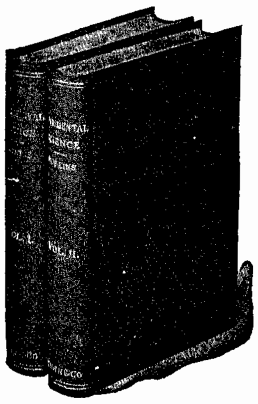

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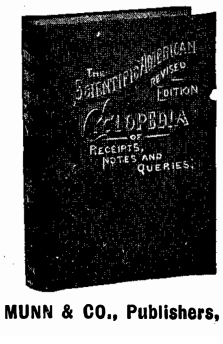

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Vehicle brake, P. H. Fuller	804,111
Vehicle gear, F. E. Wilcox	803,949
Vehicle wheel sand cap, W. E. Wright	803,867
Vehicles, antivibration device for, E. V. Hartford	803,589
Ventilator. See Door ventilator.	
Veterinary forceps, S. Brower et al	804,094
Vibratory impacts, implement for imparting, J. H. Champ	803,877
Vise, bench, W. & S. Vanmanen	804,179
Voting machine, A. A. Farwell	804,187
Wagon body supporting device, O. W. Shaw	804,059
Wagon brake, C. M. Marcom	803,773
Wagon brake, J. L. Shaw	804,058
Wagon, hose, B. B. Briggs	803,870
Washing machine, J. J. Green	803,753
Washing machine, J. P. Gordon	803,894
Water elevating apparatus, G. W. MacKenzie	804,196
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Weighing machine, automatic, G. W. Lottridge	803,912
Welding clamping device, electric, A. F. Rietzel	804,045
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Wire stretcher, W. T. Martin	804,146
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Wire working machine, Nilson & Olson	804,029
Womb supporter, Barchfeld & Hunt	804,086
Wood, producing liquid tight joints for impregnating, G. Kron	803,603
Wood, saturating, W. C. Jones et al	804,132
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Stove, heating, A. F. Harter	37,657
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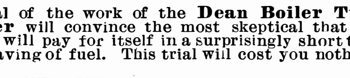

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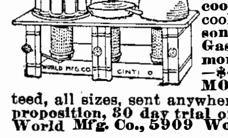

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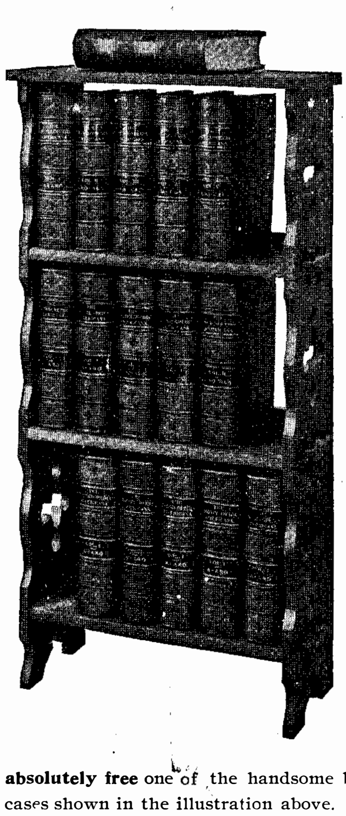

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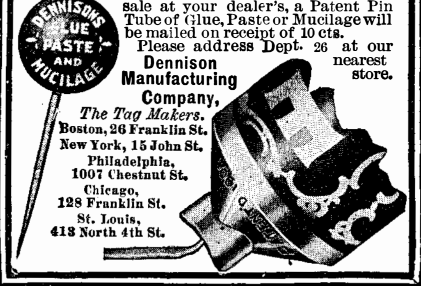

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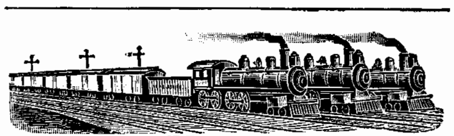

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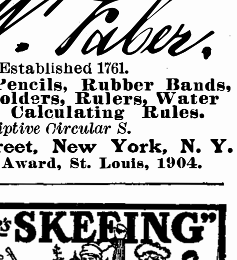

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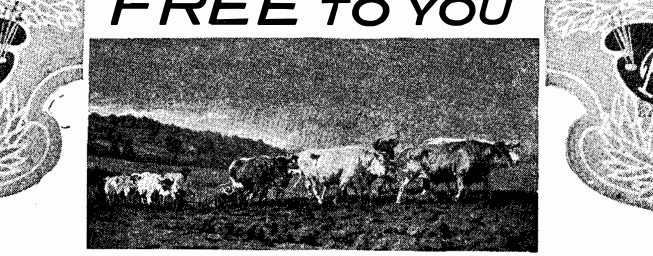

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2. PLOUGHING . . By Rosa Bonheur — In the Luxembourg Gallery
3. SPRING . . . . By Corot — In the Louvre, Paris
4. THE GLEANERS . . . By Millet — In the Louvre, Paris
5. THE MILL . . . . By Ruysdael — In the Amsterdam Gallery
6. DANCE OF THE NYMPHS By Corot — In the Louvre, Paris
7. SHEEP IN SNOWSTORM By Schenck — Metropolitan Museum, N. Y.
8. DANIEL'S ANSWER TO THE KING . . . By Riviere — Owned by British Government
9. SISTINE MADONNA . By Raphael — Royal Gallery, Dresden
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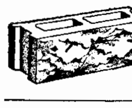

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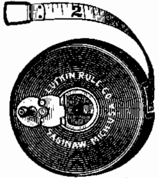

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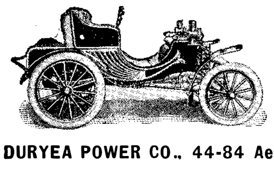

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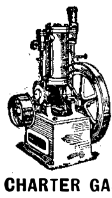

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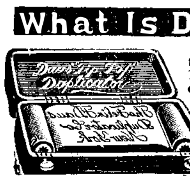

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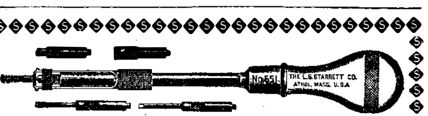

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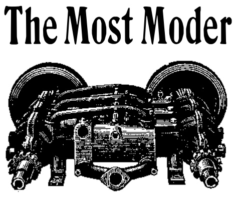

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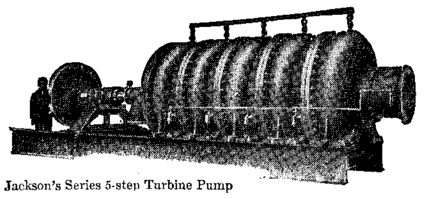

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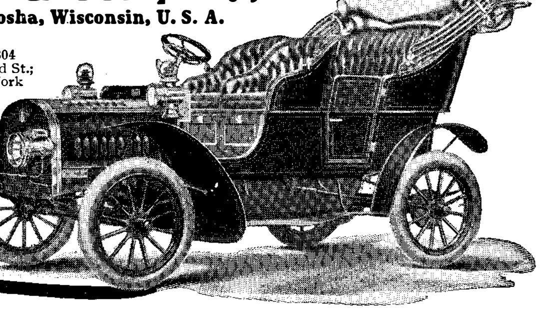

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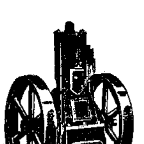

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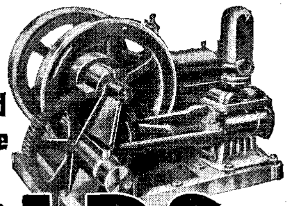

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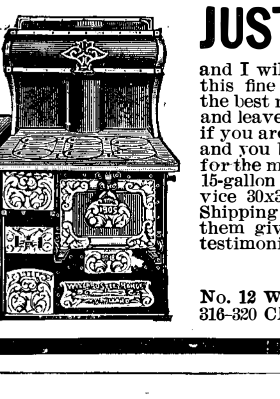

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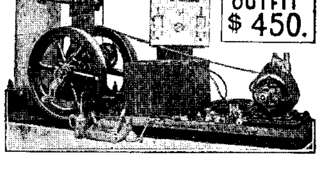

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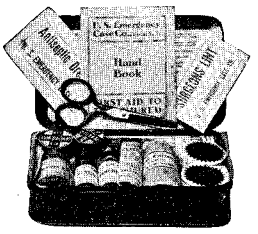

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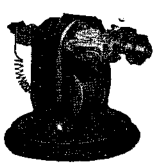

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