SCIENTIFIC AMERICAN

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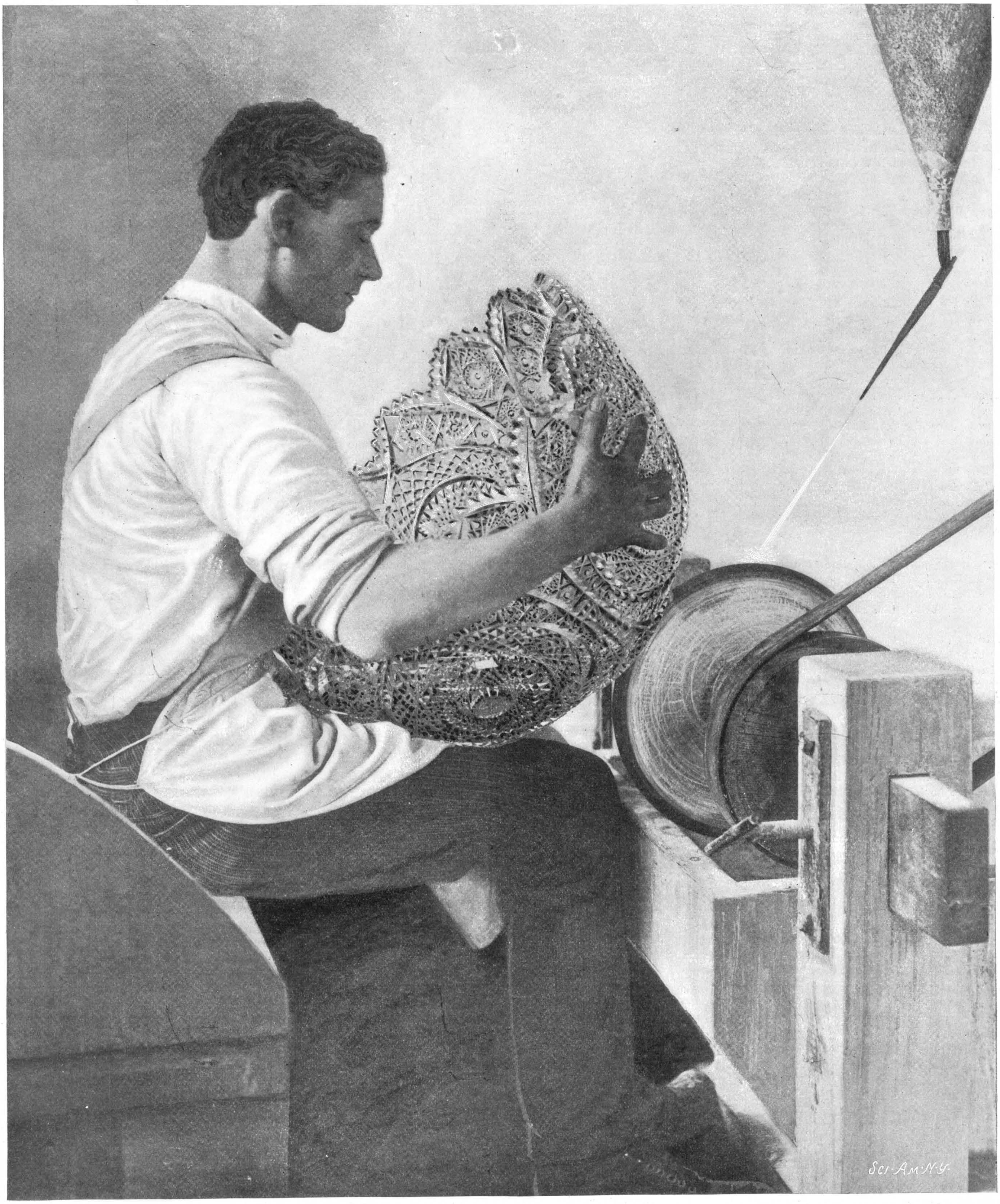

Polishing a 25-Inch Glass Bowl for Exhibition at the St. Louis Exposition. Height with Foot, 24 Inches; Weight of Bowl and Foot Before Cutting, 143 Pounds.

THE LARGEST PIECE OF CUT GLASS IN THE WORLD.—[See page 348.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, APRIL 30, 1904.

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

THE AQUEDUCT COMMISSIONERS AND THE NEW YORK CITY WATER SUPPLY.

The object of constructing the new Croton dam, which was begun in 1892, was to relieve the pressing danger of a water famine in the city by increasing the storage capacity of the Croton system to its fullest extent. The Jerome Park reservoir was begun in 1895, with the object of providing an adequate distributing reservoir within the city limits, capable of impounding between two billion and three billion gallons of water, and providing Manhattan and the Bronx with from a week's to ten days' supply of water, which could supply the city temporarily, should there occur any break in the thirty-five miles of the new Croton aqueduct. It was the intention of the contracts that the new Croton dam be finished by July 1, 1899, and Jerome Park reservoir by November 1, 1902. As matters now stand, four years and ten months have passed since the contract date of completion of the Croton dam, and over two years more will be required to complete the structure. That is to say, if we may be so optimistic as to hope that the intolerable delays that have marked the construction of this dam in the past will not be repeated, it is possible that this urgently-needed work will be ready for public use seven years after the date on which it should have been completed, the contract taking fourteen instead of the seven years contemplated and promised for its execution. In 1903 the Acting Chief Engineer, in an official report to the Aqueduct Commissioners, stated that the Jerome Park reservoir, at the then rate of progress, would not be finished in less than four years from that date, that is to say, five years after the original contract date for completion.

In the presence of these astounding facts, it is not surprising to learn that the Merchants' Association of this city, whose good work in the safeguarding of the city's interests is on record, have considered the matter to be so serious as to call for the preferring of charges against the Board of Aqueduct Commissioners, upon whose shoulders they consider that the chief blame for this inexcusable neglect of the city's interests is to be laid. The Association states that it can be clearly shown, by the records of the Aqueduct Commission, that the Commissioners had knowledge of the grave exigencies confronting this city in the way of a possible water famine, and that they have explicitly recognized the need for expedition in providing new reservoirs; that these Commissioners have been specifically informed, by their Chief Engineers and by the Department of Water Supply, that action was urgently necessary for the due progress of the work; and that although they were thus informed, they refrained during several years from taking any steps toward compelling the active prosecution of the work and, indeed, that at no time since 1898 have they taken any effective or proper steps to compel the contractors of either the Cornell dam or the Jerome Park reservoir to observe their contract obligations as to time. The Merchants' Association claims that it is shown by the Aqueduct Commissioners' report that, in the case of the new Croton dam, the Chief Engineer, as far back as 1899, protested officially to the Aqueduct Commission against "the inexcusably flagrant delay" of the contractors, and recommended measures to compel satisfactory progress; but that no measures to compel progress were adopted at the time or since. It is further charged that in the case of Jerome Park reservoir also, the Aqueduct Commissioners have taken no action of any kind to enforce a reasonable degree of progress, despite the obvious and unjustifiable delay in every branch of the work, including the complete stoppage for about four years of work upon the northern half of the reservoir, on which expedition had been previously ordered by the engineers.

The indifference of the Aqueduct Commissioners to the needs of the city is claimed to be the more culpable, because they have repeatedly granted unmerited extensions of time, and this in the face of many reports made to them by their own engineers, that the contractors' delay was extreme and altogether unnecessary. These are grave charges, and in view of the unparalleled delay on both these urgently-needed public works, the public will not fail to draw its own conclusions as to the inefficiency of the Aqueduct Commissioners, and their apparent indifference to the trust that has been reposed in them.

The Commission is a body of laymen who were appointed for the express purpose of safeguarding the city's interests and seeing to it, not merely that contractors do their work well, but that they do it within contract time. Now, the Scientific American is perfectly well aware that there have been justifiable causes for some of the delay. There has been a change from core wall to solid masonry on a portion of the Croton dam, while at Jerome Park further delay has been occasioned by a similar change from core-wall embankments to solid retaining walls. We are perfectly willing to admit that these changes were necessary at the Croton dam, and that they may have been to a certain extent necessary at Jerome Park reservoir; but having admitted this much, we must confess that after reviewing the history of these two works, and going carefully over the charges made by the Merchants' Association, we cannot but feel that the Commission has done very little to justify its existence. Amid the continued and reiterated complaints against the delay in these works, we fail to remember a single instance in which the voice of the Commission has been heard in similar expostulation. Judging by its silence, the citizens of New York might well believe that the delay was causing the Commission but very little uneasiness.

It is gratifying to know that the charges of the Merchants' Association will be presented before a Mayor who has shown himself to be thoroughly independent and fearless in protecting and promoting the welfare of the city over which he presides.

LONGITUDINAL BULKHEADS AND BATTLESHIP STABILITY.

A correspondent has asked us to give an editorial discussion of the probable cause of the Russian battleship "Petropavlovsk's" capsizing so suddenly. At the outset we must frankly confess that in the present state of our knowledge of this disaster, it is impossible to give a definite answer; but we are inclined to think that, when our correspondent asks if the capsizing of the ship was due to a too great subdivision of the water-tight compartments, he has failed to understand the true functions of the multiple-compartment system. The primary object of subdivision is to localize the effect of under-water penetration of the hull, so that should a vessel run aground, the entering water would be confined to certain compartments of a limited capacity, and her buoyancy would not be too seriously impaired. An ordinary grounding of the vessel, a ripping open of the outer shell by a jagged point of rock, will usually admit water only to the double bottom. This has been shown in the majority of the accidents of this character to our own ships that have happened of late years. As a defense against the smashing in of a considerable area of the under-water hull by the ram or by the torpedo, it is customary to divide the ship transversely by several bulkheads, and also by a continuous longitudinal bulkhead that bisects the ship in the line of the keel from stem to stern. The various compartments thus formed are further subdivided both longitudinally and laterally, particularly in the wake of the magazines and engine and boiler rooms.

Our correspondent is under the impression that the capsizing of the "Petropavlovsk" was largely due to the existence of the longitudinal bulkheads, and he asks whether, had there been no bulkheads of this kind, the water would not have distributed itself across the vessel, and, by preventing the ship from listing heavily, have delayed her sinking until the majority of the crew had been rescued. The question is not by any means a new one, for it was brought into prominence many years ago by the sinking of the British battleship "Victoria," when she was rammed by the "Camperdown" during naval maneuvers in the Mediterranean, and went down with Admiral Tryon and most of her officers and crew. The hull was perforated on the starboard side a little forward of the 16¼-inch gun turret. The water entered rapidly, and, filling the starboard compartments, it caused the ship to list so quickly that she "turned turtle" before the boats from the other ships of the fleet could rescue her crew.

A naval board of inquiry that investigated the disaster considered the question of removing the longitudinal bulkheads, with a view to preventing the quick capsize of a rammed or torpedoed warship. But it was decided that, all things considered, longitudinal bulkheads were desirable; and they remain to-day a most important feature in the design of all modern warships. Furthermore, it is a mistake to suppose that all longitudinal bulkheading is water-tight. The keel of the ship in the double-bottom, and some of the other longitudinal members there, are perforated for the express purpose of allowing the water to flow freely across the ship in case of injury to the bottom. To follow out the same principle, however, on the various decks, would be to double, and in some cases quadruple, the amount of water that would be admitted to a ship were she rammed or torpedoed, a result which would merely mean that buoyancy was sacrificed to stability.

That the accepted system of subdivision is the correct one has received most emphatic demonstration in the present war; for there seems to be very little doubt that the quick loss of the "Petropavlovsk" was due to the fact that when the burst of flame of the exploded mine or torpedo tore its way into the ship, it ignited and exploded the magazines and rent the ship asunder, the action being similar to that which occurred in the case of our own battleship "Maine" in Havana Harbor. Therefore, the sinking of the "Petropavlovsk" can scarcely be quoted against the longitudinal subdivision system. The true test came in the case of the two battleships "Czarevitch" and "Retvizan," and the cruiser "Pallada," which were torpedoed in the opening engagement at Port Arthur. These vessels were undoubtedly saved by their elaborate system of subdivision of hull; for they were able to proceed from the outer roadstead under their own steam and beach themselves, thereby rendering subsequent salvage operations and repairs possible. Naval constructors, generally, consider that the salvage of these ships is a great tribute to the efficiency of the present cellular system of construction.

THE PREPARATION OF PURE ARGON.

In a paper recently read before the Academie des Sciences, Messrs. Henri Moissan and A. Rigaut describe a method which they use for preparing argon in large quantities in a pure state. In their first experiments, Lord Rayleigh and Sir Wm. Ramsay used the action of the spark on a mixture of oxygen and nitrogen, in order to separate the argon of the air. Afterward they used metallic magnesium, which retains the nitrogen in the form of nitride. In more recent experiments, Ramsay used the action of a mixture of lime and magnesium on the nitrogen of the air.

M. Moissan had previously shown that calcium combines easily with nitrogen at a low red heat, giving a crystalline nitride having the formula Ca_3N_2. As metallic calcium also has the property of absorbing hydrogen at the same temperature, giving a crystalline hydride CaH_2, and as this hydride is not dissociated at 500 deg. C., the writers proposed to apply these properties of the metal for the extraction of argon from the air. The preparation of the argon includes four different operations. 1. Preparation of 100 liters of nitrogen. 2. Increasing the proportion of argon contained in the gas. 3. First purification. 4. Second purification by circulating the gases over calcium. In this way a practically pure argon is obtained. The first operation is carried out by using two tubes 4 feet long and 1.2 inch inside bore, filled with copper turnings which had been first oxidized in air, then reduced by hydrogen. The gas is drawn through the tubes by suction into a gas-holder. The proportion of argon in the gas is then increased by making it pass through an iron tube 3 feet long filled with copper turnings; then, after a set of sulphuric acid and potash tubes, the gas passes through two iron tubes 2.5 feet long, filled with a mixture of 5 parts powdered quicklime and 3 of powdered magnesium. The tube containing the copper is heated to redness. After driving off the hydrogen, a rubber bag is placed at the end of the apparatus. Then 100 liters of nitrogen are passed in the apparatus, and in two hours it becomes diminished in volume and is brought down to 10 liters. The gas which is collected in the rubber bag contains 10 per cent of argon.

The next step (purifying the gas) is carried out by passing the gas through a potash drier into a large tube of Berlin porcelain 3 feet long and 1.5 inches diameter. The tube is heated in a Mermet furnace. It receives a sheet iron trough containing 80 grammes of the lime and magnesium mixture. After it comes a second tube of Jena glass containing the same mixture, then a smaller tube full of copper oxide. A sulphuric acid and potash drier complete the apparatus, which is connected to a mercury pump for the purpose of drawing the gas through and sending it into a large glass collecting cylinder 2.8 feet high and having a capacity of 1,100 cubic centimeters (67.14 cubic inches). By repeated operations, the pump empties the gas-bag in 2 hours. The gas which is finally collected is nearly pure argon, containing only 5 to 10 per cent of nitrogen.

To obtain a practically pure argon, the following operation is carried out: The gas is passed from the cylinder through a tube of Jena glass containing 45 grammes of lime and magnesium mixture. After it comes a second tube containing four troughs of nickel in which are placed 3 or 4 grammes of metallic calcium in small pieces. Two mercury pumps are connected to the apparatus by a three-way cock. The first pump serves to produce a vacuum in the apparatus in the beginning. The second causes the circulation of the gas in the tubes, which are heated to low redness. In this way, by applying the characteristic properties of calcium noted by M. Moissan, the small quantities of nitrogen and hydrogen are retained by the calcium and the argon comes off in a practically pure state. The gas is collected in bottles of 250 c.c. capacity. To find out whether the argon is pure, it was studied by the spectrum of an induction spark, which showed the characteristic lines for argon, while nitrogen was practically absent. This new method therefore affords a good working process for preparing pure argon in considerable quantities.

SOARING FLIGHT.

BY GARRETT P. SERVISS, JR.

Among the many phenomena exhibited by flying birds, and observed and studied in attempted solution of that most interesting and baffling of all engineering problems, mechanical flight, there is one which is so remarkable in its paradoxical nature, that it has attracted perhaps more attention than all the others together. I refer to soaring, or, as it is sometimes called, sailing, and, in one of its aspects, aspiration. In performing this feat, the bird holds its outstretched wings absolutely motionless, and remains suspended in the air, traveling in any desired direction without, so far as can be observed, the expenditure of the slightest amount of energy. This feat seems so absolutely impossible on first sight that men have doubted their own senses, and have taken photographs of soaring birds, hoping that the camera plate, more rapid than the eye, would be able to detect some lightning-like movement of wing which would account for the bird's support. So far as the writer is aware, no such movement was ever detected. It remains then for us to explain the phenomena on mechanical principles, or else to admit that our theories of the action of elastic fluids, such as the air, are erroneous. Such explanations have been given, it is true, but so many of them are erroneous—indeed, I hope to show that only one of them is entirely reasonable—that it seems desirable to review them, and to endeavor to show that there is one other way in which the birds frequently use the energy of the wind for their support and propulsion.

For convenience in reviewing the explanations already suggested, it will be well to divide them into three general classes:

1. Attempts to explain soaring in uniform horizontal winds.

2. Explanations which require the assumption of ascending wind currents.

3. Explanations depending upon a wind continually varying in velocity or direction, or both.

The advocates of the first class of explanations have held that some particular shape of the bird's wings might have a peculiar action upon the air, so deflecting it that the wing would be forced upward and forward into the teeth of the wind. Others have invented highly ingenious but totally inadequate evolutions, by the performance of which the bird would be enabled to gain elevation, and eventually travel in any direction by sailing down an inclined path. It is not necessary here mathematically to treat in detail these explanations, though it is entirely possible. It will suffice to show by very simple considerations, the essential fallacy involved in any theory of soaring in uniform horizontal air currents. In the first place, consider a bird being supported stationary in the wind. The downward pull of gravity upon the bird must be counteracted by an equivalent upward force. This upward force on the bird has its reaction upon the air particles under the bird's wings, and the downward force on the air produces a downward acceleration of the air particles, which, combining with their forward motion, produces a resulting velocity greater than the original velocity. This means that the air, in passing the bird, has its energy increased, which is contrary to the law of the conservation of energy. In case the bird is performing evolutions instead of remaining stationary, the force upon the bird and air particles varies both in direction and amount, but an integration still shows an increase of total energy in the wind.

This is the basis of an exact treatment, and is given because the increase or non-increase in total energy of the wind when passing the bird furnishes a universal criterion for determining the possible correctness of any explanation of the phenomenon in question. A much simpler conception, however, has been suggested by someone, and we will give this briefly before taking up the next class of explanations. The air confined in a railroad car in motion constitutes a true uniform horizontal wind with regard to the earth. Yet no one could conceive of a bird performing evolutions with motionless wings, and remaining supported indefinitely in the air carried by the car.

In the second class of explanations, it is assumed that the lower strata of air moving over the earth's surface are retarded by friction and piled up, thus deflecting the strata above, and giving the wind a slight trend upward. Marked upward wind currents also exist over natural wind breaks, and on the slopes of hills when the wind is blowing toward the higher ground. Soaring birds, it has been stated by careful observers, seem to prefer such places in which to perform their aerial evolutions. Granting the existence of upward wind currents, we can understand one way in which soaring is accomplished.

Consider a kite against which a horizontal wind is blowing. The pressure of the air is normal to the kite surface, and is thus a force directed upward and backward. If now the backward component is neutralized by the pull of the string, the kite will remain suspended in the air through the vertical component of the wind's pressure. If we release the string, the kite will drift backward by virtue of the horizontal component of pressure, and sink to the ground. Suppose, however, that the wind takes an upward trend. The kite may now be tipped down in front; and if the wind is rising at a sufficient angle, the kite may even take a horizontal position, and still present the same angle to the wind. In this case the pressure upon the kite, always normal, will become a vertical force. If the wind tends upward at a still greater angle, the kite may be tipped down in front until the front edge is lower than the back, in which case the horizontal component of the pressure is directed forward opposite to the direction of the wind. If the kite could maintain equilibrium, it would advance into the wind under these conditions, and remain in the air indefinitely. Kite experimenters have observed this very action at times, and it is a true case of soaring, or better, aspiration.

Thus we see that the existence of upward wind currents is sufficient to render flight without exertion possible, but that soaring is always or even frequently due to such currents is very doubtful. We must then look to our third class of explanations to complete the theory.

Prof. Langley, by careful measurements of air velocities, has shown that all winds are extremely variable, his readings having indicated changes in velocity of ten miles or more per hour in a small fraction of a second. His investigations are fully described in his paper, "The Internal Work of the Wind," but his theory will be briefly stated here. A bird flying in such a variable wind would be carried along at the average velocity of the air, while the alternate puffs of high and low velocity would constitute alternate virtual winds, first blowing by him in the direction of his motion, and then against him in the contrary direction, his inertia preventing him from following the rapid fluctuations. Under these conditions, the bird by facing about first toward the virtual wind in one direction, and then toward that in the other, could always present his inclined wings to a current of air, and obtain a supporting reaction. The facing about might be accomplished by sailing in circles, an evolution often observed. This in brief was Langley's theory, and highly ingenious it is. It may under exceptional conditions be the manner in which soaring is accomplished, but in ordinary winds the variations in velocity certainly cannot exceed fifteen miles an hour, and even if these variations occurred extremely rapidly, the bird would only be subjected to a virtual wind of less than seven miles per hour, which is totally inadequate to support any known soarer.

Looked at in a slightly different way, however, the writer believes that the variations in velocity of the wind may be shown to be sufficient to account for all the observed phenomena of soaring. In the first place, the relative velocity of the bird to the air, which is effective in supporting the former, must be quite high. Langley has shown that at certain velocities a plane may support as much as three hundred pounds per horse-power expended, but this velocity is much higher than the five or six miles an hour which is secured in the action just described. The bird, then, cannot drift with the same velocity as the average wind, but must possess a velocity of perhaps twenty miles an hour with regard to it, to obtain support with the energy available. How, then, can this internal energy existing in the wind by virtue of its streakiness be utilized to propel a body traveling at twenty miles an hour with regard to it? Obviously, only by taking advantage of changes in velocity occurring at *right angles* to the direction of the bird's motion. Each time such a change occurs, the bird has added to its velocity a perpendicular component, which, combining with the motion which it already had, produces a resultant velocity greater than the initial. Since the kinetic energy due to the bird's motion is proportional to the square of the velocity, and since the square of the resultant velocity is the sum of the squares of the initial and the impressed velocities (being perpendicular to each other) it is evident that the bird has absorbed all the energy which the variation in the velocity of the wind could impart, and converted it into energy of motion in its new path. Of course, if the acquired energy is being continually used for support, no increase in velocity will result.

In performing such an evolution, the bird would be forced to bring its wings into a more or less vertical position, to take full advantage of these horizontal puffs of wind, and this probably accounts for the frequency with which soaring birds move in circles, for while moving thus, the centrifugal force allows them to tip up the plane of their wings. In describing this path, the center of the circle may drift with the average wind, while the bird takes advantage of every favorable puff to produce an acceleration perpendicular to the tangent at the time it occurs. The writer has many times observed sea-gulls soaring in just such distorted circles as would be produced by this action. In this action the bird takes full advantage of the "internal work of the wind" to maintain the velocity for support which its ratio of weight to wing surface renders most efficient.

Whether or not this proves to be the final solution of the problem, it is evident that soaring is much too complicated for man to imitate, at least until he has had long experience with motor-driven machines.

SCIENCE NOTES.

E. Salvioni has devised and accurately examined a microbalance which consists of a thin thread or very thin ribbon of glass or other material, fixed at one end and placed in a closed case; the case also contains a number of small weights (the larger of platinum wire, the smaller of silk thread) which, with the aid of a handle, can be placed on the flexible thread or ribbon. The flexure of the thread when loaded is observed by means of an ocular micrometer, and, as verified by the author for his instrument, is proportional to the weight which produces it; a conveniently placed spider thread serves as a sight-line for the measurement of the displacements. A glass thread 10 centimeters long, and one of two-tenths of a millimeter in diameter, will support by flexure a weight of more than 100 milligrammes, and, if provided with an optical arrangement which magnifies one hundred times, will serve to weigh to one-thousandth of a milligramme. To avoid the inconvenience caused by subsequent elasticity, the balance is provided with a stop, which enables the flexure to be maintained after unloading. Salvioni finds that the loss of weight of musk by volatilization is clearly demonstrated by this instrument. The loss is proportional to the time.

In a study of the circulation of the atmosphere of the sun, in the Monthly Weather Review, Prof. Frank H. Bigelow presents a mass of data and observations showing that "the sun should be regarded as an incipient binary star." Recent scientific work in investigating the circulation of the solar atmosphere in accordance with the laws governing the convective and radiative action of a large mass of matter contracting by its own gravitation, have led Prof. Bigelow to the hypothesis, that "the single fiery envelope conceals two disks." A series of observations extending over many years on the period of solar rotation at various points on the surface shows that "the same meridian of the sun is seen twice in a single rotation of the entire mass, first as the eastern limb, and second, thirteen days later, as the western limb. Whatever may be the intrinsic activity of the sun at a given zone and on a given meridian, that display becomes visible twice, first to the east, and second, to the west." The tables prepared by Prof. Bigelow giving the rate of angular rotation of various zones of the sun's surface show that it is far from uniform, being increased in proportion to the distance from the equator. As yet little has been done regarding "the fundamental problem of the mode of the internal solar circulation." This difference of external activity of the sun "on two opposite sides of its mass, as if a certain diameter had greater energy than the one at right angles to it," is similar to a recent discovery of Prof. Bigelow in regard to the earth's atmosphere, and leads him to the conclusion already stated, that "this persistent excess of outflowing energy on two opposite sides of the sun suggests the possibility that the sun should be regarded as an incipient binary star where the dumbbell figure of rotation prevails instead of the spheroidal. If this is really the case, and the evidence suggests it, then there would be a reason for the existence of the two primary centers of activity of the sun instead of its having a single center. From this we would expect to find that the sun has two magnetic and two meteorological systems, and indeed some double-acting system appears to impress itself generally upon the solar cosmical relations. This view is quite in harmony with the well-known fact of the existence of numerous binary systems of suns more or less widely separated, and it can not be regarded as unlikely that the sun is developing in the same way. The enormous mass of the sun would seem to entice its constituents to group themselves preferably about two centers for the physical processes involved in circulation and radiation, rather than about one, and I suspect that this is the correct explanation of several well-known phenomena."

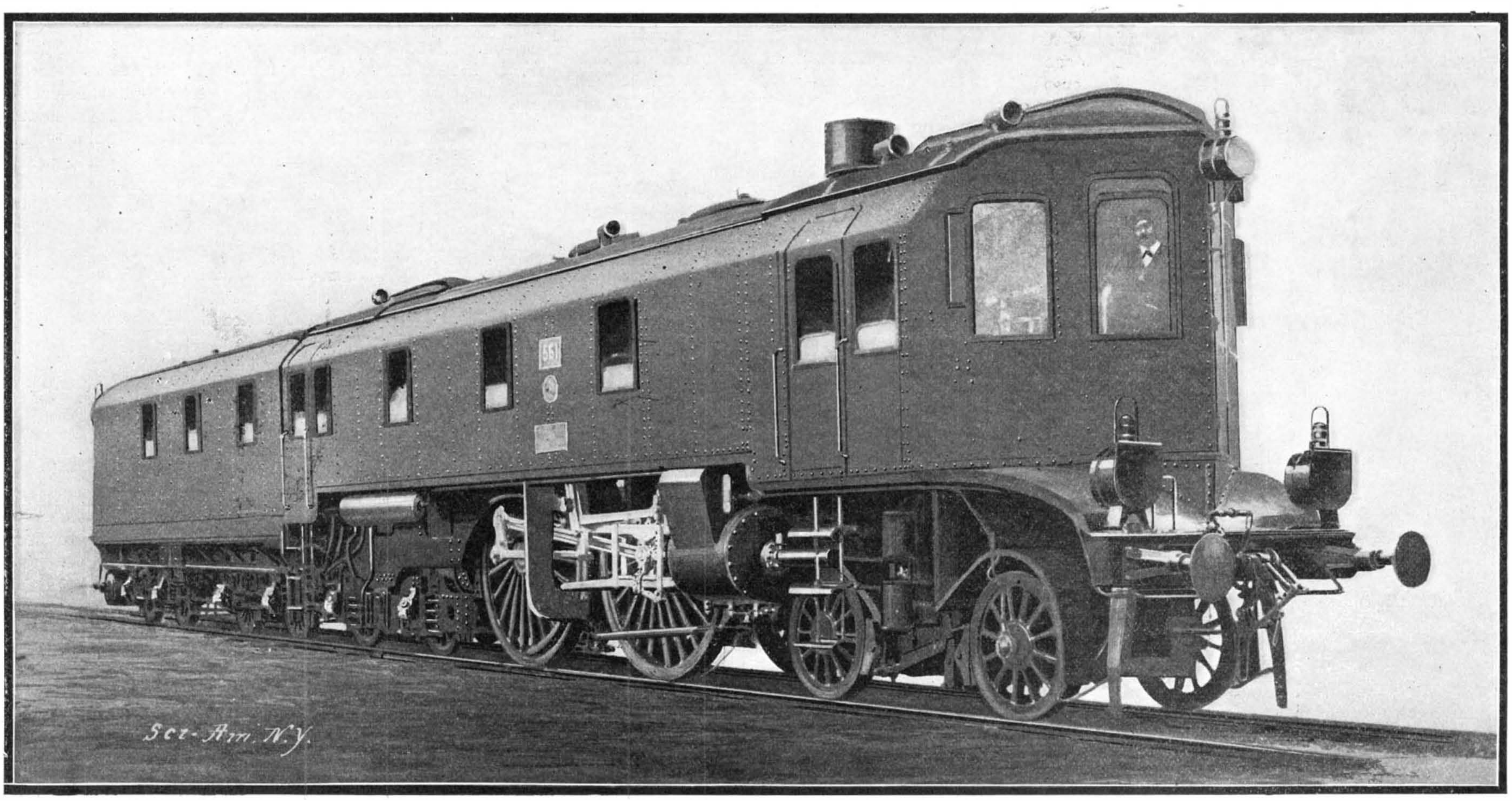
A GERMAN HIGH-SPEED LOCOMOTIVE.

It will be remembered that toward the close of the recent high-speed electrical tests on the Berlin-Zossen government railroad, it was decided to carry out another series of tests, this time of steam locomotives, to determine what was the highest practicable speed that could be obtained with railroad trains of a given weight hauled by steam locomotives of exceptional power designed especially for this work. The accompanying illustration was made from a photograph of one of these engines which, a short time ago, was completed at the works of Messrs. Henschel & Sohn, Cassel, Germany. The locomotive was designed to haul a train of four or five corridor passenger coaches, of a combined weight of 200 American tons at a sustained speed of 80 miles an hour, and with an indicated horse-power of 1,400.

The locomotive is a three-cylinder compound, with the high-pressure cylinder located inside, and the two low-pressure cylinders on the outside, of the frames. The inside high-pressure cylinder is connected to a crank on the axle of the forward pair of driving wheels, while the low-pressure cylinders are connected to the rear driving wheels; all four wheels are coupled together. Forward under the smokebox is a four-wheeled truck, and another four-wheeled truck is located beneath the firebox.

The tender is carried on two four-wheeled trucks, and all the wheels, both of locomotive and tender, are fitted with both hand and air brakes, the latter working under a pressure several pounds higher than is customary. The total length of the engine from the front of the locomotive to the rear of the tender is 81 feet. The peculiar appearance of the locomotive is due to the fact that both the engine and tender are completely incased in a sheet steel covering, which is finished at the front of the locomotive with a wedge shape, with the object of reducing the air resistance. The chief engineer has his cab in this wedge-shaped front, which is provided with large glass windows to give him an unobstructed view ahead. He has an assistant engineer in the cab, who takes his turn at stoking with the fireman. Communication between the fireman and engineer is had by means of running boards located inside the engine casing; while at the rear of the tender there is a gangway, which permits of communication from end to end of the train, from the engineer in his cab to the conductor or "guard" at the rear of the train.

The locomotive has a grate area of 50 square feet, and a heating surface of 3,000 square feet. The capacity of the tender is 4,000 gallons of water and 7 tons of coal. When it is fully equipped for service, the locomotive weighs 177,000 pounds, and the tender 128,000 pounds, the total weight of engine and tender being, therefore, about 150 short tons. This load has been so distributed that the concentrated wheel load will in no case exceed that which is allowed by the official regulations. It is interesting to know that this locomotive, which has been designed according to Baurat Wittfeld's data, is to be exhibited at the St. Louis World's Fair after a series of trial runs has been completed.



GERMAN HIGH-SPEED LOCOMOTIVE.

A New Mineral from Ceylon.*

BY SIR WILLIAM RAMSAY.

In the beginning of February I bought from Mr. Holland five hundredweight of the mineral described by Prof. Dunstan in Nature. It crystallizes in cubes, and the density is substantially that found by him. Mr. Tyrer, of the Stirling Chemical Works, Stratford, was so kind as to promise to work it up for me, and the process is still being carried on.

I had hoped to have positive and definite results to communicate before describing its constituents, but the publication by Prof. Dunstan of an analysis, and his statement that he is still engaged in its investigation, makes it necessary to write this letter.

The mineral, when heated alone, gives off 3.5 cubic centimeters of helium per gramme; fused with hydrogen potassium sulphate, the amount is increased to 9.5 cubic centimeters. From this source I have already stored about 12 cubic feet of pure helium extracted in Mr. Tyrer's works.

It was at first believed that the mineral was rich in uranium, but different specimens contain only from 8 to 12 per cent of that element, agreeing in this respect with the analyses published by Prof. Dunstan. Next, the other main constituent was believed to be zirconium, but the high density of the mineral rendered this improbable. An analyst of high standing, whose daily business it is to analyze minerals of this kind, returned 82 per cent of zirconia as a constituent; the percentage of thorium was trifling—under 1 per cent. The mineral contains practically no thorium; this has been repeatedly confirmed in my laboratory. Nor does it contain any appreciable amount of cerium, lanthanum, and didymium. The oxalate is almost completely soluble in excess of ammonium oxalate—a reaction which excludes thorium and the cerium group, but which points to zirconium. The equivalent of the elements of the oxalate group, which I at first took for zirconium, excludes the presence of any large quantity of zirconium, although that element is undoubtedly present. Fractionation shows that the oxalate precipitate (the portion soluble in ammonium oxalate) gives equivalents between 25.0 (the most insoluble portion of the double sulphate) and 44.7 (the most soluble portion); by far the major part of the element has the last-mentioned equivalent. The separation of this portion is now being carried out with large quantities of material; several hundredweight is being worked up.

Assuming that the element is a tetrad, which is probable from its behavior, it undoubtedly possesses an equivalent approaching the highest number (44.7), and for this there is a gap in the periodic table between cerium and thorium; one at least of the elements present (supposing that there is more than one present) will probably have an atomic weight of about 177, preceding tantalum (182.5) in the horizontal row of the periodic table.

I am at present engaged in mapping the spectrum of this new body or bodies.

As for the radio-activity, the mineral was bought in the hope that it would have a high content of radium. There is a trace of radium present, due, no doubt, to the spontaneous change of the uranium which the mineral contains. But the radio-activity due to this source is certainly not 5 per cent of the total.

The period of decay of the emanation appears to point to the presence of a radio-active element closely resembling thorium X. The half value is 50 or 51 seconds, and while this is not quite the time for the decay of thorium emanation, it very nearly approaches it; at present the balance of evidence appears to point to the presence of an element closely resembling thorium, but not identical with it. The total radio-activity, moreover, is much greater than can be accounted for by the supposition that the one consists of pure thoria. Within the limits of a letter I am obliged to omit many more characteristics of this curious ore which have been ascertained, but I hope soon to be able to publish more definite results; as it is, I regret to have been obliged to tell an imperfect story.

I should like to conclude by acknowledging the great assistance given me in this work by Mr. Tyrer and by my students, Messrs. Gimingham and Le Rossignol.

* Nature.

Utilizing Whale Carcasses.

It is announced that the American company which established the plant at Balena, Newfoundland, using the Russmuller process of utilizing the carcasses of whales, has met with complete success and that the government of Newfoundland has established new plants at Chateau, St. Lawrence, Agnaforte, Cape Royal, and Snooks Arm. There are now in the course of construction and nearing completion plants at St. Mary's, Trinity, Safe Harbor, Lemonine, Lance au Loupe, Cape Charles, Notre Dame Bay, and one in Labrador, all of which are operated under the same process. Up to 1892 the business of utilizing commercially the carcasses was carried on by an English syndicate, which employed a number of experts, but gave up the business after expending a capital of $180,000. Every ounce of the whale is used in the manufacture of oil, stearin, bone meal or bones, and other articles of commerce which are shipped abroad. This new industry employs a capital of more than $1,000,000 and furnishes employment to over 1,000 men, many of whom were forced to go elsewhere each season to obtain work.

Discovery of a New Comet by Dr. Brooks.

Dr. William R. Brooks, director of Smith Observatory, and professor of astronomy at Hobart College, discovered a new comet on the evening of April 16, in the constellation Hercules. Its position at discovery was right ascension 16 hours, 58 minutes, 10 seconds; declination north, 44 degrees, 10 minutes.

A second observation was secured on the evening of April 17, with a position of right ascension 16 hours, 55 minutes, 5 seconds; declination north, 44 degrees, 48 minutes. This gives a daily motion of three-quarters of a degree in a northwest direction. The comet is at present a fairly bright telescopic object with a short tail.

It is the first comet of 1904 and the twenty-fourth comet discovered by Prof. Brooks.

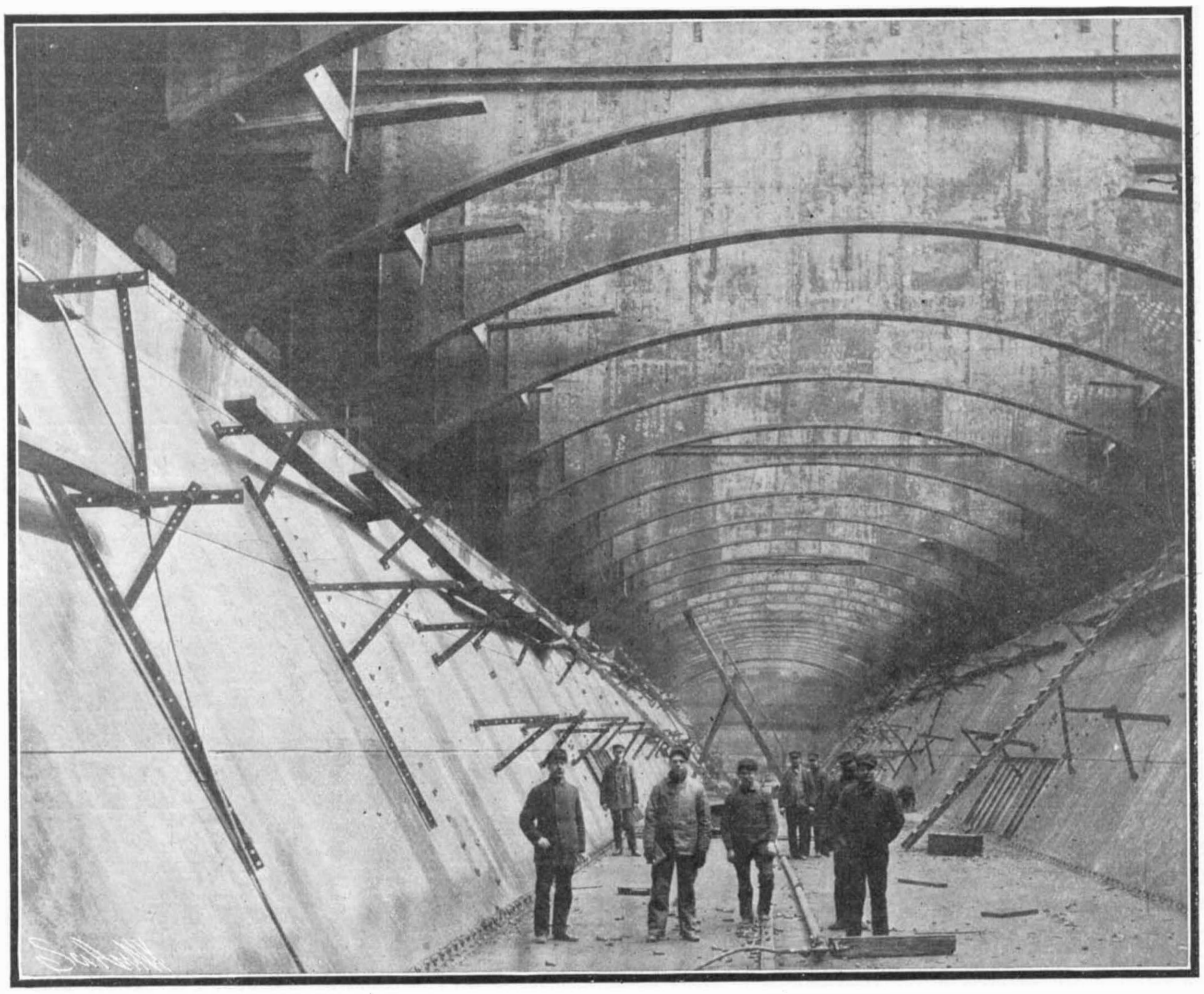
THE "WOLVIN," THE LARGEST FRESH-WATER STEAMSHIP AFLOAT.

BY W. FRANK M'CLURE.

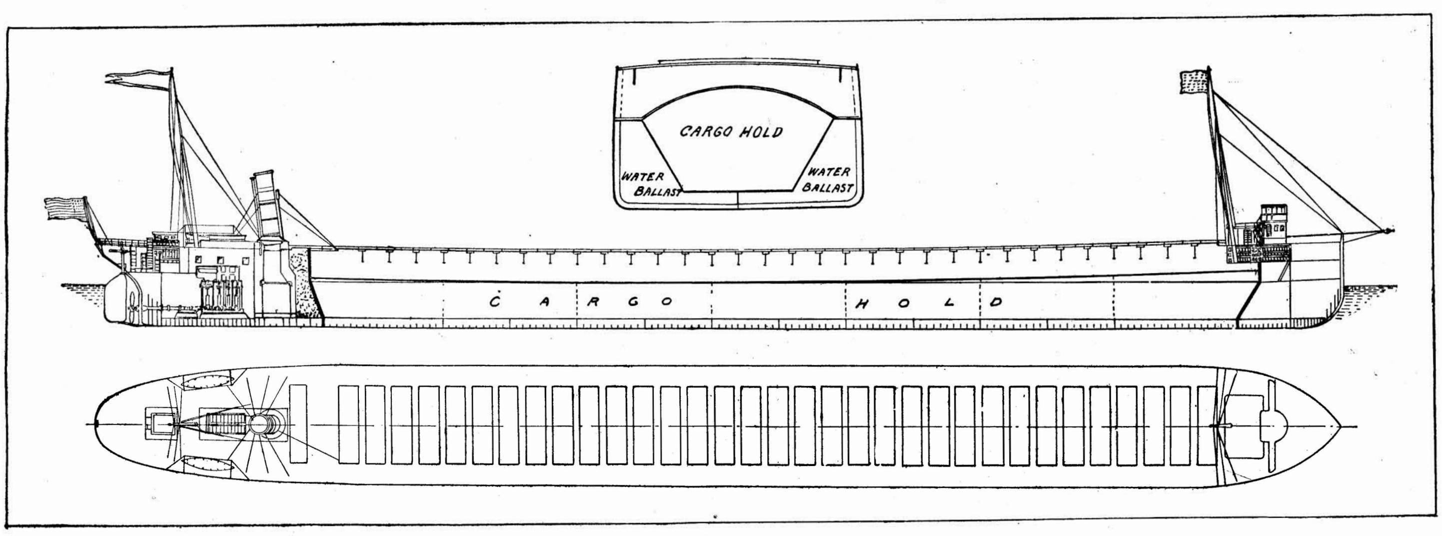
On April 9 the new steamer "Augustus B. Wolvin," the largest fresh-water vessel in the world, was launched at the yards of the American Shipbuilding Company at Lorain, O., harbor. Inasmuch as this vessel is 62 feet longer than the largest vessel ever before built for the Great Lakes, and embraced several important new features of construction, the launching was of unusual interest throughout the industrial world, and was witnessed by some 20,000 people. Men from the coast yards were present.

In dimensions, it is said that there are few strictly freight vessels upon the ocean that exceed the "Wolvin." She is 560 feet over all, 540 feet keel, 56 feet beam, and has a depth of 32 feet. She is built of steel, and in this connection it is a noteworthy fact that she is just twice the length of the first steel vessel built for the lakes, in the year 1887. About three years ago four vessels were launched from the yards at Lorain with a length of 498 feet, 52-foot beam and 30-foot depth. These were the "John W. Gates," "J. J. Hill," "Isaac L. Elwood," and the "Edenborn." The cost of the new steamer "Wolvin" is close to a half-million dollars. On account of the building of this boat, the drydock at Lorain was lengthened 60 feet, at a cost of $10,000.

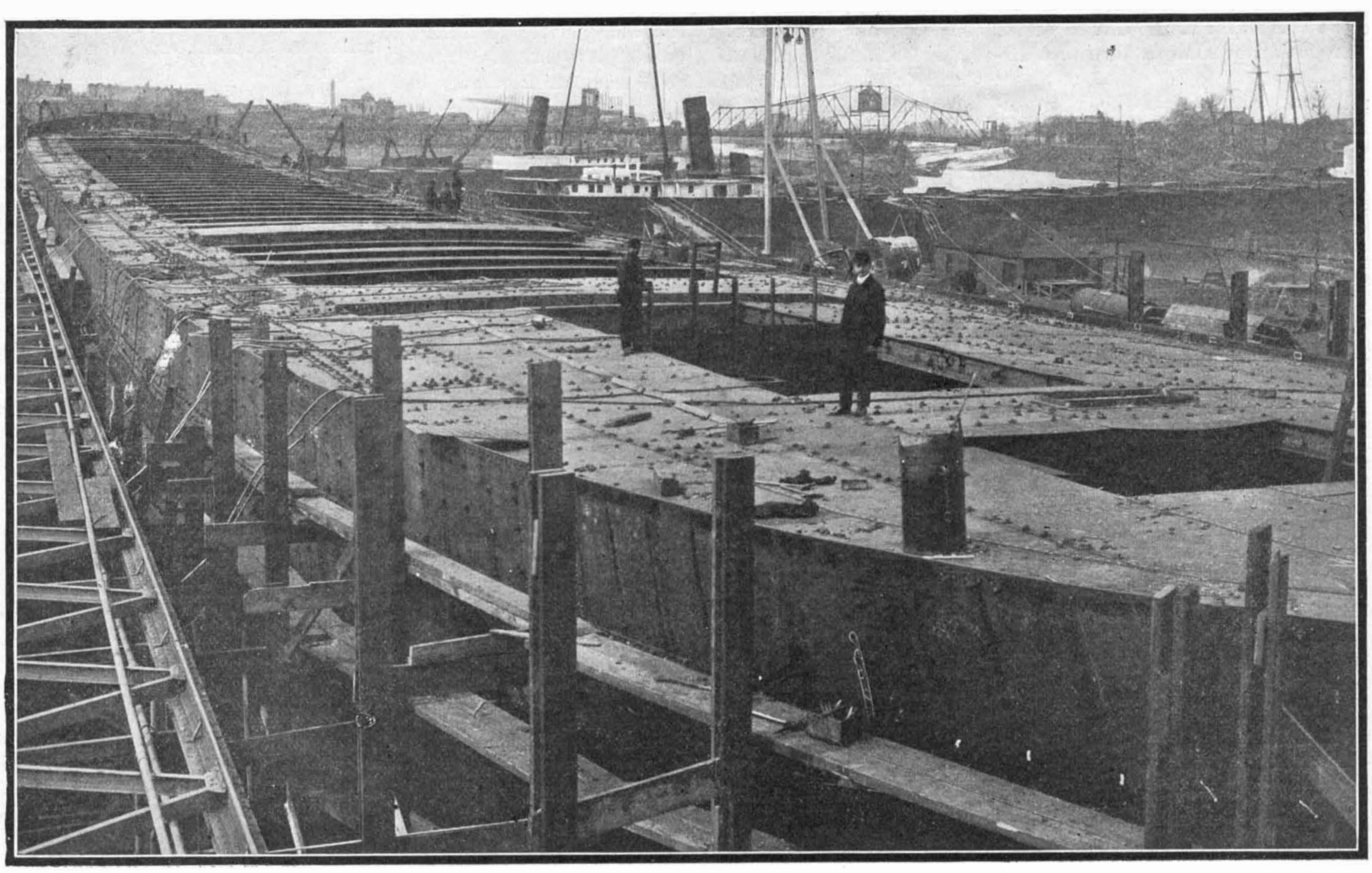
One of the most interesting features connected with the construction of the new vessel is the shape of the cargo hold, which is built in the form of a hopper, with sides that slope from the main deck to the tank top, and ends built on the same slope. The continuous length of this hopper, without divisions of any kind, is 409 feet. Its width at the top is 43 feet and at the bottom 24 feet. This form of construction, it will at once be seen, will best accommodate the automatic "clamshell" unloading machines, by keeping the ore cargo at all times within the grasp of the giant scoop. This will therefore obviate the greatest difficulty heretofore experienced in operating these machines.



The Hopper Hold, Showing the Steel Arches Which Support the Upper Deck and Hold the Sides of the Hull to Form.



Transverse Section, Inboard Profile and Plan, Showing the One Great Hopper Hold, 409 Feet Long, with Its 33 Hatches.



Length, 560 feet; Beam, 56 feet; Depth, 32 feet; Cargo capacity, 12,500 tons.

THE "WOLVIN," THE LARGEST FRESH-WATER SHIP IN THE WORLD.

The space between the sides of the hopper and the sides of the vessel is used for water ballast, so that the latter, as well as being in the usual double bottom underneath the hopper, extends up the sides to the height that may be desired. The water-ballast space is divided into compartments by water-tight athwartship bulkheads at intervals of some 60 feet. The total water-ballast capacity is 8,000 tons of water. Instead of the ordinary hold stanchions, there is a system of girder arches which support the upper deck as well as the sides of the ship. More than 750,000 rivets were used in the construction of this vessel. In all, it contains 4,500 tons of steel.

There are thirty-three hatches with 12-foot centers. Each hatch measures 33 x 9 feet in the clear. The patent hatch covers are opened and closed by machinery. The only erections on the spar deck are the dining-room skylight aft, the coamings around the engine and boiler openings, and the pilot-house and texas forward. Steam has been used in every possible instance where manual labor could be saved. On the spar deck there are six 8-inch by 10-inch single-drum engines, each carrying a steel-wire mooring line. Then there is a steam windlass to be used for handling the two 8,000-pound anchors, while on the spar deck aft there is a steam capstan.

The cargo hold, heretofore described, has a capacity of 12,500 tons of coal or 401,000 bushels of grain. The vessel is expected to carry from 10,000 to 11,000 tons of iron ore on an 18-foot draft. In her coal bunker, which is located in front of the boiler room, she will carry 350 tons of fuel. During the early part of May the "Wolvin" will take on a cargo of 12,500 tons of coal at Lorain for the head of the lakes, and will thereby break all cargo records of the Great Lakes. In order to accommodate this vessel at some of the lake ports, quite extensive harbor improvements would be necessary. It is probable that her lower lake destination this season will be at Conneaut, the "Carnegie port," where the giant automatic unloaders were first installed, and where they are found to-day in largest numbers.

Comfortable staterooms, social parlor, and dining-room for the owners of the "Wolvin" and their families are situated immediately under the pilothouse and texas. The officers' quarters are on the deck immediately below those of the owners. Alongside of the engine aft are the quarters of the engine-room officers. The kitchen, dining-room, and messroom for the crew are also in the after end of the ship.

The new vessel has quadruple-expansion engines, cylinders 18½, 28½, 43½, and 66 inches, and having a 42-inch stroke. All the propelling machinery is located in the after end of the vessel. There are two boilers, both of the Babcock & Wilcox type, using 250 pounds working pressure, and the steam is superheated. Mechanical stokers are used, which is in keeping with the policy that nothing that can be done by machinery shall be done by hand. The coal is first fed into hoppers, from which it passes on to traveling grates. The ashes are taken from a point at the rear of the boilers and thrown overboard by means of steam-driven elevators. The boilers are fitted with a system of induced draft.

The new freighter, aside from its size, will be striking in appearance among other vessels of the Great Lakes, in that it is painted yellow. The bodies of most lake freight vessels are black in color. The vessel is named for Mr. A. B. Wolvin, of Duluth, who was instrumental in having this great ship built.

The Commerce of the Siberian Railway.

The total distance from St. Petersburg to Port Arthur by the Russian Trans-Siberian Railway and the Russian lines in Manchuria is 5,913 miles, or practically twice the distance from New York to San Francisco. This is one of the numerous interesting facts about Russia and her railway and commercial systems presented in a monograph just issued by the Department of Commerce and Labor through its Bureau of Statistics, entitled "Commercial Russia in 1904." The publication, which occupies more than 100 large pages, discusses in detail present commercial and financial conditions in Russia and other subjects closely allied therewith. Area, population, railways, water transportation, methods of communication, agriculture, manufactures, commerce, and many other subjects of this character are among those discussed. Agricultural conditions, and especially Russia as a rival of the United States in wheat production; mining conditions, and especially Russia as a rival of the United States in mineral oil production; manufacturing conditions, and Russia as a possible competitor of the United States in the markets of the Orient for manufactures are discussed in detail.

Regarding the railways, which are a subject of especial interest at the present time, in view of present conditions in Russia and the Orient, the report says:

The importance of railways as means of communication is now greater than that of the rivers and other water routes, as is shown by accompanying tables. The building of the trunk lines, with the exception of the St. Petersburg-Warsaw-Vienna, built during the years 1845-1848 and 1853-1862, respectively, and the St. Petersburg-Moscow (Nicholas line), constructed between 1843 and 1851, dates back to the decade between 1860 and 1870. These years witnessed the construction of the entire group of railways, with Moscow as their common starting point, viz.: Moscow-Nijni-Novgorod (1861-62), Moscow-Voronezh (1862-1869), Moscow-Volodga (1862-1872), Moscow-Kharkov (1866-1869), with its branch to Kief (1868-1870), and Moscow-Warsaw (1866-1871). Next in point of time comes the construction of roads connecting the black-soil region with its natural outlets, the ports of the Baltic and Black seas: Riga-Tsaritsyn (1861-1871), Kief-Konigsberg (1870-1873), Libau-Rommy (1871-1874), and Samara-Viasma (1866-1871), all of which lead to the Baltic. Simultaneously lines were built connecting each one of the more important southern seaports with the agricultural provinces. Chief among them are: The Odessa line, with its branch to Yelisavetgrad (1867-1869), and its Bessarabian branch (1871-1874), Kharkov-Nikolaiev (1869-1873), Kharkov-Taganrog (1869), Voronezh-Rostov (1861-1876), and, finally, Kharkov-Sevastopol (1869-1875).

The Russo-Turkish war of 1878-79 caused an almost entire suspension of railway building. It was only during the decade beginning with 1880 that activity in this field was again resumed, but the character and method of construction of the newly-built roads changed abruptly. In place of the former trunk lines, connecting either the black-soil area with the seaboards of the Baltic, Azov, and Black seas, or with the central industrial region around Moscow, these years witnessed the construction of great strategic railroads, such as the Trans-Caspian, the Polessie system, besides roads primarily destined for the service of relatively small though important industrial regions (Catherine line, Ivangorod-Dombrovo). Moreover, the system of granting franchises (concessions) was superseded by the building and working of roads directly by and on account of the state. At the same time the redemption by the government of great railway systems was going on, so that for some time it seemed as if all private roads were going to be acquired by the state. Although of late greater latitude has been given to private initiative, by for the greater part of Russian railways is in the hands of the government. Out of 36,673 miles under the control of the ministry of communication on January 1, 1904, 24,436 are worked by the state, and 12,237 miles only by private companies.

The adverse years, 1891 and 1892, gave a new impetus to railways. "In order to give employment to the starving peasantry" the government undertook and encouraged the construction of new roads. A new era of railway building began with these years, which, in its vigor, soon surpassed anything seen not only in Russia itself but anywhere else in Europe. Thus, while during the above years the number of versts opened for traffic was but 123 and 419 respectively, the succeeding years mark the beginning of an exceedingly energetic expansion of the railway system, whose termination does not seem to be at hand even in the near future. According to official figures there were opened for traffic during:

Year.	Miles.
1893	1,043
1894	1,147
1895	1,277
1896	1,953
1897	1,190
1898	1,897
1899	3,297
1900	1,647
1901	2,235

These figures include roads built not only by the state, which has its hands full with the construction of the grand trans-Siberian railway, but also by corporations whose activity now almost surpasses that of the early years of the decade beginning with 1870, the first period of great railway coustruction, when the building of roads, for some time at least, became the monopoly of a few private companies. At present franchises are eagerly contested by competing corporations, a fact unheard of until recently in Russia, where the state, not so very long ago, had yet to guarantee the interest on the stock and bonds of the chief railroad corporations. The ministries of finance and transportation have, during the latest years, been literally swamped with petitions coming not only from railroad and construction companies, but also from representatives of "local interests," as mining, manufacturing, and agricultural groups. The length of Russian railways in Europe alone has thus considerably increased during the last ten years, and surpasses now that of France and Great Britain, respectively, being inferior only to that of Germany.

Simultaneously with the redemption of the greater part of Russian railways the government undertook the difficult task of regulating the railway tariffs for both passengers and goods. The principles adopted were those of the "zone" tariff, and the results of the innovation have been very encouraging, for both passenger and freight traffic have increased considerably since the introduction of the new tariffs.

The present state of the Russian railways, according to the recently published returns of the ministry of communications, is stated as follows: At the beginning of 1902 the total length of all Russian railways (exclusive of railways in Finland) was 35,187 miles, of which 28,982 miles were in European Russia, 5,138 represented the length of railways in Asia (exclusive of the Manchurian Railway), and 1,067 were secondary railways of local character. Of this total of over 35,187 miles, 23,557 miles, or over 67 per cent, were owned and operated by the government. The value of this system, exclusive of the local secondary roads, is given as 5,149,399,000 rubles, or about 99,000 rubles per verst. Of this grand total expended in the construction of railways the government's share is 4,914,805,000 rubles, or about 95 per cent. This amount includes the value of all corporate securities, both stocks and bonds, the income from which was guaranteed by the government, those of the bonds amounting to 2,920,428,000 rubles, which are held by the treasury, and the total amount of subsidies granted for the construction of railways.

For January 1, 1904, the length of the entire Russian railway system, exclusive of 1,944 miles of railroad in Finland and 1,555 miles of the eastern Chinese road, is officially stated as 36,673 miles. Of this total, 31,493 miles were in Europe and 5,180 miles in Asia. Of the European railways, the government operates 19,256 miles, while 10,954 miles of railway of general interest and 1,312 miles of railways of local interest were operated by private corporations. The total length of double-track roads was 6,830 miles. The length of miles opened for operation during the year 1903 was 446 miles. The total number of miles under construction was 3,931.

For the five years 1897-1901 the net earnings per mile of the American railways and railways in European Russia compare as follows:

	American railways.	Russian railways in Europe.
1897	$2,016	$1,789
1898	2,325	1,778
1899	2,435	1,705
1900	2,262	1,664
1901	2,854	1,493
Average	$2,378	$1,686

It is seen that the net average per mile earnings of the American railways for the period in question are over 40 per cent higher than those of the Russian railways. Still more unfavorable comparisons might be drawn if the financial accounts of the Russian railways were set side by side with the same accounts of European railways having a much larger density of traffic than the United States railways.

Engineering Notes.

An immense scheme of additional irrigation for the Punjab, costing 6½ crores of rupees, is being prepared, and in order to keep pace with what is being done, the government of India has sanctioned a second chief engineer for irrigation for that province.

A new type of automatic loom has been devised by two Burnley operatives. In this device all the features of the existing Lancashire loom are retained, and by the introduction of a hopper containing weft in steel tubes and some simple mechanism on the slay, an automatic loom is produced. When the weft thread breaks, the weft fork sets in motion mechanism which forces the old weft tube out of the shuttle at the top, a full tube immediately taking its place at the bottom.

Pulverized coal for combustion under steam boilers was the subject of a paper read at a recent meeting of the Western Society of Engineers, Chicago, by Mr. John M. Sweeney. According to the results of comparative trials cited by him, 9.4 pounds of water, equivalent evaporation from and at 212 deg. Fahr., were realized per pound of fuel with the pulverized coal and 7.5 pounds per pound of fuel with hand firing. On the basis of combustible the equivalent evaporation in the two cases was 10.47 and 8.4 pounds, respectively.

A record railroad run is to be inaugurated by the London and South-Western Railroad of England in connection with the recent decision of the American Steamship Line to make Plymouth instead of Southampton the port of call in their transatlantic traffic. The boat train of this company is to convey the passengers direct from Plymouth to London without a single schedule stoppage, a total distance of 230¾ miles, in 270 minutes. This will represent an average speed of 51.27 miles per hour, which considering the difficult nature of the track will be a commendable performance. Furthermore, it will constitute the longest railroad run without a stop in the world.

The famous Morris Canal in New Jersey is practically condemned in a report just rendered to Governor Murphy by ex-Governors Werts, Griggs, and Voorhees. The canal company was incorporated in 1824 and built this waterway soon afterward, from Phillipsburg on the Delaware River to Jersey City, a distance of 106 miles. A number of reservoirs were constructed, some of which are now summer resorts and surrounded by valuable estates. The State has a right to take the canal in 1974. It was leased in 1871 to the Lehigh Valley Railroad Company, which has since operated it. The eminent commissioners report that even were the property in perfect condition, it could not be operated at a profit. The decline in its value has been due to the construction of railways which became powerful competitors, carrying freight at cheaper rates than is possible with the canal boats except at a loss. Eventually all traffic was diverted from it except the trifling amount from the lessee. At the present time it stands in the way of needed public improvements, but its abandonment involves the untangling of a complication of interests, including the stockholders of the canal company, the lessee railroad company, the State, the municipalities along the route, the landholders about the reservoirs, and the people having contracts for important water rights, not to mention a lot of trifling claimants for consideration. While the abandonment is assured, it now appears that it will involve more trouble and delay than the original construction of this canal, once the pride of northern New Jersey.—Engineering Record.

Correspondence.

Prevention of Premature Firing of Big Guns.

To the Editor of the SCIENTIFIC AMERICAN:

Referring to the gun explosion on the battleship "Missouri" on the 13th instant, will inquire if it would not be a simple mechanical problem to design a device which would make it impossible to fire one of these guns until the breech was closed, similar in principle to the safety attachment on the handle of a Smith & Wesson pistol, which prevents the trigger being pulled until the palm of the hand grasps the handle?

GEORGE BRECK.

San Francisco, Cal., April 15, 1904.

[The latest types of guns are provided with a safety device for the purpose of preventing premature firing. The gun is fired by closing an electrical circuit, and the contacts are not in a condition to close until the breechblock is entirely screwed home.—ED.]

The Blondlot, or N-Rays.

In this laboratory we have obtained uniformly negative results in experiments on the Blondlot rays. Our experiments were made with the help of seven observers, including five doctors, one student, and one laboratory attendant. Calcium sulphide screens rendered fluorescent in a separate room by burning magnesium were employed. They were brought into an absolutely dark room in which the observers had been kept for some time. Two forms of screens were used:

(1) Flat screens on which a circular area on a slip of glass is covered by calcium sulphide.

(2) The later form in which a circular area at the back of the hemispherical lens is covered by calcium sulphide.

The screens were either held by the hands of the observers or were clipped on stands.

The observers were told first to look steadily at the screens and report any variation in brightness, calling out "bright," "dimmer," "dim," "brighter," etc., as the appearances seemed to change. Even with the screens on the slips of glass the observers after a few moments were able to call out the changes, *although there was no attempt at muscular contraction.* With the lens form of screen the changes in brightness were very marked.

We next attempted to find whether muscular contraction behind the screen caused an increase of brightness. Of course, where the observer sees a change in brightness without muscular contraction it is easy to be misled on this point. We made the observer continue to call out the degree of brightness, and we contracted the muscles of the arm behind the screens sometimes after he had called out "bright" and sometimes after he had called out "dim." In the great majority of cases the effect we looked for did not follow. In the few cases in which it occurred we naturally attributed the results to the changes in brightness which can be observed without any muscular contraction.

We next told our observers to look, as it were, into the distance beyond the bright spot, and to report on the brightness of the screens. When the accommodation of the eyes for the near vision was relaxed they reported without exception that the brightness of the screens was constant, and that muscular contraction made no difference.

When observers were then asked to touch the backs of the screens, thus warming them, they reported an increase of brightness.

It is not easy to explain the phenomena we have described. We believe that there is difficulty in accommodating for the fluorescent circle, and that there is a wavering movement of the ciliary muscles, and probably also a wavering in the size of the pupils. Yet it is asserted that we can focus a point of light in a dark room, and it is difficult to see why the fluorescent screen cannot also be kept steadily in focus when it consists of a flat glass slip with fluorescent circle. In the case of the later, and presumably more successful form of apparatus, the difficulty is easily understood. In that form the fluorescent rays proceed from the back of a hemispherical lens, that is, from a point within the posterior principal focus, and they are widely divergent and thus strain the accommodation of all but near-sighted people. The fact that in every instance we found that the light becomes steady after relaxation of the accommodation is very striking.

But the phenomena observed by us do not go any distance toward explaining the results described in M. Blondlot's papers. How is it that he and many of his compatriots see increase of brightness under conditions in which we see none? Is the explanation to be found in the paper by Heinrich, "Die Aufmerksamkeit und die Funktion der Sinnesorgane" (Zeitschr. für Psychologie u. Physiol. d. Sinnesorg., vols. ix. and xi.), in conjunction with our observations? Heinrich found after many careful experiments that the pupil dilates when attention is directed to an object situated in the field of indirect vision, and that it dilates still more during a short mental effort, such as a calculation. He found also that on directing attention to an object in the field of indirect vision the ciliary muscle relaxes, thus diminishing the curvature of the crytalline lens, and that during mental calculation this change is very marked, causing a curvature even less than that required for vision of a remote object. He found also that under the same conditions the axes of vision tend to become parallel or even divergent.

Can it be that the mental condition of some observers in a state of expectancy reacts on the intrinsic muscles of their eyes, and thus they see what they think they should see?

We have also experimented with the rays from a Nernst lamp, but without result.—Physiological Laboratory, the University, Glasgow, March 29. John G. McKendrick, Walter Colquhoun, in Nature.

TWO HOME MADE WIRELESS TELEGRAPH RECEIVERS.

Wireless telegraph receivers or "kumascopes," to adopt the name given them by Prof. Fleming, nearly all depend upon the principle of an imperfect contact in a local circuit being made better by oscillations generated by the Hertzian waves. Most of these kumascopes have an exceedingly simple form and can be constructed by any amateur. One of the simplest is that

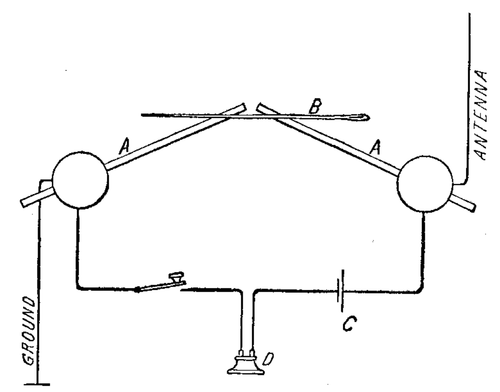


Fig. 1.

shown in Fig. 1, which only requires two binding posts, two pieces of No. 12 aluminium wire, and a large sewing needle. The wires *A* are supported at an angle with each other, as shown in the diagram, and across them lies the needle *B*. The kumascope is connected up in the usual way to a telephone receiver *D* and a local battery *C*. Care should be taken to make the battery sufficiently weak, for this is a very common cause of failure. A battery of suitable power can be made by filling a half-pint fruit jar half full of water and dissolving in the water a heaping teaspoonful of common salt. An electric-light carbon and an ordinary battery zinc rod may then be used for the electrodes. The kumascope may be used in connection with transmitting apparatus, such as that described in the SCIENTIFIC AMERICAN of September 14, 1901. The Hertzian waves sent out by the transmitter will be detected by the usual bubbling or buzzing noise in the telephone. In our diagram we have shown one of the binding posts connected with the ground, and the other to the antenna. This is necessary only where considerable distances are to be covered, but may be dispensed with where the transmitter and receiver are both located in the same room or building. The imperfect contact in this kumascope is due to the thin film of oxide which always covers the surface

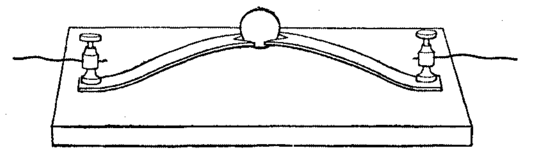


Fig. 2.

of aluminium. The film is sufficiently thick to normally prevent the passage of the low-power current of the local circuit, but its conductivity is readily increased by the peculiar action of the electric surgings or oscillations set up in the aluminium wires by the Hertzian waves. The resistance of the oxide, however, is immediately restored when the oscillations cease, and the buzzing sound in the telephone is therefore due to the rapid variations in the battery current.

Another kumascope which will be found just as easy to make, and which gives equally good results, consists of two strips of copper or tin secured to a board, as shown, and having notches cut in their adjacent ends to form a seat for a carbon ball. The ball may be carved out of an electric light carbon and rounded off smoothly with a file. Connections with a telephone and local battery are made, similar to those described above. The imperfect contact between the carbon ball and the copper strips normally offers a great resistance to the current in the local circuit which is greatly lessened by the electric oscillations. It will be observed that both of these kumascopes are self-restoring, that is, they require no tapper or other mechanical device to effect decoherence.

Electrical Notes.

Some interesting experiments have been carried out in Milan with an electric street railroad car equipped with a single-phase alternate-current motor of the series laminated field type. This motor is the device of Dr. Finzi, and is designed for a frequency of 18 periods per second. The motor weighs 16 hundredweight. In this apparatus the ordinary series parallel controller is replaced by a transformer giving respective voltages of 80, 100, 120, or 140 volts as desired, when supplied with a current at 500 volts in its primary. The commutation proved highly satisfactory at starting loads, and under full voltage sparking was no greater than is the case with a good continuous-current motor. The commutator and brushes were examined after a run of 125 miles, and were found to be clean, and showed no signs of appreciable wear. The starting acceleration was not quite as good as that of a continuous-current motor, but was maintained constant longer, so that a car speed of 16 miles per hour was reached in the same time by both, the energy taken being 14.85 watt-hours per ton in the case of the continuous-current motor, as compared with 10.6 watt-hours per ton in that of the alternator.

The Kelvin Compass.—In the marine world the Thomson compass still holds its own, and its users apparently have not even yet got used to the change in name from Sir William Thomson to Lord Kelvin. We notice, however, that the most recent patent compass issued by Messrs. Kelvin and James White, Limited, bears the name of Lord Kelvin. The feature in connection with the design of this which calls for special attention is the improvement in the means of suspension, in order to secure a steady card in spite of the greater vibration due to higher speed in steamships. Another feature is the illumination of the compass at night entirely from the underside. This can be done either with electric light or by means of oil lamps. In either case adjustment in the intensity of the light is provided, as this has been found particularly useful when taking bearings from stars or other faint lights. A new form of helmet is now introduced having rifle sights upon the top. This helmet moves round freely in any direction, and bearings of the sun, lights, buoys, or other objects are taken instantaneously and read directly upon the compass card. Bearings by azimuth mirror in the usual way can also be taken by day or night without removing the helmet. These facilities for taking bearings smartly and conveniently are being greatly appreciated by shipmasters and navigating officers.

M. Routin, of Lyons, has devised an electro-mechanical governor which is described in a recent article by M. F. Brock in the Elektrotechnische Zeitschrift. The device consists of a solenoid, magnetized by a few series turns and a coil which is in shunt with the generator. The magneto-motive forces of the two windings are opposed, that of the shunt coil, however, predominating under normal conditions. The field switch, the valve mechanism and a rheostat in series with the shunt coil of the solenoid are mechanically connected to the armature of the solenoid. The last-named switch performs the function of securing the predominance of the shunt coil of the solenoid for any position of the latter's armature. Assuming additional load to be put on the generator, the armature of the solenoid will drop a certain distance, because the increased magnetomotive force of the series winding of the solenoid will, by more nearly balancing that of the shunt coil, diminish the strength of the electromagnet. In falling, the armature will have acted upon the valve gear, at the same time cutting out resistance from the field circuit of the generator as well as from the circuit of the shunt coil of the solenoid. If load is taken off, the action is reversed and the armature is drawn higher up into the solenoid, and if a short circuit takes place the series coil largely predominates, the armature is drawn right up and steam is shut off. If the fuse blows in the generator circuit, the same thing occurs, the shunt coil now being responsible for this.

The Current Supplement.

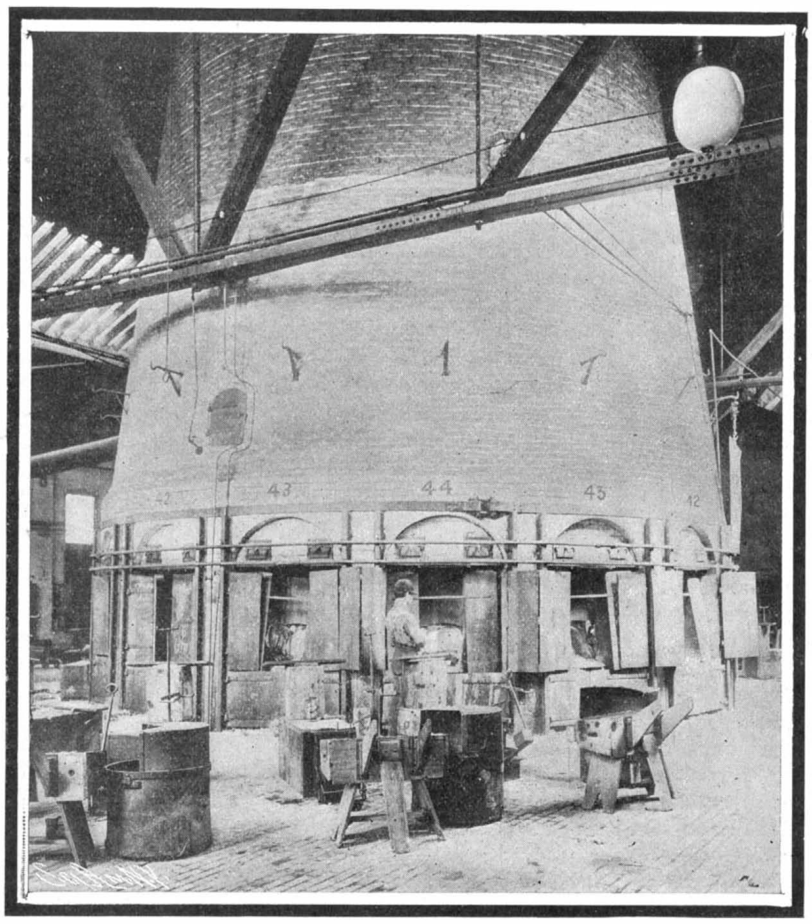
The article begun by Frank C. Perkins, in the last number of the SUPPLEMENT on the "Development of the Electric Mining Locomotive," is concluded. Some well-known foreign and American locomotives are described and illustrated. "Electrolytic Rectifiers for Charging Storage Batteries," is the title of a very instructive paper. Dr. G. Erlwein begins an admirable discussion of the "Purification of Potable Water by Means of Ozone." Mr. Hiram Percy Maxim's very thorough study of the cost of operating automobiles for commercial purposes is concluded. Assistant Naval Constructor Gleason writes instructively on the steam turbine. Mr. Charles H. Stevenson has much that is of value to write on the menhaden industry. How an automobile can be run on a railway track is a subject that is well illustrated in the current SUPPLEMENT, No. 1478. The usual electrical, engineering, and consular notes will be found in their accustomed places.

THE MANUFACTURE OF INCISED, OR CUT GLASS.

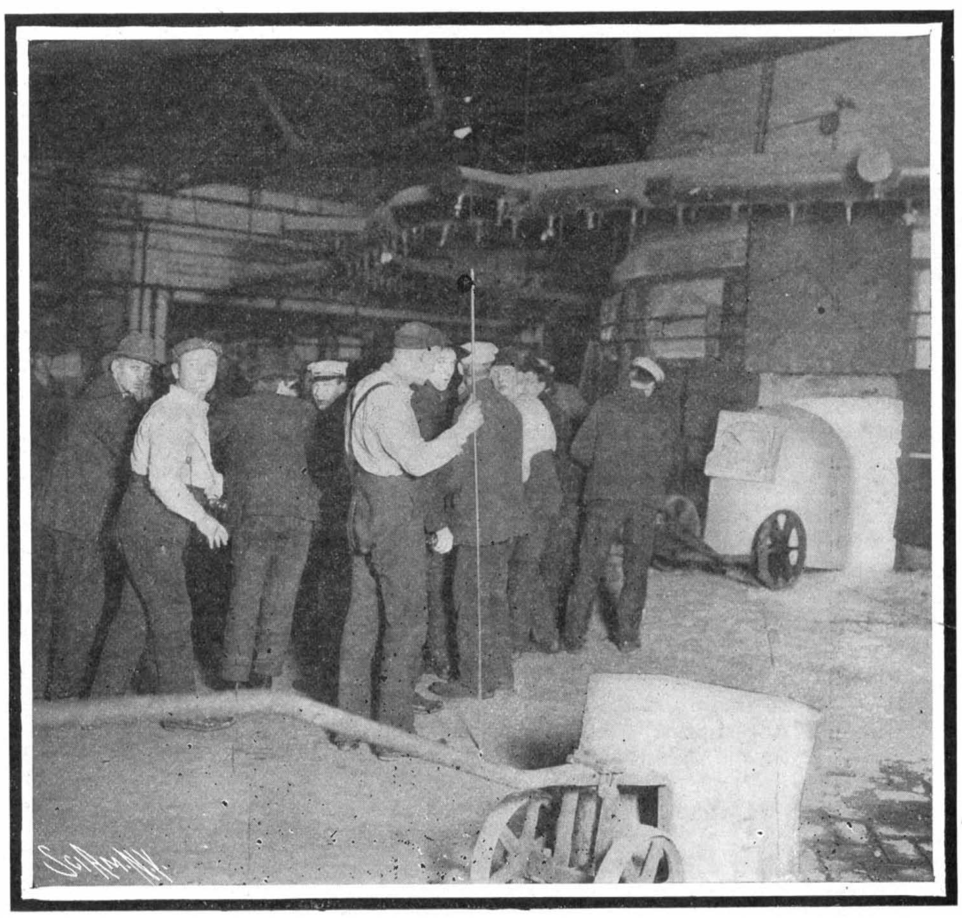
GLASS is a singularly versatile material, at once refractory and yielding, yet lending itself to use in thousands of ways. It is as a means of artistic expression that it is chiefly interesting, for its utility is beyond all question. The iridescent chatoyant colors of antique glass—Nature's destructive action—do not distract us from the charm of perfect form. Venetian glass, the beautiful product of the lagoon-island of Murano, is so very impracticably fragile, that even its possession is a care. Probably glass would have remained in a rather humble position, if it had not been that a Bohemian glass-worker more than two hundred years ago conceived the idea of a new invention, which was destined to change the glass product of the world. He thought of making the heavy "flint" or "lead" glass larger as regards the dimensions of the walls of the article, in order that he might have more stock to work on, so that he could deeply incise, or cut the glass to form patterns, the sides of the rough cut being in turn polished to give the effect of a many-faceted jewel. The success of the new *objet d'art* was not immediate, and it was only when the crude designs and imperfect workmanship of the earlier cutters gave way to the labors of highly-skilled artisans directed by talented designers that cut glass, or "art glass," as we might term it, took the place to which its great beauty entitles it. It is to America that we must look for the perfection, and the superiority of design and skillful workmanship of this branch of the industry. There is no such thing as absolute interchangeability in the glass-cutting establishment, and the artistic bent of the various cutters is encouraged. For purposes of illustration of this interesting industry, we have selected the plant of the Libbey Glass Company, of Toledo, Ohio, as being the best exponent of this really American industry.

Blowing a Glass Blank

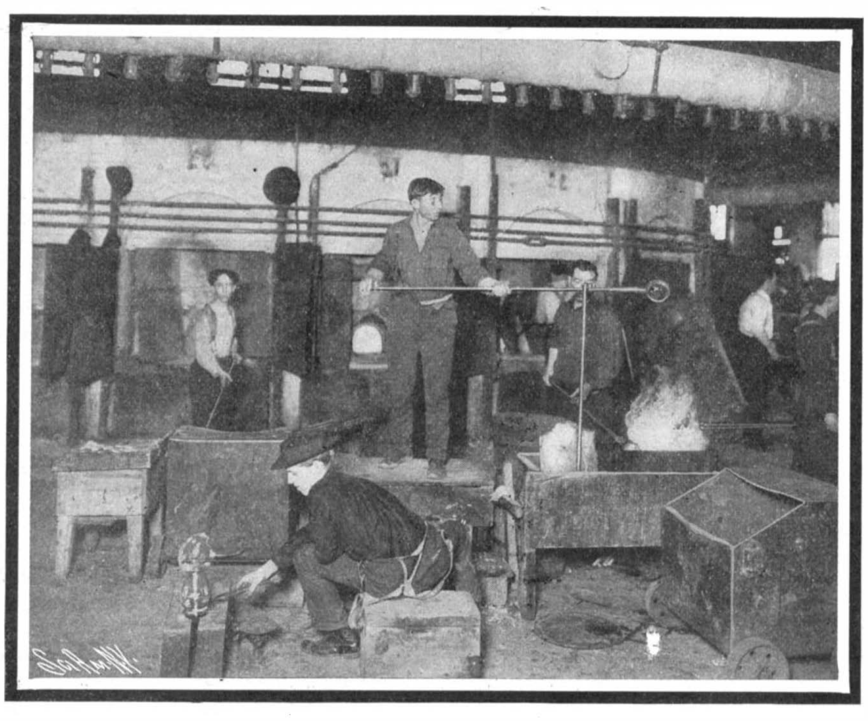
Glass is a peculiar product, having as a base silica, which is fused with alkalies and metallic oxides to form a hard transparent substance which we all know as "glass." It can be wrought in various ways, and is susceptible of a high, and, when properly cut, a lasting finish. There are a number of varieties of glass, composed of varying ingredients, but we need only concern ourselves with lead glass, used for decoration by incision, or the cutting away of portions of the reinforced wall so as to form an ornate pattern. The raw materials consist of a sand, so called, of exceptional quality as regards sharpness and color. It is not a sand in the ordinary sense of the word, but is a quarried rock which has been crushed. This accounts for the uniformity of its color, which is so necessary in producing a steely-blue white glass, which is to be used for giving the prismatic colors caused by the cutting process. The red lead, saltpeter, and sodium carbonate are accurately mixed with the sand, and a small percentage of white arsenic or manganese is added to bleach or clarify it. The proportion is varied ac-



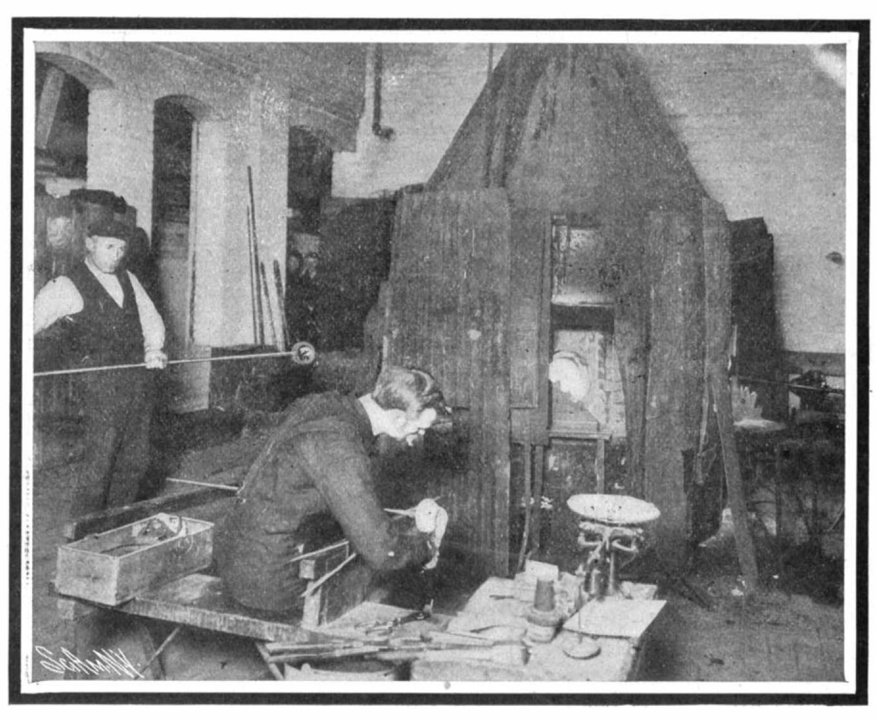
A Glass Furnace.



Setting a White-Hot Melting Pot.



Blowing Glass Articles.



Forming a Glass Article.

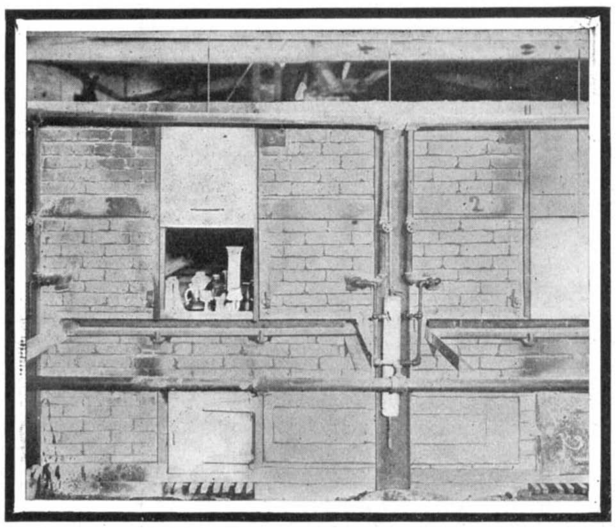
THE MANUFACTURE OF INCISED, OR CUT GLASS.

cording to the nature of the finished product. A glass furnace is a large round or oval fire-brick oven, capable of holding an aggregation of melting pots, which rest on a floor in common under a dome called a crown. These pots are made of unbaked fire-clay. A mouth gives entrance for the raw material and the workmen's blowpipes, to which the molten glass adheres. A furnace may contain as many as sixteen pots arranged radially on the floor of the furnace. They are heated before setting, and are subsequently filled with about 1,600 pounds of raw material, which soon melts at a temperature of 2,500 deg. F., caused by the intense flame of gas and air, which is deflected from the dome downward, the products of combustion passing out through a stack.

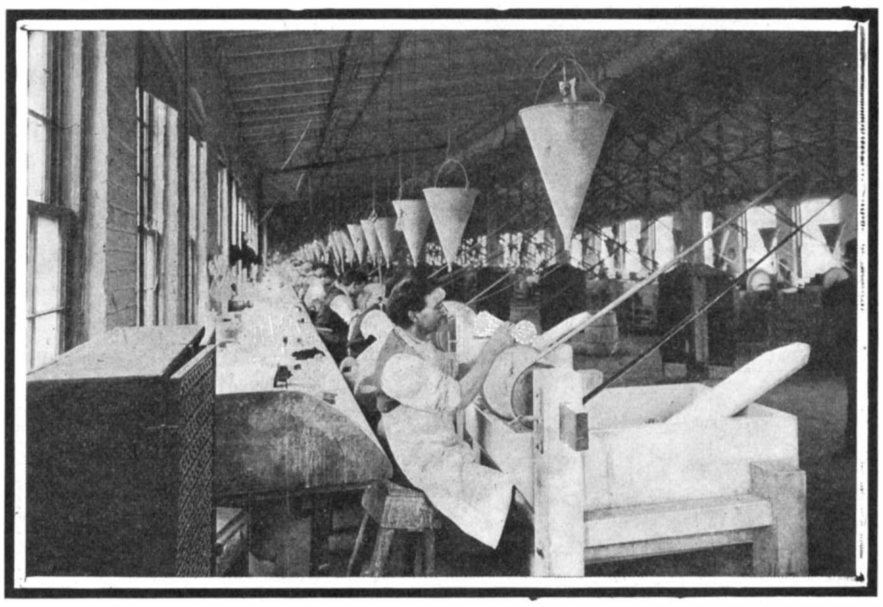
The glass gatherer receives his order for a specified size and shape for his article; and after obtaining a sample to guide his memory, takes his iron blowing-tube, and collecting sufficient of the molten glass from the pot in the furnace, rolls it to and fro on a metal plate to produce a uniformity of distribution of the mass, which is then reheated in a furnace called a "glory-hole." He then turns it over to a glass blower, who takes the pipe and blows the article to approximately its final shape. It is then reheated and given definite form and finish by the most expert workman of all three. The tender glass must now be annealed or tempered to equalize the strains, otherwise the piece would break. It is then placed in kilns or tempering ovens, where it is first reheated and then gradually cooled.

The heavy uncut articles are then ready for the cutting operation, by which they lose considerable weight. In some cases the loss is one-third. The cutting operation really consists of three stages. The article is first roughed with sand and a steel grinding wheel. It is then smoothed by a stone cutting wheel, and is lastly finished by a wooden polishing wheel. A workman holds the article against the conical edge of a steel wheel secured to a shaft driven by belts and pulleys. Fine sharp clean sand and water are allowed to drip on the wheel from a cone-shaped bucket. The article is pressed against the rapidly-rotating wheel, and is deeply scored or cut. The heaviest and principal lines in the pattern are roughed-in by these steel wheels and the sand. In order that all articles may stand level, the bottoms are ground on a horizontal grinding wheel, sand and water still being used. The roughed article is now ready for the wet smoothing stones, which resemble steel wheels both as to size and edge, but no sand is used; these wheels follow the cuts that the steel wheels have made, and also cut in the finer lines of the pattern. The practically finished piece is now ready for the polisher, whose rouge-charged wheels are of wood, their size and edge being the same as those of the steel and stone wheels, and therefore adapted to follow every line with almost mathematical accuracy. We have now the finished piece, which may grace a table or which may adorn the buffet of the White House. While cut glass is made abroad, the examples lack shape and depth and uniformity of cut. For this reason American cut glass forms an object of export, and the examples of art in this glass which will be exhibited at the St. Louis Exposition will be a revelation to most visitors.

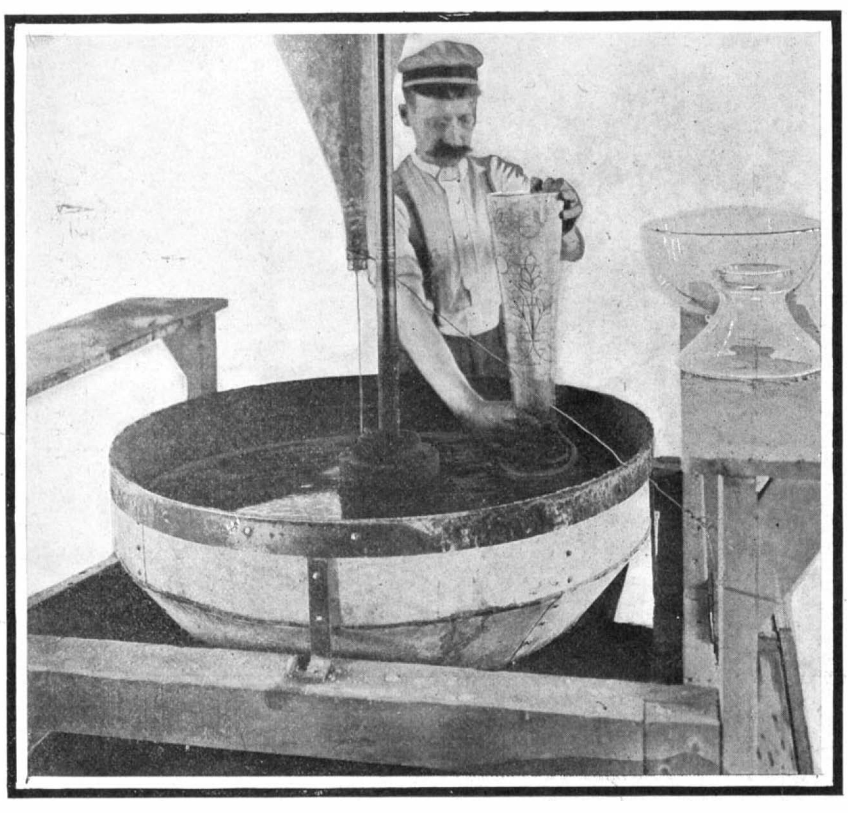
The Romans and the Orientals were fond of both the cameo and the intaglio processes of engraving, and they had a peculiar combination of both which we now designate as "rock-crystal engraving." This is a long and expensive process, but the superb and highly artistic results fully warrant the expenditure of labor. The somewhat formal and mathematical lines give way to floriated designs, or free rein is given to the plastic fancy by the possibility if not the ease of modeling. The sculptor in his studio adds clay while he is working at his bust or group, while his marble-worker cuts off the marble to attain the same effect, in one case addition and in the other subtraction—the glass engraver does both. This



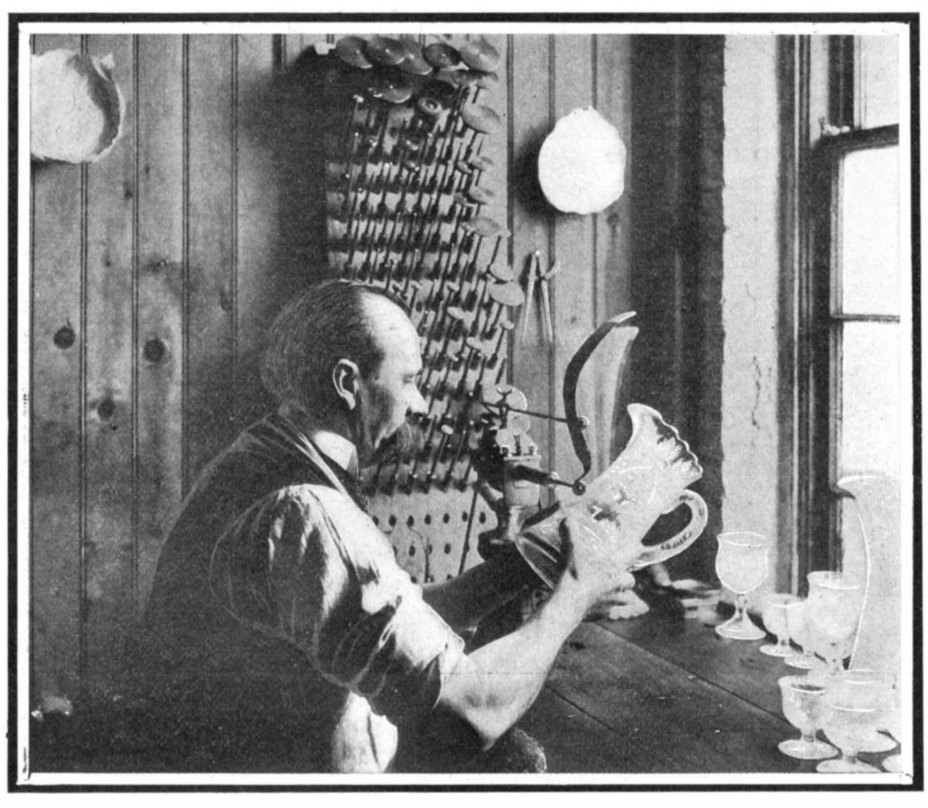
The Tempering Furnace.



Polishing the Cut Glass.

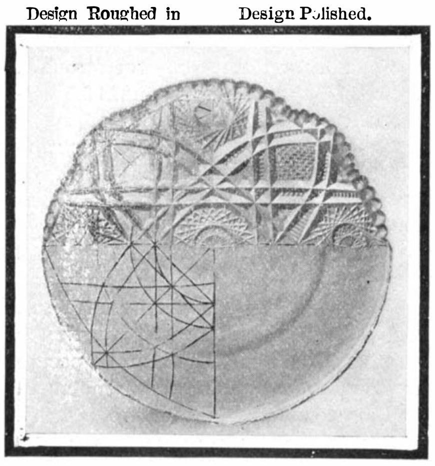


Grinding the Foot of a Vase.



Engraving Glass.

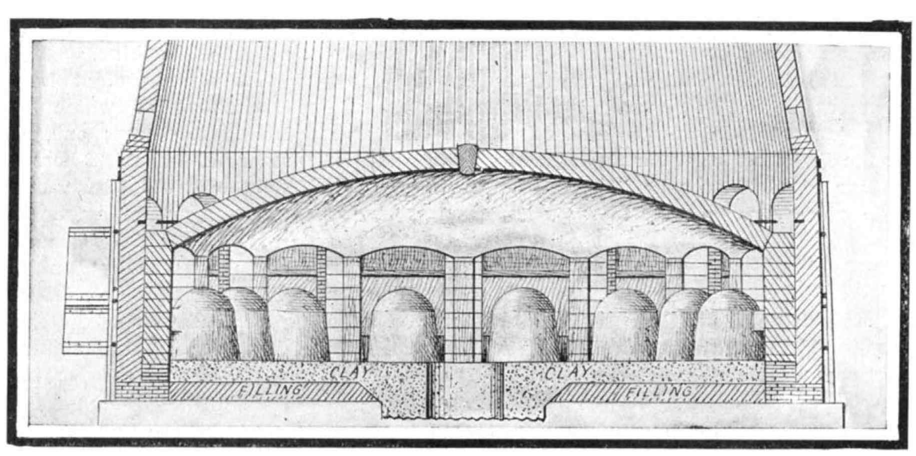
Design Roughed in Design Polished.



The Pattern. The Blank.

A Cut Glass Plate.

An Engraved Plate.



A Glass Furnace, Showing Melting Pots.

THE MANUFACTURE OF INCISED, OR CUT GLASS.

style of glass art work is also carried on by the Libbey Glass Company. The engravers use copper disks of various diameters and thicknesses. The steel spindles carrying the disks are secured to a rapidly-rotating polishing head, the copper being charged with olive oil and emery powder. The tools are changed as often as necessary to obtain the desired effect. Both smooth and matt surfaces may be produced, or delightful combinations can be made of them. The cut glass industry certainly has a bright future in this country.

THE AUTOMOBILE AND MOTOR-BOAT RACES AT NICE AND MONTE CARLO.

BY THE SCIENTIFIC AMERICAN'S SPECIAL CORRESPONDENT.

Interest in the annual automobile speed trials at Nice was increased this year because of the motor-boat races in the Bay of Monaco, which were run off a few days later in connection with an exhibition of this new type of speedy craft.

The automobile speed trials were held on the first day of April, and were carried out without accident and with a considerable lowering of existing records. These trials took place on an extension of the Promenade des Anglais, and the road, while not so straight or smooth as the cement road of the Promenade, was not bad enough to prevent the breaking of records.

Last year the Serpollet steam racer swept all records away and won for the third time (and thus permanently) the original Rothschild cup for the flying kilometer, in 29.19 seconds. A new cup was immediately donated by Baron de Rothschild, and was won for the first time last year by Hieronymus on a Mercedes car in 31.66 seconds. This, the best time previously of a gasoline racer in the Nice speed trials for the flying kilometer, was cut this year to 23 3-5 seconds by Rigolly on a 100-horse-power (nominal) Gobron-Brillié car. This new time for the kilometer corresponds to a speed of 152.54 kilometers, or 94.70 miles, an hour, which is an increase of 24.37 miles an hour in the rate of speed over that attained last year by Hieronymus on the 60-horse-power Mercedes. When the fact is taken into consideration that this much faster speed was attained on a poorer roadbed than that on which last year's records were made, one can readily see that there has been not only a considerable increase in the power of the machines, but also an increase in skill in guiding them. The sensations of going at a 95-mile-an-hour gait in an open automobile are graphically portrayed by Rigolly in the following words: "I felt I was traveling very fast—faster than at Ostend; but I was quite unable to judge the pace. I saw nothing of the road but a white ribbon which I did my best to follow in the middle. The only real sensation of my speed was the impression that my head was coming off—was being torn backward by a furious wind. I was in great need of a support, such as photographers employ." Asked if he could have maintained such speed for half an hour, he replied that the strain on his eyes and neck was so great that he did not believe anyone could keep up such a pace for 20 kilometers. Despite the fact that the machines, throwing up clouds of dust, all traversed this curving "ribbon" of road, whose surface had numerous small holes and hummocks, and which was lined on both sides with sightseers, not a single accident marred the events of the day.

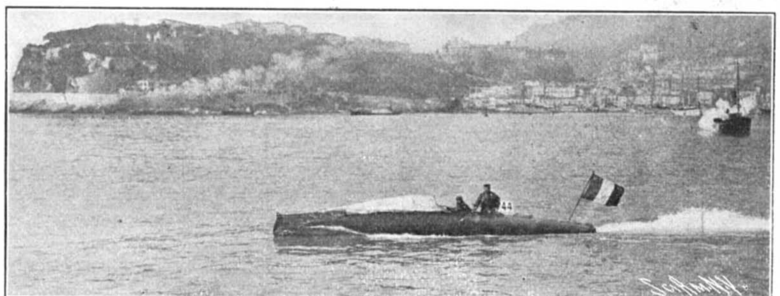
These began with the mile speed trials from a standing start, which were opened at about 2:30 P. M., by a motor bicycle. Tamagni, on an Italian, 5-horse-power, twin-cylinder Marchand machine, won in 1 minute, 7 2-5 seconds, averaging a speed of 53½ miles an hour. A 5-horse-power Griffon machine was second in 1 minute, 9 seconds. The previous world's record for this event was 1 minute, 13 4-5 seconds, held by a Griffon machine.

There were eight huge racing cars in the speed trials, two of which were 100-horse-power Gobron-Brillié machines; one, a new 100-horse-power Napier racer; and four, 80-horse-power Mercedes racers. The Gobron-Brillié cars won all the trials, and tied each other in the mile from a standing start, which they covered in 53 3-5 seconds. The older of these two machines, driven by Duray, is fitted with three speeds, while the new car, driven by Rigolly, has four. This gave Duray an advantage when there was but a short distance in which to start, or in starting from a standstill. Four Mercedes machines made the next best times to the Gobron-Brillié's in the mile from a standing start, the first of these, driven by Werner, making it in 57 4-5. Mark Mahew, on his Napier, was seventh in 1 minute, 3 seconds.

The great events of the trials were the flying kilometer tests for the second and third Rothschild cups, which can be competed for by machines with explosive motors only, and by machines of any motive power, respectively. The weight of the machines in both instances must not exceed 1,000 kilogrammes (2,204.6 pounds). A distance of 600 meters (656.4 yards) was allowed in which to get up speed for these flying kilometer trials. The one for the second Rothschild cup was won by Rigolly in 24 seconds, with Duray second in 26 3-5 seconds, and Mark Mahew third in 28 3-5 seconds. Three out of the four 80-horse-power Mercedes cars finished next in 29 2-5 seconds, the fourth covering the 6-10 of a mile in only 2-5 of a second longer time. Although the Mercedes cars were beaten, they nevertheless showed their great uniformity by making such an even performance.

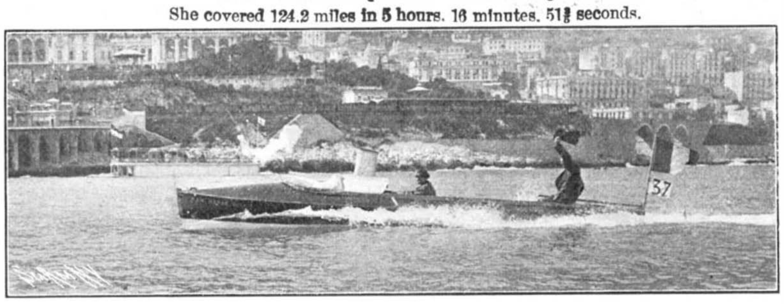
It was in the trials for the third Rothschild cup that Rigolly broke all records. Mark Mahew, on his Napier, flashed by first at 82.24 miles an hour. His time for the kilometer was 27 1-5 seconds. Hardly had the roar of his machine died away when sounds like those of a rapid-fire gun of large caliber were heard in the distance. One had barely time to guess what machine it was, when a huge racer with boat-shaped prow flashed by and was hid in a cloud of dust. The car jumped and bounded on the rather rough road in a most startling manner. But it was past before one could realize one's danger should anything go wrong. The spectators expected that a new record had been created, and cheered vociferously. Rigolly's machine covered the kilometer in 23 3-5 seconds, or at a 12½-mile-an-hour faster rate of speed than that attained by the Napier. The other Gobron-Brillié was second in 25 1-5 seconds, and the times of the Mercedes machines were 29, 29 1-5, 29 3-5, 29 4-5, and 30 2-5 seconds respectively. The Mercedes, which we illustrate, driven by Werner, was fifth in 29 1-5 seconds.

The Gobron-Brillié machines have been manufactured in France for a number of years past, and a full description of them will be found in the Scientific American for December 28, 1901. Their great peculiarity is the employment of a double piston motor in which the explosion occurs between the two pistons, driving them apart. The four-cylinder motor used on the present car has eight pistons. The casings on top of the cylinders cover the piston rods and the connecting rods which extend down to the crank shaft. The positive fuel-feed device which has been used heretofore has, we understand, been now abandoned for an

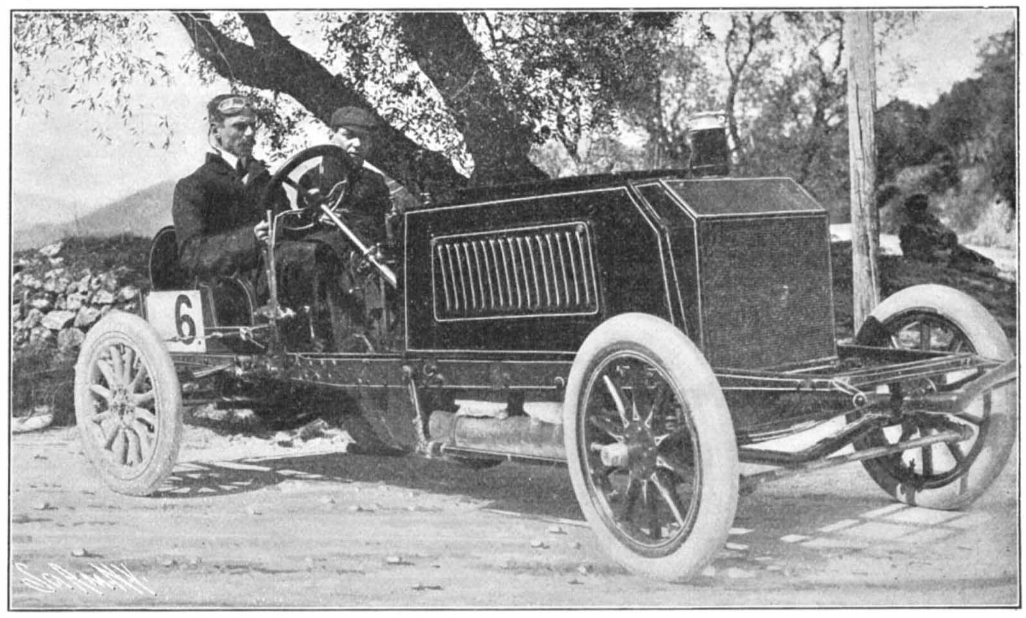


The "Trefle-a-Quatre" at Full Speed.

She covered 124.2 miles in 5 hours, 16 minutes, 51⅗ seconds.

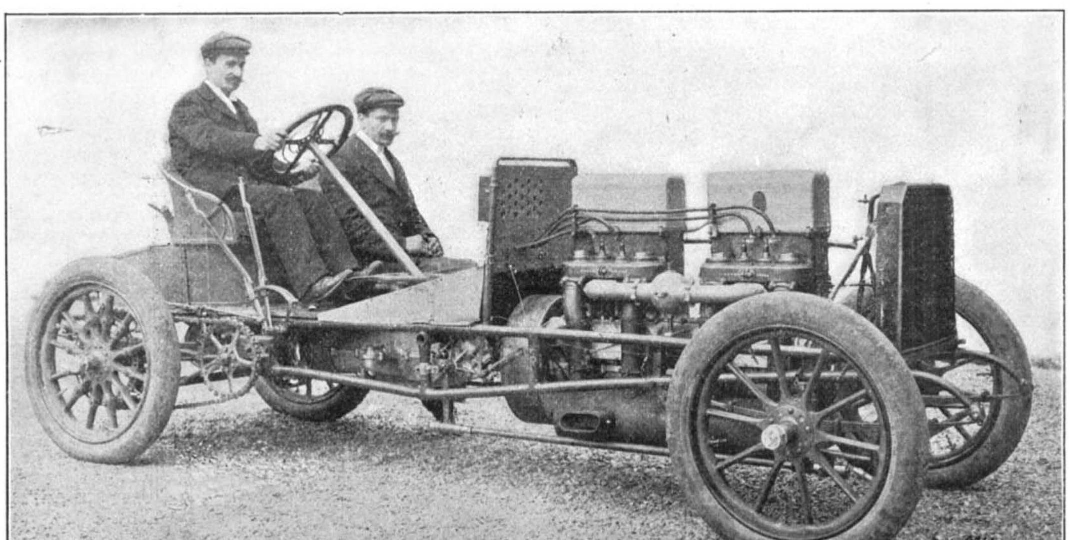


"La Rapee III." Winning the 93.15-Mile Race in 4 Hours, 30 Minutes, 22 1-5 Seconds.



Lieut.-Col. Mark Mahew on His 100-Horse-Power Napier Racer.

Record: One mile from a standing start in 1 minute, 3 seconds. One kilometer with a flying start in 27⅕ seconds. (Third place.)



Rigolly on His 100-Horse-Power Gobron-Brillie Racer.

Record: One mile from a standing start in 53⅗ seconds. One kilometer with a flying start in 23⅗ seconds.

Werner on an 80-Horse-Power Mercedes Racer.

Record: One mile from a standing start in 57⅘ seconds. (Third place.) One kilometer with a flying start in 29⅕ seconds.

THE AUTOMOBILE SPEED TRIALS AND MOTOR-BOAT RACES AT NICE AND MONACO.

automatic carbureter. The Gobron-Brillié motor was one of the first to be adapted to the use of alcohol for fuel. The motor on the record-breaking racer is said to develop in reality nearly 130 horse-power.

All three of the machines illustrated are prospective contestants in the Gordon Bennett Cup Race to be held in Germany in June.

The last event of the day was the third annual hill-climbing contest for the De Caters cup. This cup was first won by Serpollet in 1902, the contest being that year held over a kilometer course on the long Nice-La Turbie hill on the Corniche road, and Serpollet's time being 59 seconds. Last year the test was made over a like distance on Laffrey hill, and Rigolly, on the same Gobron-Brillié machine which Duray is driving this year, cut nine seconds off Serpollet's record. The test this year was over a 500-meter (547-yard) course on the Nice-La Turbie hill, which has an average gradient of about 10 per cent. Duray, on the three-speed machine that won last year, won again this time in 26 seconds, Rigolly, on the four-speed Gobron-Brillié, taking one second longer. Werner, on the 80-horse-power Mercedes, was fourth in 28 seconds. Another Mercedes came in fourth in 28 3-5 seconds, while the Napier racer took fifth place in exactly half a minute. Fletcher and Jenatzy, on Mercedes cars, made a dead heat in 30 1-5 seconds.

The motor-boat races, which were sailed over a hexagonal course 12.5 kilometers (7.84 miles) in length in the Bay of Monaco, began on April 5 with a 150-kilometer (93.15-mile) race for the large, powerful racing boats less than 8 meters (26¼ feet) in length and having a total cylinder capacity less than 7.5 liters (457.66 cubic inches); and with a 60-kilometer (37¼-mile) race for the smaller cruising launches less than 6.5 meters (21.32 feet) long and with a cylinder capacity of less than 2.5 liters (152.55 cubic inches). A special traveling crane conveyed the boats from the exhibition space to the water's edge, and laid them upon a long incline running out into the water, down into which they were readily slid.

The 150-kilometer race was won in 4½ hours, 22 1-5 seconds by "La Râpée III.," a 7.98-meter (26.18-foot) boat built by Tellier and fitted with a Panhard & Levassor, four-cylinder, 35-horse-power motor having a cylinder capacity of 7.363 liters (449.30 cubic inches). The "Princess Elizabeth," which came in second in 5 hours, 18 minutes, and 4 seconds, is exactly the same type and length of boat, and is fitted with a four-cylinder Delahaye motor having a cylinder capacity of 7.443 liters (454.186 cubic inches).

Out of seven racers and six cruisers which started, only three of the former completed the race, while five of the latter succeeded in finishing. This shows that the ordinary launch with an engine of moderate horse-power is much more reliable than the light racing shell propelled by a high-power motor and generally termed an automobile, or motor, boat.

The winner of the 200-kilometer (124.2-mile) race—the "Trèfle-à-Quatre"—as well as "La Râpée III.," are shown in the photographs taken during the race. An idea of the fine lines of these boats can be had by noting the bow wave, which is so thin as to be quite transparent, the waterline of the boat being readily seen through it. The "Trèfle-à-Quatre" is fitted with a Georges Richard-Brazier four-cylinder motor. Its time for the 200 kilometers was 5 hours, 16 minutes, 51 3-5 seconds.

The motor-boat races were carried out successfully and with but one serious accident. This happened to the "Parisienne II.," a very long racer equipped with three motors of about 70 horse-power each. This boat caught fire from a gasoline leak, and the gasoline in her tanks made a furious flame. The three men of the crew escaped by jumping overboard, and two of them were badly burned. As the boat had a steel hull, it was not destroyed, although the engines were ruined.

There are said to be 42,000 locomotives in this country, and of these about 3,200 are supplied with electric headlights, while 1,650 are equipped with acetylene generators. The remainder of these engines are making use of oil for the headlight illuminant.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

PRINTING-TELEGRAPH RECEIVER.—J. D. WHITE, 50 Clanricarde Gardens, London, England. The present receiver differs in various ways from a simple form of printing-telegraph receiver and one more complex described in two former patents granted to Mr. White. The mechanism is operated by an electro-mechanical device by which the rotation of the type-cylinder is effected by currents of one polarity sent along a single wire, while the other cylinder is operated by currents of the opposite polarity sent along the same wire; but the operation is not limited to this particular device. It may also be operated by any of the other electro-mchanical devices used in receivers to rotate type wheels and to effect printing.

RELAY-MAGNET.—W. PALMER, JR., Rincon, New Mexico. The object in this case is to provide a simple and practical relay-magnet of a kind designed to enable the current from a local battery to be directed at will through either one of two electromagnets by merely reversing the polarity of the current on the main line at a remote point.

MEGAPLEX RELAY.—R. A. ENGLER, Dubuque, Iowa. In Mr. Engler's invention the improvement relates to relays, and more particularly to a type of relay for increasing the effect of feeble currents—such for instance, as are employed in telephony. The structure is such as to increase the effect in various ways, and especially to permit several distinct devices to act cumulatively.

Hardware.

SASH-FASTENER.—J. A. LONG, Spokane, Wash. In this patent the invention relates to a device for securing the meeting-rails of an ordinary window-sash that operates in a vertical direction. One object is to provide an improved form of sash-fastener that will engage the under face of the upper-sash rail and not be dependent upon the means of securing one portion of the sash-fastener to said rail. Another, to provide an improved form of device that will securely hold the rails together and prevent unauthorized operation of the window-sash.

WIRE-FENCE TOOL.—J. A. MILLER, Avondale Col. In the present case the invention pertains to tools employed in the erection and repair of wire fences, and has for its object to provide a tool of that character having details of construction that adapt it for efficient service as a wire-stretcher and a staple-pulling implement.

LEVEL, PLUMB, AND INCLINOMETER.—J. HAPPLE, Cleveland, N. Y. The purpose in this instance is to provide details of construction for a device which adapts it for convenient and reliable service to determine if an object or surface that may be fixed or movable is plumb, level or inclined, and define the degree of inclination or deviation from a perpendicular or horizontal plane.

SASH-LOCK.—C. W. RANDALL, Lockport, N. Y. In this lock the object in view is to provide a device which may be applied to one of the meeting-rails of a pair of sashes, said device serving to hold the sash or sashes in adjudged positions for preventing rattling thereof under the pressure of wind, the device being readily adjustable to sashes of different thicknesses in order that it may be used generally on different sizes and styles of sashes.

Household Utilities.

SAD-IRON.—M. JOYCE, Salt Lake City, Utah. To enable this iron to compete commercially with cheaper irons, the inventor casts the body in one integral piece, with guide-lugs projecting upward therefrom, and provides a wooden handle with a metallic connection-plate adapted to lie between the lugs of the iron-body and separated from the handle by a non-conducting shield, said plate having a stop-bar and a spring-dog connected with a headed pin or screw fastened on the upper side of the iron-body. The invention relates to irons of the type disclosed in two prior patents granted Mr. Joyce.

BED-COVERING.—E. W. BROWN, New York, N. Y. Mr. Brown's invention relates to coverings for beds, couches, cribs, and cots. His improvements enable the bed-clothing to be fastened in place easily and quickly so that the covering cannot be "kicked off," thus affording protection to the sleeper. Covering may be suspended in elevated position and in a way form a drapery, which depends from the suspended covering to the sides and foot end of the bed, thus keeping from coming in contact with the person, while protecting from drafts.

Of General Interest.

SELF-LOCKING TACKLE-BLOCK.—J. O. WALTON, Boston, Mass. The present invention consists in a simple guard combined with or formed on the block on its rear side just behind the cramping-pulley, so that the run of this part of the rope will be thrown laterally away from the cramping-face on the rear side, but will not interfere with the locking of the rope on the front side. A self-locking pulley-block has been shown and described in a former patent granted to Capt. Walton.

WINDOW-CLEANER.—J. C. G. FRITZ, New York, N. Y. The object of the invention is to provide a window-cleaner more especially designed for use on windows of locomotive-cabs, platform-windows of street-cars, and other vehicles and arranged to permit the engineer, motorman, driver, or other person to keep the outlook-window perfectly clear from frost, moisture, dirt, and the like and permit at all times a clear view of the path in front of the vehicle to avoid collisions.

NON-REFILLABLE BOTTLE.—W. C. BEAL, Fernandina, Fla. In this patent the improvement refers to a class of liquid-packages that are provided with means to expose or prevent the reuse of the receptacle after the contents have been removed, and has for its object to purovide novel details of construction for a bottle and its closure which will effectively prevent the refilling of the bottle after the contents have been partially or wholly decanted.

GARMENT-SUPPORTER FOR MEN.—W. A. WRIGHT, New York, N. Y. The purpose in this case is to provide a form of garment-supporter especially adapted for use in connection with trousers and so constructed that it will include a button or stud to receive a suspender-end, a member for supporting engagement with a pair of trousers, a member, if so desired, adapted to prevent the upward movement of a belt, and a member whereby to apply the device to the inner face of the trousers waist-band.

STEERING AND STEADYING MECHANISM FOR BOATS.—W. H. YOUNG, Troy, N. Y. In this patent the invention has reference to improvements in steering and steadying mechanism for marine vessels, the object in view being the provision of a simple means whereby the boat may be easily steered and also prevented to a great extent from rocking and pitching.

CIGARETTE OR CIGAR BOX.—A. G. PSIAKI, New York, N. Y. The present invention has reference to improvements in cigarette or cigar boxes of the kind in which cigarettes or cigars are originally packed for sale; and an object is to provide a box of novel construction and having a receptacle for holding matches furnished with each package.

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.

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Inquiry No. 5452.—For the address of the Pyle National Electric Headlight Co.

Inquiry No. 5453.—For makers of a bower-barff-ing equipment.

Inquiry No. 5454.—For dealers in sulphuric acid in tank cars in quantities.

Inquiry No. 5455.—For a small ice machine. which is not expensive, and which is realy suitable for family use.

Inquiry No. 5456.—For the address of Geo. W. Shaw, manufacturer of wooden mantels, coal and gas grates.

Inquiry No. 5457.—For an electrical device by means of which the number of feet of water in a reservoir or tank can be ascertained at a distance of 4 or 5 miles.

Inquiry No. 5458.—For manufacturers of stamped steel ceilings.

Inquiry No. 5459.—For machines for making paper boxes and cartons.

Notes and Queries.

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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.

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(9378) H. L. J. says: I was recently shown an optical illusion which puzzles me. A chicken feather was placed near my eye, and looking through it at my hand with fingers slightly opened, and distant about 15 inches, I saw the bones in my fingers, as clear and distinct in outline as with the X-ray. So did others of the party. Again, the feather held in same manner between the eye and the sun when near the setting horizon, showed all the colors of the rainbow in same order and position. Please give the philosophy of all this. A. The experiment you made in looking through the meshes in the feather was an experiment in diffraction. When you looked at your finger held at a distance from the feather you saw a fringe or shadow which followed the outline of the edges of the finger. It did not resemble the outline of the bones at all, as they are seen on the fluorescent screen by X-rays. By the X-ray you see the bones as shadows, larger at the joints; you see the tapering shafts of the bones also. Here you only see the outline of the flesh of the fingers in a double line on each side of the finger. To test the matter use a lead pencil or a stick of about the size of the finger, and you can see the bone in a stick exactly as well as in your finger. There has been a very ingenious toy called the "bonescope" made on this basis. A piece of fine cloth is stretched over a half-inch hole in a bit of wood, which may be two inches across and a half inch thick. On looking through the hole in the center you may see all that you describe. The colors seen on the horizon and in looking at the setting sun are due to the interference of light. You will find all these appearances described, under "Diffraction and Interference of Light." The experiment is very curious, but is explained without difficulty. See Weight's "Light," which we can furnish for $2 mailed.

(9379) G. E. C. asks: 1. How many cubic feet capacity would be necessary in a tank or other reservoir, holding compressed air at a pressure of 200 pounds to the square inch, at the start, to run an engine furnishing 1 horse-power one hour? How large if the pressure was only 100 pounds at start? A. An engine running at a uniform air pressure of 50 pounds per square inch, at one half cut-off, requires 13½ cubic feet of free air per minute, delivered at ordinary temperature. The supply of air from a high-pressure tank, say of 200 pounds to 50 pounds, reduces the temperature over 300 deg. F. with an expansion of about two and one-half volumes; so that if heat can be added to the air after expansion from the tank, a considerable economy may be obtained in using compressed air from both pressures. The tank must have a reserve capacity for the engine running pressure at 50 pounds, and, therefore, the relative volumes being 14 1-3 at 200 pounds and 4 1-3 at 50 pounds, we find that the tank should have a capacity of 81 cubic feet at 200 pounds pressure, or say 3 feet diameter by 12 feet in length; and for 100 pounds initial pressure, a tank twice the capacity, or 4 feet diameter by 13 feet long. 2. Could a windmill be used for compresing the air, thus conveying the energy of the wind to the engine, and thence to a dynamo, for electric lighting, etc.? Would we not by so doing convert the unsteady, jerky motion of a windmill to an even, steady motion suitable for any purpose? A. A windmill can be used for compressing air to run a motor for driving a dynamo, and with ample storage the 24-hour day's work of the windmill may be stored for supplying the evening light current, either by compressed air or by direct driving of a dynamo and charging storage batteries. See SCIENTIFIC AMERICAN SUPPLEMENT Nos. 709, 606, on windmills for electric supply. 3. About what power would one get for use on the dynamo from an ordinary 8-foot windmill with the speed of wind at which it would do satisfactory work pumping from an 80-foot well? A. An 8½-foot windmill is only equal to one-tenth of a horse-power in a 16-mile-per-hour wind, and is totally unfit for transmission of pneumatic or electric power for any available work. A 30-foot mill is a useful source of power for such work, or equal to 3 horse-power in a 16-mile wind. 4. How many gallons of water flowing from an elevation of 50 feet, when applied to a water motor, will give 1 horse-power for one hour? If I could not use the compressed air as above suggested, could not the wind and water method be used? A. Four thousand gallons of water falling 50 feet in one hour are equal to one theoretical horse-power, and in the way you suggest may be made available for constant power by a reservoir of 12,000 or more gallons. A windmill 25 feet diameter, which has a capacity of 6,000 gallons per hour, 50 feet high, in a 16-mile wind, and with an adjustable pump which will work in any wind down to 8 miles per hour, may be made a useful source of power.

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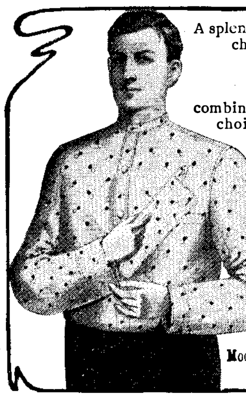

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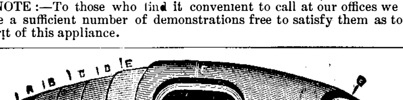

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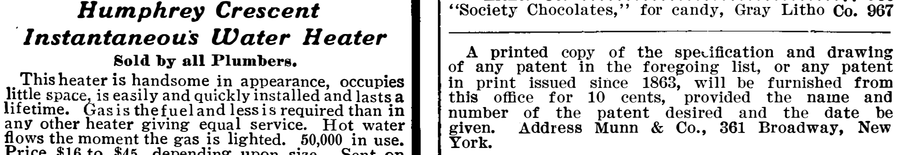

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