SCIENTIFIC AMERICAN

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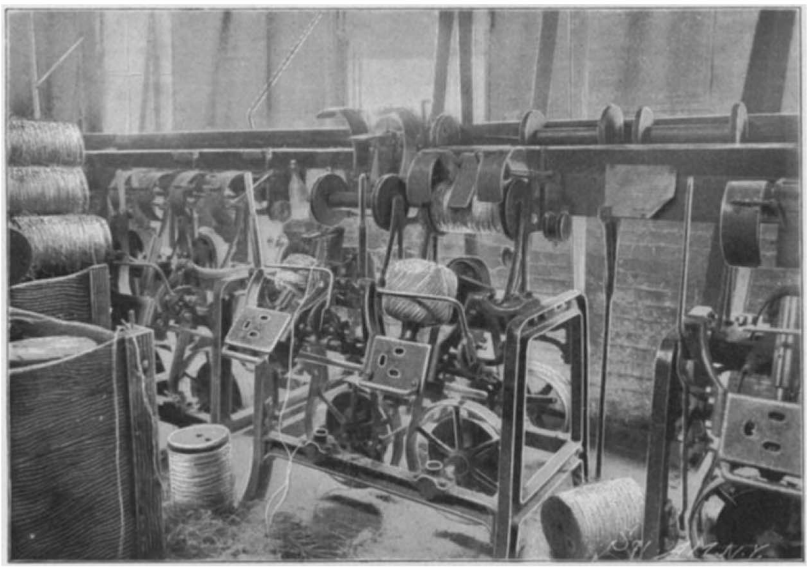
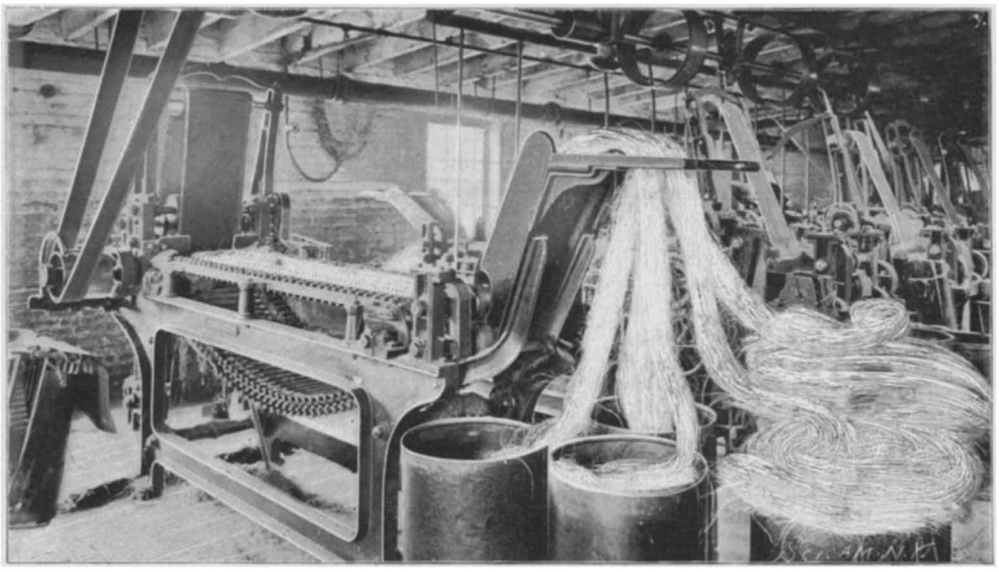
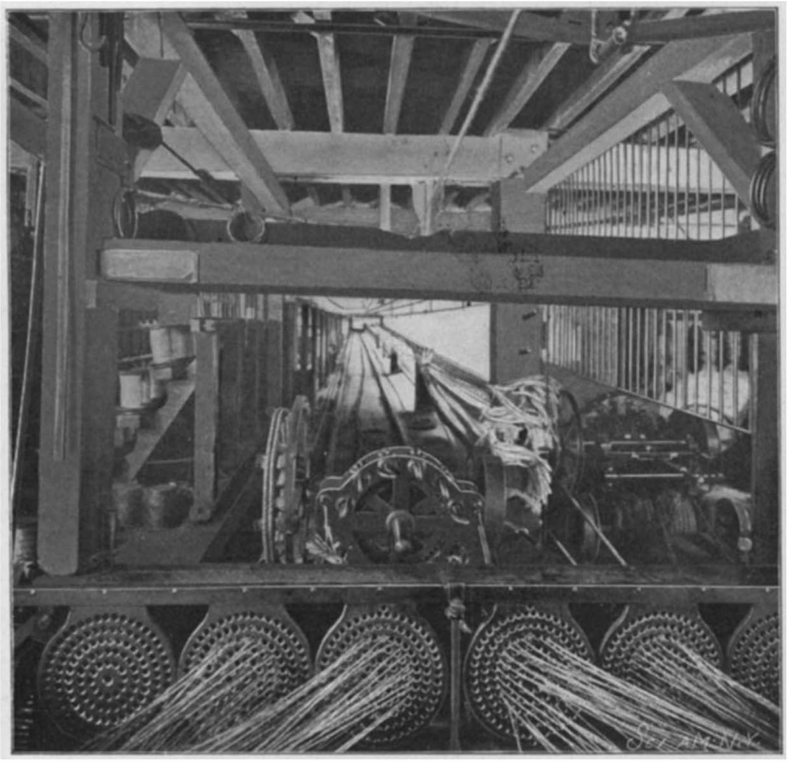


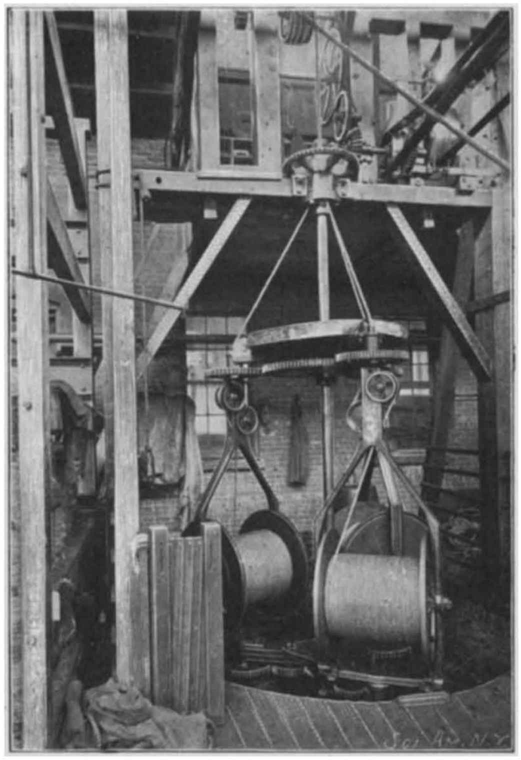
Balling Binder Twine.



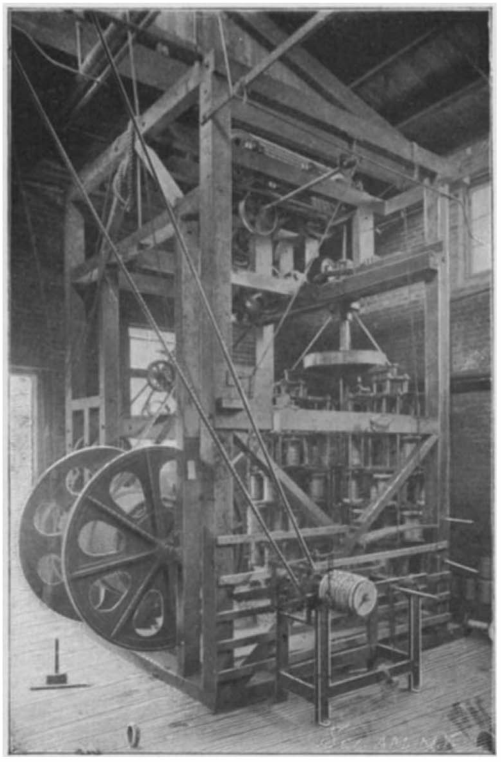
Preparing the "Sliver" by Finishing Machines.



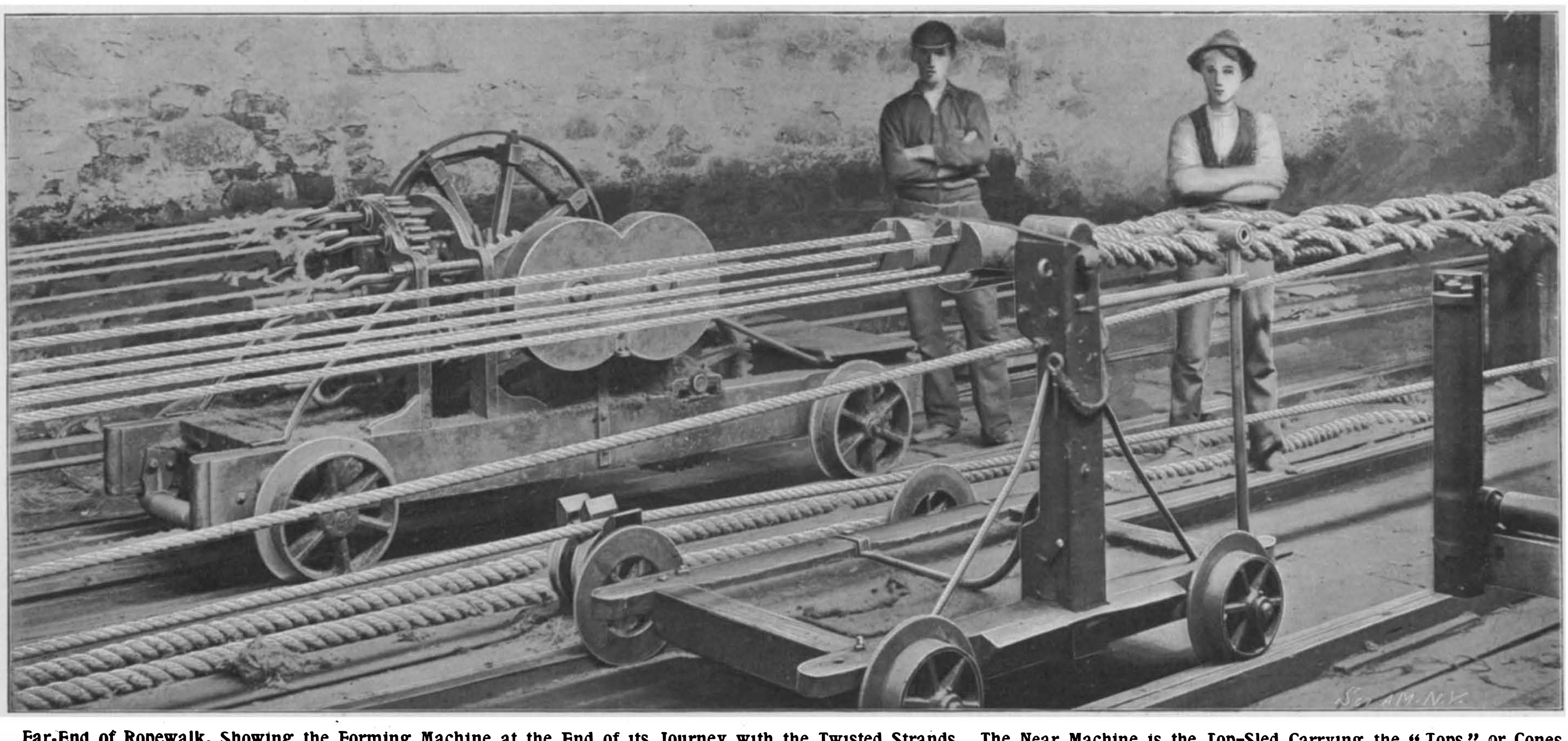
Looking Down the Ropewalk, Showing the Forming Machine.



Making Cable—Twisting Ropes Together.



Former and Layer Combined.



Far-End of Ropewalk, Showing the Forming Machine at the End of its Journey with the Twisted Strands. The Near Machine is the Top-Sled Carrying the "Tops" or Cones which Guide the Strands, which are being Twisted into a Rope by the Laying Machine.

THE MANUFACTURE OF CORDAGE.—[See page 244.]

Scientific American.

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NEW YORK, SATURDAY, OCTOBER 19, 1901.

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.

DELAYED NAVAL CONSTRUCTION IN PRIVATE YARDS.

On perusal of the report of the Naval Bureau of Construction, recently made public, we note with much regret that the private yards have, as yet, done no work whatever upon six of the most important vessels of our navy, although the contracts for the same were let as long ago as last winter. The six vessels include the four battleships "Virginia," "Nebraska," "New Jersey," and "Rhode Island," each of 15,320 tons and 19 knots' speed, and the two armored cruisers "South Dakota" and "California," of 14,000 tons and 22 knots' speed. Moreover, one of the new battleships, "Georgia," of the same class as the "Virginia," let at the same time, is in practically the same condition, only 1 per cent of the work being done, while of the armored cruisers of the same class as the two mentioned above, the "Colorado" is only 7 per cent completed, the "Pennsylvania" 4 per cent, the "West Virginia" and the "Maryland" 1 per cent. The blame for this delay is certainly not to be laid at the door of the Construction Department, to whose credit it may be said that its work in the preparation of plans has always been far ahead in expeditiousness of the contractors who undertake to build the vessels. The record of naval construction in private yards during the past ten years has shown very clearly that the government work is regarded, at least in some of these yards, merely as a kind of stop-gap to fill in the slack times between the execution of private orders.

It is a notorious fact that warship construction in the United States drags out to a weary length, and that ships are delivered in some cases years behind the contract date for completion. It is neither expedient nor patriotic that this should be the case. How can the country be expected to vote the required appropriations for warship construction when the builders give practical evidence that these appropriations are made years in advance of the capacity of the private shipbuilding yards to complete the vessels? In the case of the ten important vessels referred to above, at the present rate of construction the types will have become not a little out of date before the ships can be set afloat.

This indifference on the part of the private shipbuilders to the interests of the country is a significant commentary upon the fact that the bitter opposition which has prevented the construction of warships in government yards has found its source and support chiefly in and around the shipbuilding centers. The shameful state of things shown in the Construction Department's report should prove to the country, once for all, that the desire of our naval constructors to have some of our warships built in the government yards is prompted by the very best motives. Whatever may have been the case in the '80's and early '90's, the most completely equipped of our navy yards, particularly the New York yard at Brooklyn, can now build just as cheaply and certainly as well as the best of the private yards, and there is no question that a decision of the government to give some of the future ships to the navy yards would put a stop to the inexcusable dilatoriness which, particularly of late years, has marked the construction of new ships for the United States navy.

THE AFTERMATH OF THE "AMERICA" CUP RACES.

The American public sympathizes with Sir Thomas Lipton, both in the natural disappointment which he must feel in having the coveted "America" cup slip through his grasp by such a narrow margin, and also in his sportsmanlike determination to leave his very capable boat on this side of the water for the purpose of sailing her next season against the best of our 90-footers. Although he does not carry away the cup, the owner of "Shamrock II." has at least the satisfaction of knowing that his handsome craft has pushed the American cup-defender as never any of her predecessors was pushed before; and he may also carry with him the assurance that the most excellent impression which he made on his first attempt of two seasons ago has been abundantly confirmed by the extremely pleasant spirit that has pervaded the present races, a spirit to which the Irish knight has contributed a most generous share.

It has too often been the case that the year succeeding a series of "America" cup races has been a very dull one in yachting circles; but, thanks to the decision of Sir Thomas to leave the "Shamrock" on this side of the water, there is every prospect that the season of 1902 will be the most exciting in the history of American yachting. With "Shamrock," "Columbia," "Constitution" and "Independence" fighting it out for the weather berth and the winning gun, not amid the flukes and chances of the three brief races of an international cup contest, but throughout the long four months of a yachting season, there will be witnessed a series of contests that will be worth going far to see.

A veteran skipper, who sailed three previous cup-defenders to victory, is credited with the remark that, although the owner of "Shamrock II." did not lift the cup, he has "set it rocking." He certainly has; and his statement that, failing a challenge from any other British yachtsman he will himself make another attempt, will be good news to his friends, among whom may safely be included the whole American public.

DETERIORATION OF THE BROOKLYN BRIDGE.

The report of the engineers appointed by District Attorney Philbin, after the recent partial collapse of the Brooklyn Bridge, to make a thorough survey of that structure and ascertain its present condition, has just been made public, and will be found in the current issues of the SUPPLEMENT. The shameful condition of neglect which was revealed by that accident, a full account of which was given in the SCIENTIFIC AMERICAN of August 3, 1901, fully justified the District Attorney in ordering an investigation. The conclusions of the report show that the neglect of the bridge, which was only accidentally discovered through the failure of certain details, is more or less general throughout the whole of this costly and magnificent structure.

While it was due in part to neglect, we had hoped that the failure was precipitated merely by local conditions inherent in the design and construction of the bridge at the point of failure; and that on a general examination of the structure it would be found that although other parts of the bridge had been neglected no serious results had followed. The report before us, however, shows that, as far as inspection and upkeep are concerned, the whole main span, including the saddles on the towers, is in an unsatisfactory condition; and after perusing the careful findings of the engineers one is impressed with the fact that the Brooklyn Bridge, which, because of its size and importance, should have received the most minute and careful inspection, has actually been left in a state of neglect which would be unpardonable even in an out-of-the-way and little-used county bridge.

Of the two engineers who made the investigation, one is considered to be the most expert authority on long-span suspension bridges in the world. The examination consisted of a thorough inspection of every part of the main span, and a careful computation of the stresses to which the bridge is subjected under the increased dead and live loads which have been put upon it since it was first designed. As the result of this increased loading the engineers find that the present margin of safety is so reduced that the necessity for repairs is urgent, and they suggest means by which, the safety can be largely increased without materially interfering with the traffic and at a comparatively small cost. They further state that the present methods of supervision, inspection and maintenance are very faulty, and are not such as will with any certainty maintain the bridge in a safe condition.

Referring to the accident of July 24, 1901, they state that transverse bending was the cause of the breaking of the suspender rods, part of this being due to the absence of lubrication in the trunnion-blocks, and part of it to the fact that there was no provision for the side-play resulting from the pressure of the wind. They consider that this wind pressure was the immediate cause of the fracture, and that the suspender rods broke transversely to the bridge. We do not agree with this decision, as our investigation, made on the spot while the broken suspender rods were being taken out, showed that the fracture of the rods was due to an alternate bending strain in a plane parallel with the stiffening trusses, this strain resulting from the unlubricated and rusted condition of the trunnion-blocks.

Next to the failure of the suspender rods and the shameful condition of neglect in which these parts were found, most serious evidences of neglect were found in no less important a portion of the bridge than the saddles supporting the cables on the tops of the towers. These saddles are placed on rollers to allow a certain amount of longitudinal movement of the cables as they adjust themselves to the varying stresses upon the bridge. Like the trunnion-blocks and the suspender rods, the saddle bearings should have been regularly lubricated and all dust and foreign substances removed. To learn from the report that these saddles have been so far neglected that the inspection "shows no efforts whatever in this direction, ridges of rust, paint, and dirt being found on the bed-plates along the outer rollers," will come as a shock to all engineers who appreciate the necessity of living up to the principles on which the bridge was designed. Other evidences of neglect are that many of the diagonal bars and sway rods have been allowed to wear by rubbing against each other, and many of the suspender ropes by rubbing against the floor of the promenade; that water and mud have been allowed to collect and remain in portions of the bottom chords, and road sweepings in the bottom of the floor beams around the suspender stirrups; while a number of the stirrup rods of the wire suspenders were found to be improperly adjusted. We are entirely in accord with the report when it says that "the method of inspection in vogue on this bridge is at direct variance with the methods in general use on good American railroads." The safety of the bridge demands that the present methods of inspection by mechanics should be changed at once to that which is generally recognized as best, namely, an inspection by engineers in person at frequent, stated intervals, the results being recorded on printed forms. With the bridge in its present condition, the engineers consider that some parts of it should be inspected daily, others weekly, and every part of it at least monthly.

The investigation of the actual stresses to which the bridge is subjected has been gone into at great length, and is of extreme interest. We can merely summarize a few of the important findings. With regard to the main cables, it was found that under the increased loading which has been placed upon the bridge the maximum stress imposed is 75,400 pounds to the square inch. If it be admitted that the stays take a certain part of the load, the stresses in the cables may be put at 71,000 pounds per square inch, or 18 per cent in excess of the permissible working stress of 60,000 pounds to the square inch, the 71,000 pounds, however, being increased by the wind pressures, but to what extent is not now known. The masonry of the towers is also greatly overstrained. The maximum pressure in the towers with the saddles, thanks to gross neglect, rusted to the foundation plates, is at least 39.6 tons per square foot, whereas the working stress of the masonry should not be more than 20 tons per square foot. The report suggests a means by which this pressure can be reduced to about 25 tons per square foot. The floor system, as was to be expected, is subjected to excessive stress. The intermediate floor beams of the railroad tracks should be subjected to only 14,000 pounds to the square inch, yet the actual stress is 27,000 pounds. The intermediate floor beams of the road are also subjected to 25,000 pounds, as against a lawful stress of 14,000 pounds to the square inch. The wooden stringers of the railroad tracks should have a stress of only 1,300 pounds, whereas the actual stress is 1,750 pounds to the square inch. The anchorages are estimated to be perfectly safe, their factor of safety against sliding being 2.45, whereas ordinary practice requires only a factor of safety of 2. It is estimated that the alterations and improvements to bring the bridge up to the desired standard of strength can be made for between $500,000 and $750,000.

Whatever action may be taken upon this report, there is one lesson that should be immediately laid to heart by the people of the city, namely, that the bridge has been shamefully and willfully neglected, and that if the process of deterioration is not to continue they must see to it that the care of the structure is committed to those who are technically qualified to exercise a conscientious and systematic inspection of the kind suggested by the report.

THE LATEST TRANSATLANTIC RECORD BREAKER.

In all the history of the transatlantic steamship, there has been nothing quite so remarkable as the consistency with which the Vulcan Works at Stettin, Germany, have produced in each transatlantic steamer that leaves that yard a vessel that is appreciably faster than its predecessor. Some three years ago this firm built for the North German Lloyd Company the "Kaiser Wilhelm der Grosse," 649 feet in length and of 30,000 horse power, the largest and fastest ocean steamer of her time. She made the quickest maiden trip on record, and steadily added to her speed until, last year, she covered the eastward passage at an average speed of 22.8 knots per hour. She was followed in 1900 by the "Deutschland" of the Hamburg-American Company. This magnificent ship was an enlarged "Kaiser Wilhelm der Grosse," her length being 686 feet and her contract horse power 33,000. She also broke the record on her maiden trip to the eastward, the time being five days, sixteen hours and fifteen minutes. On every successive trip the "Deutschland" showed an improvement in her speed, and after six months' service she covered the distance between Sandy Hook and Plymouth in five days, seven hours and thirty-eight minutes, at an average speed of 23.36 knots per hour, the engines showing an average indicated horse power for the whole trip of just under 37,000. This year the North German Lloyd Company have added to their fleet the "Kronprinz Wilhelm," which, in size and horse power, holds a middle position between the "Kaiser Wilhelm der Grosse" and the "Deutschland." She is 663 feet 4 inches in length and her horse power is 33,000. On the return trip of her maiden voyage, she gave promise of soon breaking all records for speed on the Atlantic, the route being covered in five days, nine hours and forty-eight minutes, or in several hours less time than the maiden trip of the "Deutschland." The best day's run of 540 knots was made at an average speed of 23.3 knots per hour.

A curious fact, not generally known, regarding vessels built by the Vulcan Works for the two great German companies is that while the Hamburg-American engineers are in favor of forced draft, the engineers of the North German Lloyd are strongly opposed to it. Forced draft is conducive to a high indicated horse power and a superior showing in efficiency; but while this fact is admitted by the North German Lloyd people, they claim that the decreased fuel consumption, (the "Deutschland" consuming only 1.3 pounds per horse power hour), is more than offset by the great wear and tear upon the boilers, the more frequent repairs, and the decreased life. The contest between the "Deutschland" and "Kronprinz" for the much-coveted record will be watched with great interest during the two years which will intervene before the giant vessel which is now building at Stettin for the North German Lloyd Company is completed and put in service. It is expected that the new vessel, which will be the longest and fastest in the world, will make its maiden voyage in May, 1903.

THE DEVELOPMENT OF THE BITUMINOUS COAL INDUSTRY.

BY WILLIAM GILBERT IRWIN.

There are no more interesting recitals in the annals of trade than that of the development of the fuel industries, for commerce and industry are very largely dependent upon the fuel supply. For many years the chief source of the world's fuel supply has consisted of those hydrocarbon compounds found in nature and known as coal. Scientists have long disputed over their origin, while in the meantime modern industry has adapted them to its varied requirements, and as a result has brought about achievements scarcely dreamed of a century ago. In the diversified fields of industry from which the capitalist reaps his millions and the workman toils for the necessities of life the coal trade has played a most important part. In its development we see the mightiest struggles of genius, the boldest strokes of business stratagem, the most gigantic projects involving the expenditure of enormous capital, and the organization of great armies of employés. The coal trade has constantly undergone an evolution involving a struggle for "the survival of the fittest," whether that of inventive genius, mechanical superiority, labor or capital.

In its adaptation to the uses of modern economic industry anthracite coal preceded bituminous, but of recent years the latter fuel and its products has had a much wider use in the iron and steel and allied industries, and present conditions foreshadow a continuance and even a rapid increase of this lead. The original area of the anthracite coal fields in this country did not exceed 500 square miles, and embraced the great field in Eastern Pennsylvania and the comparatively unimportant fields in Massachusetts, Rhode Island, Colorado, and New Mexico, while the bituminous fields already partially exploited in this country exceed 200,000 square miles, which shows conclusively that the latter coal is to form the fuel of the future.

Anthracite coal was first discovered in this country in Rhode Island in 1768, and in 1791 this fuel was discovered near Mauch Chunk, in Eastern Pennsylvania. The first discovery of coal in America was that of a bituminous vein near the present site of Ottawa, Ill., mentioned by Father Hennepin in 1679. The first coal mine opened in this country was a bituminous mine near Jamestown, first worked in the latter part of the seventeenth century. It is not the purpose of this article to trace these fuel industries through the period of their early development, but rather to trace the growth of the bituminous coal trade and the benefits which it has conferred upon modern industry.

The development of the bituminous coal industry up to 1850 was confined to the eastern part of the country. Then, as now, Pennsylvania held the lead, with Virginia, Illinois, Maryland, and Ohio making up the residuum of the output. The soft coal production in 1850 was, in round numbers, 10,000,000 tons. As yet the railway development of the country had not really been begun, and the iron and steel industries had not yet emerged from that period when charcoal formed the principal fuel. The coal trade then depended upon the rivers for transportation to the markets. In the development of the soft coal fields of Western Pennsylvania we can divide the industry into a number of epochs in accordance with the development of transportation facilities. The latter days of the seventeenth century witnessed the opening of small mines for local consumption; this was followed by the days of keel-boating down the Ohio and the Mississippi; about 1817 the flatboating epoch began; in the early forties the development of the slackwater systems on the upper Ohio streams ushered in the days of steamboating as applied to the coal-carrying traffic; in the meantime the coking industry was undergoing its infantile vicissitudes; then came the iron way of the railroad; lastly, the introduction of modern mining appliances and advanced mine engineering practice marks the highest point in the history of this great fuel industry.

Coming down to 1870 we find nineteen States and Territories producing soft coal, and in that year the output was 17,000,000 tons; ten years later twenty-five States and Territories were producing 43,000,000 tons; by 1890 the number of bituminous coal producing States had increased to twenty-eight, and the aggregate output for that year was 111,000,000 tons. During the past ten years the industry has been developed in no new States, but many new fields have been exploited in the already soft coal producing States, as will be seen from the fact that the output for 1900 was, in round numbers, 208,000,000 tons. While, in part, the marvelous increase in the soft coal output for the past ten years has been due to the development of new fields this is not entirely the case. During this period the introduction of the mining machine, the application of electricity and compressed air to mining operations, steel tipples and automatic tipple appliances, and the advancement of mining engineering, have had much to do with the development of the industry, as have the stimulating influences of the great industrial revival which this country has experienced during that time.

The Western Pennsylvania field, better known as the Pittsburg coal field, has during all these years maintained its lead with comparative ease, the production for 1900 being, in round numbers, 78,000,000 tons. Of the other principal coal States Illinois follows with 25,000,000 tons; West Virginia, 22,000,000; Ohio, 17,000,000; Alabama, 8,000,000; Indiana, 6,000,000; Kentucky and Iowa, each 5,000,000; Kansas, a little over 4,000,000.

According to geology the bituminous coal fields of our country are classed in seven groups. The Triassic field embraces the Richmond basin in Virginia, and the Deep River and Dan River areas in North Carolina. The maximum output of this field was reached many years ago, and its present annual production does not exceed 50,000 tons. While not the largest in area, the Appalachian field far exceeds all other fields in importance, its annual production being about two-thirds of the entire bituminous output of the country. It embraces Central and Western Pennsylvania, Southeastern Ohio, Western Maryland, West Virginia, Eastern Kentucky and Tennessee, Northwestern Georgia, and Northern Alabama. It contains the well-known Connellsville coking field, the Clearfield and Pittsburg gas and steaming coal seams, and the Monongahela field in Pennsylvania; the Blossburg and Cumberland fields in Maryland; the Pocahontas and New River fields in Western Virginia; the Fairmount, Flat Top, Kanawha, Georges Creek, Elk Garden and other important fields in West Virginia; the Massilon and Hocking fields in Ohio; the Jellico field in Kentucky and Tennessee; and the Birmingham field in Alabama. The central field, including the coal areas in Indiana and Illinois, and Western Kentucky, has a considerable area and a large production, as will be seen from the production of States given above. The Western field embraces the States of Iowa, Missouri, Nebraska, Kansas, Arkansas, and Texas and Indian Territory. In extent it is the largest field in the country, and in production it ranks third. The Rocky Mountain field includes the coal areas in Colorado, Idaho, Montana, New Mexico, North Dakota, Utah, and Wyoming. This field is rapidly increasing in importance. In 1887 the production of the field was about three and one-half million tons. Within three years the annual output was doubled and the production for 1900 was, in round numbers, 14,000,000 tons. While California and Oregon produce small quantities of coal their combined annual output does not exceed 200,000 tons. The Washington field is being rapidly developed, and the output of the State has increased from 1,263,689 tons in 1890 to 2,418,834 tons in 1900.

The aggregate of the world's output of all kinds of coal for last year was about 800,000,000 tons. The production of bituminous coal in this country was more than one-fourth of the world's mineral fuel production. It exceeded that of Great Britain; was one-fourth greater than that of Germany; five times the production of Austria-Hungary; six times that of France; fourteen times that of Russia, and fifty times the production of Canada. All kinds of mineral fuel produced by Continental Europe last year exceeded our bituminous production by a little more than one-fourth. More than a third of a million men are employed in the bituminous coal mines of our country, while a like number are engaged in its shipment, in the manufacture of coke, fuel gas and other accessories of the industry, and in the other labor required in handling the product from the mines to the markets. The office forces of the concerns engaged in the industry aggregate thousands, and there are superintendents, foremen, fire bosses, engineers, electricians and thousands of other skilled laborers dependent upon the soft coal industry. The industry has stimulated the construction of thousands of miles of railway, and the great trunk lines of the country are reaping rich revenues from the bituminous coal carrying trade. The sum total of the capital invested in this great fuel industry makes another interesting recital.

The economic methods of coal mining and fuel operations already adopted in the Old World have been made necessary, because of the depleted condition of the coal fields there. So far as concerns the bituminous coal industry, there is no danger of an early depletion of the fields of this country; but this does not mean that we are not adopting the more economic measures in every department of the industry. Allowing for the variation of the bituminous coal measures of this country, which run from a little less than four feet to eight or nine feet in thickness, it would not be far out of the way to estimate a production of 10,000 tons to the acre, which would give our entire bituminous coal area a producing capacity of 1,280,000,000,000 tons. At the present rate of mining the depletion of this area would require something like 6,000 years. However, it must be remembered that thousands of acres of barren territory are embraced within this coal area, the mining operations extending over the past sixty or seventy years have been quite extensive and thousands of acres of coal have already been rendered unminable, and future operations will make it impossible to mine much of the coal. However, it will be seen that so far as concerns the bituminous coal supply this country has nothing to fear as to the future.

Already American bituminous coal is playing an important part in the export trade, and is being received with favor in Europe in competition with the Welsh product. Our exportation of bituminous coal has grown from 1,138,681 tons in 1890 to 5,411,329 tons in 1900. It has been only a few years ago that American coal was practically unknown in the European markets, while during the past year our soft coal was exported to eleven countries of Europe to the aggregate amount of over a quarter of a million tons. The scarcity of the Welsh product caused by the Boer war gave an impetus to the market for our soft coal in Europe, and it seems to have found a permanent market there. Last year our soft coal was exported to fifty countries, and American coke was sent to twenty-two foreign countries, the total exportation of this soft coal product being about 400,000 tons. Pennsylvania, West Virgina and Maryland bituminous coal figures most largely in the export trade owing to the advantageous location of the fields of these States with respect to the great Atlantic ports.

Mile Automobile Track Record Lowered.

The fastest time ever made on a track by horse, bicycle or any machine was made on Thursday, October 10, at Empire City Park, N. Y., by M. Henri Fournier and his guest, Mr. William K. Vanderbilt, Jr. The total time for the six miles was 6 minutes 47 seconds. The fastest mile, which was the third, was done in 1 minute 6 4-5 seconds. The rules require that two persons be in the motor vehicle in a record-making endurance test. Some idea of the enormous speed which was developed can be gained when it is stated that the distance was traveled on the track in faster average time than is made by the Empire State Express. M. Fournier used the same machine with which he won the Paris-Berlin race last summer, and he broke his own records by nearly six seconds. The best former world's track record was 1 minute 13¼ seconds, which was made in September at Fort Erie by M. Fournier himself.

It is anticipated that when the Solent tunnel, connecting the mainland of the south coast of England with the Isle of Wight, is completed it will have a great influence upon the transatlantic shipping traffic. A pier is to be built at Yarmouth, near which the tunnel will emerge on the island, and the North German steamers will be able to discharge their mails, passengers, and cargo at this point, instead of proceeding up to Southampton. Owing to the great care that has to be exercised in traveling up this waterway to the port, and thence down Spithead, a considerable amount of time is wasted. By stopping at Yarmouth a great economy in this direction will be effected.

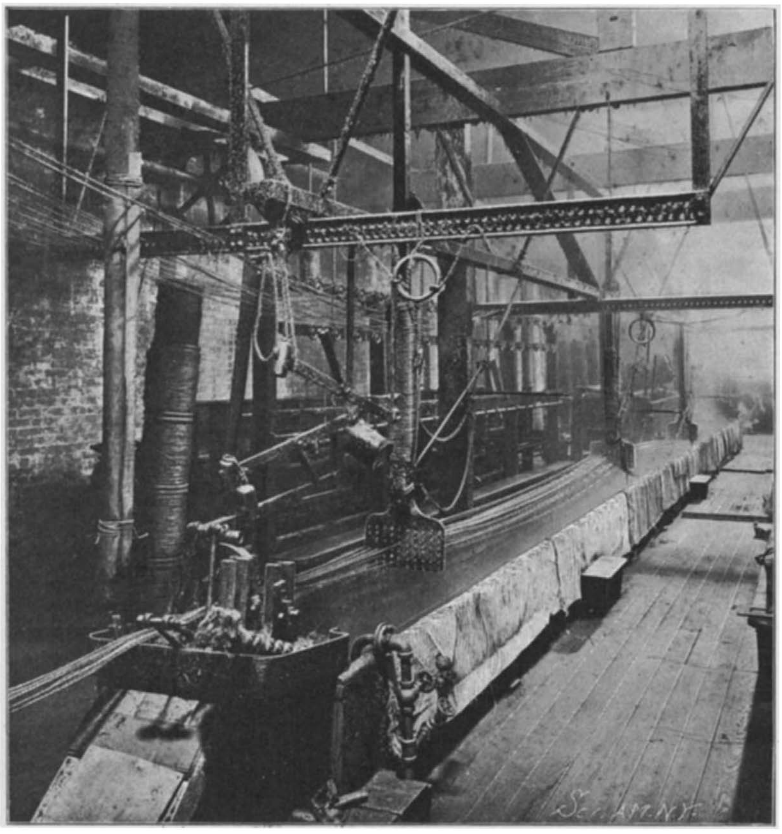
THE MANUFACTURE OF CORDAGE.

The word "cordage" is used in a comprehensive sense to include all sizes and varieties of the article from binder twine to a cable 15 inches in circumference, though strictly speaking the term is hardly applicable to a rope that is less than half an inch in diameter.

The materials employed for rope-making are various, embracing hemp, flax, manila, sisal, jute and other vegetable fibers. Sisal from Yucatan and East Indian jute are largely used for the manufacture of cheaper grades of rope and for binder twine. Russian and American hemp are preferred for standing rigging, owing to their ability to absorb a great amount of tar. Manila hemp is more extensively used in the manufacture of cordage than any other material, as its great pliancy and strength adapt it to a multitude of uses. Manila hemp is obtained from a species of wild plantain belonging to the banana family and is a native of the Philippine Islands. Its stem has a height of from 15 to 20 feet, is of a dark green color and very smooth on the surface. The fiber is round, silky looking, white and lustrous, easily separated, stiff and very tenacious and also very light. These fibers, although in themselves not very large, are composed of very fine and much elongated bast-cells. The length of the cells is about a quarter of an inch, and they are not, as commonly supposed, held together by an intercellular tissue or mucilaginous substance. The characteristic roughness possessed by Manila fiber is due entirely to mechanical causes, such as, for instance, the laceration of a cell in the separation for the leaf-stalk, or the subsequent opening out of the ends of the cells. While the fibers are weak transversely, they have great strength in the direction of their length. The tensile strength of Manila fibers will average over 30,000 pounds per square inch of section. The plantain is cut near the roots when from two to four years old, and the leaves cut off just below their expansion. The outer leaf is then stripped off, and the fibrous coats are left for a day or two in the shade to dry and then divided lengthwise into strips 3 inches wide. They are then scraped by an instrument made of bamboo until only the fibers remain. Bundles of fibers are shaken into separate threads, after which they are washed, dried and separated according to quality and shipped in bales. From 150 to 200 trees are required to produce 140 pounds of fiber.

Sisal hemp is the product of the agave, a large genus of fleshy-leaved plants found chiefly in Mexico and Yucatan. The fiber is yellowish white, straight, smooth and clean, and is about 25 per cent weaker than Manila fiber. Much of the Sisal hemp is prepared for export to this country by machinery. Its consumption is fully as large as that of Manila, and it is chiefly used for binder twines.

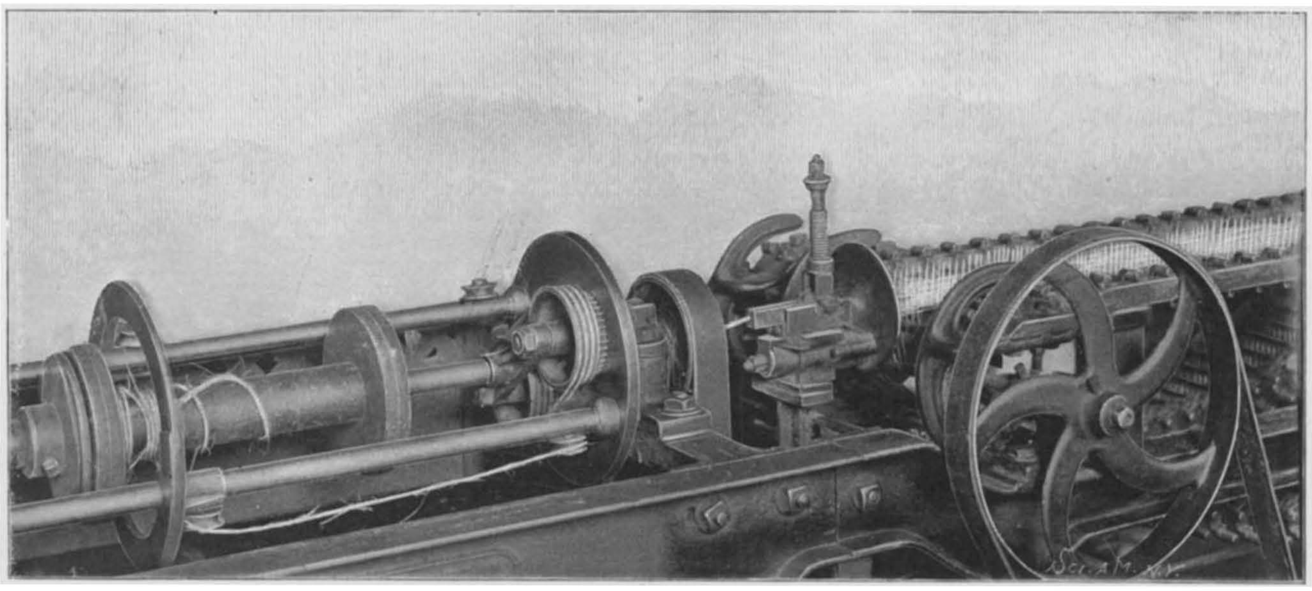
The preliminary treatment of the fiber after it arrives at the cordage mill is approximately the same whether it be Manila or Sisal, so that a description of one fiber will practically answer for the other. The plant which we illustrate is that of the Waterbury Rope Company, Brooklyn, N. Y. There are a number of buildings devoted to the manufacture of various classes of cordage, and the ropewalk is two blocks in length. The binder twine mill is separate and is not run at all times of the year, as the work ceases in the spring when the orders for twine have been filled; the rest of the plant runs throughout the year. The bales of Manila hemp, averaging about 270 pounds each, are opened in the basement of the Manila twine mill, and after the material has been lightly shaken apart it is placed in layers which are sprinkled lightly with oil to soften and lubricate the fibers previous to their passage through the machinery. The first mechanical operation consists in passing the hemp over roughing cylinders bristling with sharp steel prongs or teeth which straighten out the fibers and remove the tow and fine broken particles, dirt or other foreign substances. It then passes to the breakers, which are large frames about 25 feet long, consisting of two endless chains studded with steel pins. The first chain runs slowly and feeds the fibers to the second, which runs much faster, the effect being to comb or straighten out the fibers and draw them into a "sliver" or ribbon. The hemp is then hoisted on elevators to the top of the building. Following this operation comes the passage of the hemp through the spreaders and drawing frames. These machines are similar to the breakers, but are smaller and furnished with steel pins and teeth of gradually increasing fineness which still further comb and straighten out the fibers, a number of slivers being put together behind each machine and drawn down to one sliver again at the end of each machine. One of our engravings shows a finisher which illustrates the type of all three machines. It will be seen that a number of slivers are being fed from the cans onto the drawing pins. This drawing is repeated a number of times with machines of various degrees of fineness, in order to make the sliver even, without which it would be impossible to spin fine, even yarn. The process is completed in a very fine drawing frame, called a "finisher," and from this the material finally emerges in complete readiness for spinning, having been drawn into slivers or small, soft ribbons in readiness for the spinning frames.



TARRING THE TWINE FOR MAKING TARRED ROPE.

One of our engravings represents the essential features of the spinning jenny, the machine operates two spindles, but for the sake of clearness we show only one of them. The small sliver is fed from one of the cans over the endless belt provided with needles, as in the breakers, spreaders and finishers. These needles carrying the fiber move toward a conductor or "nipper" carrying the sliver with it. The sliver is by this time exceedingly small and is capable of passing through a small hole in the face plate of the nipper, where it is compacted in passing through the orifice. A jaw is controlled by a spring which can be regulated, so as to adjust the size of the feed. As it leaves this part of the machine the twisting begins. The speed is 1,500 revolutions per minute. The yarn is twisted in a direction called right-handed, and feeds through the pulley which will be seen in the center of the engraving, passing through the head block and moving face plate, and is finally warped around grooved pulleys in order to give the necessary strain to pull the compacted fibers through the nipper. It is then wound upon the bobbin seen to the extreme left, about a thousand yards being wound upon it. A special mechanism traverses the bobbin in order that the yarn may be evenly wound. The attendants see that the sliver is regularly supplied and that any accidental breakages in the thread are repaired. The yarn is placed in small cars and sent to the various rope-making departments. If a rope is to be tarred, the yarns are run through copper tanks filled with heated tar. The yarns enter through holes in an iron plate and are drawn through the tank by machinery. As the yarns emerge, the superfluous tar is removed by means of pressing rollers and the yarn is wound on bobbins. If the yarn is to be used for binder twine, the Sisal hemp is spun finer than Manila, and after being spun the yarn, which is now on bobbins, is carried to the twine balling and packing room, where the balling machines, shown in one of our engravings, wind the yarn into balls of proper size.

Rope-making is accomplished in various ways and is all done by machinery. The yarn is twisted into strands by means of machines called "formers," and the strands are twisted into rope by means of machines called "layers." If the rope is to be of moderate size, not exceeding one inch in diameter, the formers and layers are combined in one machine. The large machines are very impressive on account of their great size and the rapidity with which the finished product is turned out. In the Farmer machine there are many bobbins, which are arranged in three frames, each of which revolves independently around its own axis, and they are all carried around while in motion by a large frame which supports all three smaller frames. The threads from the various bobbins are passed through apertures in an iron plate, and the motion of each small frame serves to twist the yarn drawn from the bobbins into a strand. The three strands pass upward through a "top" at the upper portion of the machine. As the strands come together they are twisted to form a rope by the movement of the entire machine carrying the three sets of bobbins, which are each rotating separately. The result is a finished rope. The new rope is rotated around several pulleys in order that the proper pull may be obtained to draw the rope tightly through the "top," and it is then wound on one of the reels. This rope can, of course, be used for any purpose and can be made of large size. For well-drilling and other purposes where rope of great strength but little flexibility is required, cables are used. Cables vary from 1,400 feet in length up and usually measure from 1⅞ to 2½ inches in diameter. They are composed of three Manila ropes instead of strands, and the ropes are twisted together with a very hard "lay," so that they will not untwist when used for drilling and so that they will resist wear in the continuous rubbing against the side of the casing and the wall of the wells. Owing to their length and construction, cables are always made on machines and not in ropewalk. On one of the machines in this factory it is possible to make cables 15 inches in circumference. The reel containing the rope that has just been made, is now placed on a cable-making machine. The principle of cable-making is the same as rope-making, only that actual ropes are used instead of strands. Each reel is turned around on a horizontal plane by means of gears, while it is paying out its rope. The entire machine carrying the three reels is turned simultaneously on a hori-



DETAIL OF SPINNING JENNY, SHOWING THE FIBER BEING DRAWN FROM THE SLIVER, TWISTED, STRETCHED, AND WOUND ON BOBBINS.

zontal plane; the ropes are roved around various pulleys, and finally as they pass through a "top" at the upper part of the machine they are twisted together to form the cable, and then after being roved around grooved sheaves to obtain the necessary pull are reeled up by a power-reel. When a sufficient length of cable is obtained, it is ready for shipment. In this plant there is a large horizontal rope and drilling-cable laying machine, but the principle does not differ materially from the vertical machine.

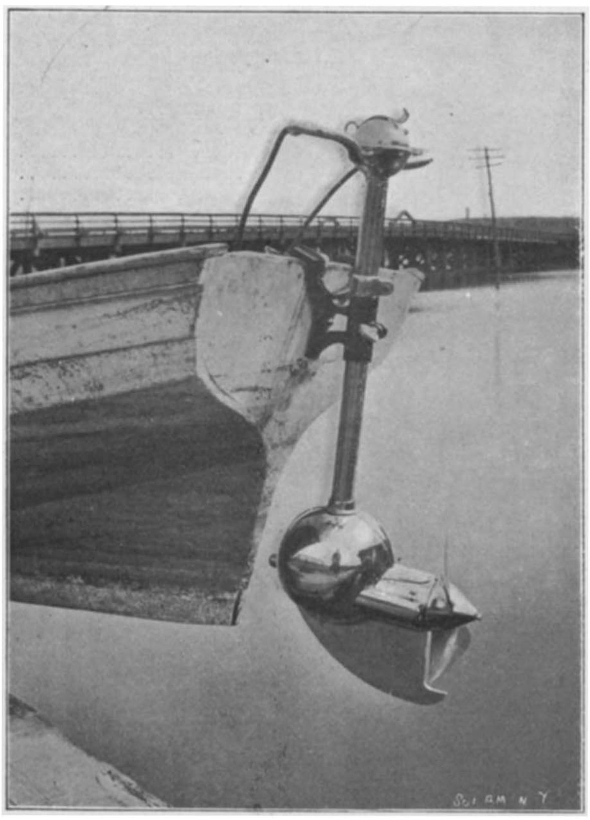
Ropes of considerable size, towing lines and ships' cables of the largest dimensions are made on the rope-walk, which is 1,100 feet long and which passes under one cross street. The yarn is rewound on larger bobbins, and the number used depends on the size of the rope. These bobbins are put on a framework of wood, located near one end of the ropewalk, and the ends of the yarn are passed through holes in an iron gage-plate shown in our first engraving of the rope-walk, and which is known as the face plate. It then passes through cast-iron tubes, and the yarn is fastened on hooks of the forming machine, which consists of a truck which travels on a track the entire length of the walk. There are as many hooks as there are strands. As the former moves away from the face plate it draws the yarn with it, and at the same time each hook revolves by means of gears, twisting the yarn left-handed into a strand. The machine is actuated by a cable which lies along the floor of the ropewalk. The cable passes over a large wheel at the left and serves to operate the mechanism which turns the hooks, and at the same time winds up a cable attached to the end of a ropewalk, thus making its motion positive. When the forming machine has reached the upper end of the rope-walk, as shown in our second engraving of the walk, the strands, each 1,100 feet in length, are completed. They are now taken and laid over on the other side of the walk, and the strands are then ready to be "laid" or made into rope. Two laying machines are required, one at each end of the walk, and are known as the "upper" and "lower" machines. They also give the rope what is known as a fore turn and an aft turn. As many of these strands as are required for the rope are stretched to full length and are attached to hooks on the laying machine. The upper machine has several hooks, but only one is used. All the strands are fastened to this hook and they turn left-handed in laying, and the lower machine has as many hooks as there are likely to be strands and operates in the opposite direction. The strands are meantime placed in the grooves of a conical wooden block called a "top," through which is passed an iron bar which is fastened to an upright post of a car called a "top sled." Pieces of rope called "tails" are fastened on the bar and wound round the rope to be laid. They help regulate the lay and assist in giving the rope a finish-gloss. The top having been mitered between the strands as closely as possible to the top, the sled is gradually forced along as the twisting proceeds in a right-handed direction. The lower machine keeps all the strands from untwisting. The top sled finally arrives at the lower end of the walk, with the full length of completed rope behind it. It is then compactly coiled by a reeling machine, covered with burlap and shipped to its destination.

At Postel in the district of Militch a cemetery 3,000 years old has been discovered. Two hundred graves have been unearthed under the supervision of the director of the Berlin Museum. The coffins are of stone, square in shape, and date from the bronze period.

A NEW SUBMERGED ELECTRIC MOTOR AND PROPELLER.

A propelling mechanism which can be transferred from one boat to another in a few minutes' time will be welcomed by many who use boats either for business or pleasure. The device which we illustrate only weighs from 30 to 45 pounds and can be removed at a moment's notice, and if desired can be taken into a boathouse for safety. The batteries weigh from 35 to 55 pounds each, according to their size. The motor and propeller occupy the place of the rudder, and the boat is steered by turning the sternpost. The motor itself is under water and is inclosed in a water-tight globe or shell, the storage batteries being placed in the boat. The motor not only propels the boat, but steers it as well, and the boat answers the propeller as readily as it does a rudder. It can be run at any speed up to four miles an hour using two crates of four cells, and a run of from 20 to 30 miles can be made on each charge. The motor is a series-wound, two-pole machine of slow-speed type. The armature is of the tunnel type with a smooth periphery and is capped with spun-heads so as to present a smooth and uniform surface to the water when revolving. The motor is entirely inclosed in a spun case made in two parts, and is supported from the tube above and held and protected by an aluminium pin below, which also protects the blade. The switch provides for two speeds in either direction and is located at the top of the tube. A bracket is clamped to the stern of the boat by thumb screws and allows the motor to be turned in any direction for steering. The tiller-head, which contains the switch, is connected to the battery by wires. These wires act as tiller cords. Brackets are supplied for either double-ended or flat-sterned boats, as may be desired. The wires to the batteries are provided at their ends with terminals which snap into sockets. There are no binding screws nor adjusting fastenings, so that it is impossible to connect the battery wrongly. The elements are placed in rubber cells which are secured in wooden boxes. The entire machine is nickel-plated. This very ingenious boat-propeller is made by the Submerged Electric Motor Company of Menomonie, Dunn County, Wis.

THE SUBMERGED ELECTRIC PROPELLER AT WORK.



SUBMERGED ELECTRIC BOAT PROPELLER.

A NEW AUTOMATIC TELEGRAPH REPEATER

A device for repeating telegraphic messages both with and without the use of sounders or other receivers at intermediate stations is the subject of an invention for which Mr. Julio E. Cordovez, of Panama, Colombia, has received a United States patent. The contrivance allows the use of the apparatus either for repeating purposes or for those of ordinary communication from station to station. Our description will be confined to the apparatus used with sounders.

In our diagram *A* represents the line-wire from one station, and *B* the line-wire from another station, the wires being connected with the binding-posts, *A'* and *B'*, respectively. The local battery, *C*, is connected by wires, *D* and *E*, with binding-posts, *D'*, *E'*. The poles of the main battery, *C'*, are connected by wires, *F G*, with the binding-posts, *F'*, *G'*. The binding-post, *H'*, is connected by the wire, *H*, with any suitable local apparatus, such as a telephone or a testing instrument. The various binding-posts mentioned are secured upon a board. From the post, *A' B'*, continuation-wires lead to a lightning-arrester, *J*; and the wires connect the lightning-arrester in turn with the switches, *A4 B4*, which are shown in engagement with contacts, *K K'*. The switches, however, can also engage another set of contacts, *L L'*, of a central contact, *M*, or rests, *N*, serving to hold the switches out of connection and to prevent them from catching in the various wires. The contact, *M*, is connected with the binding-post, *H'*. The switches can also engage grounding-plates, *O O'*.

The grounding-plate, *O'*, is connected by a wire, *F2*, with the binding-post, *F'*. From the grounding-plate, *O*, a wire, *P*, leads to the coils of a relay-electromagnet, *Q*, connected by a wire, *P'*, with the coils of an opposing electromagnet, *Q'*. A wire, *P2*, connects the coils of the electromagnet, *Q'*, with a contact, *R*, on a telegraphic key. The key has three contacts, *R R' R2*, insulated from one another. The contact, *R*, is normally engaged by a screw on the end of the key-lever. The contact, *R'*, is electrically connected with the key-lever and also with the contact, *L*. The contact, *R2*, is connected by wires, *P4 p4*, with the corresponding contact, *r2*, of another telegraph-key. The connec-

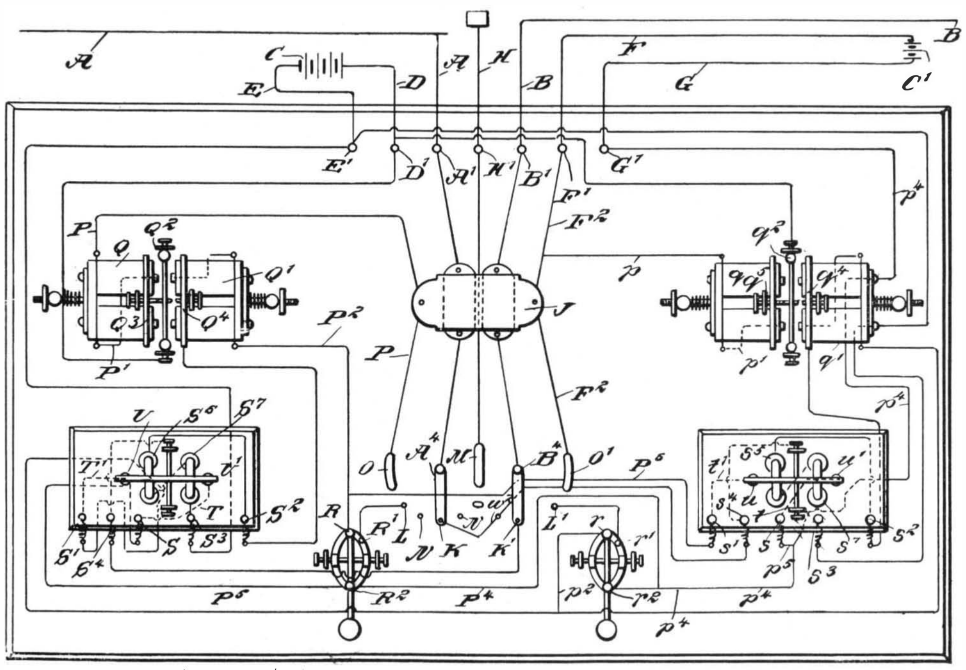
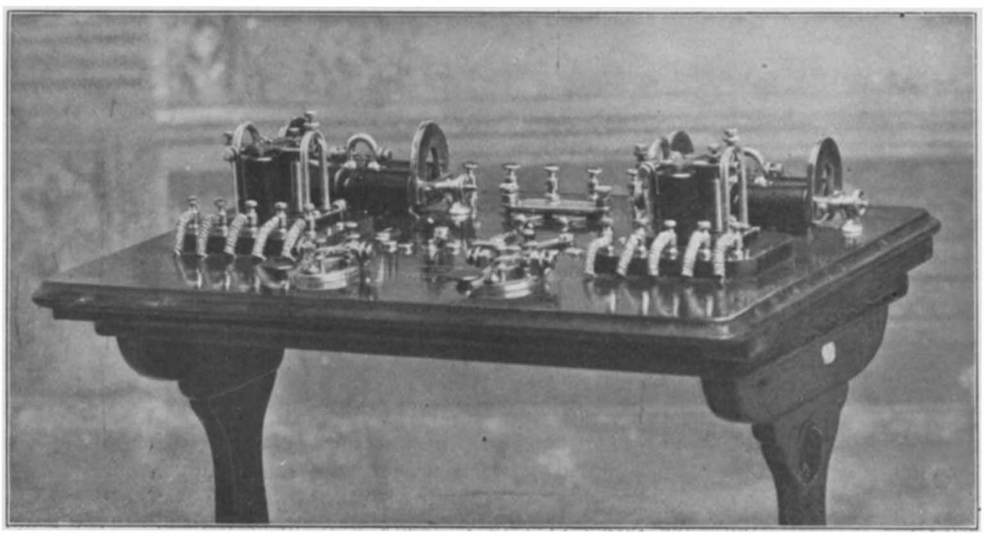


DIAGRAM OF APPARATUS IN WHICH SOUNDERS ARE USED.



THE CORDOVEZ AUTOMATIC TELEGRAPH REPEATING APPARATUS.

tions of this second key are similar to those already described, small reference letters being used similar to those designating the parts on the left-hand side of the apparatus. The wire, *p*4, is connected with the binding-post, *G'*, and also by a wire, *P*5, with a binding post, *s*, of the sounder or circuit closer, which post is connected by a wire, *t*, with a contact, *u'*, arranged to be engaged by the armature of the circuit-closer. The same connections are provided on the left-hand side of the apparatus and are there presented by capital letters. The armatures normally engage the contacts, *u U*, connected by wires, *t' T'*, with binding-posts, *s' S'*, from which wires respectively lead to the wires, *P*2 *p*2. The binding-post, *D'*, is connected by wires with the relay-armatures, *Q*2 *q*2, normally engaging the stops, *Q*3 *q*3. In their other positions the armatures engage contacts, *Q*4 *q*4, connected by wires with binding-posts, *S*2 *s*2, of the circuit closers. From these posts wires lead to the coils, *S*6 *s*6 *S*7 *s*7, from which wires lead to the binding-post, *E'*. Finally the armatures of the circuit closers are wired to the binding-post, *S*4 *s*4, from which wires lead to the contact, *K' K*.

The cores of the relay are arranged on opposite sides of the armature, and with the cores permanent magnets are connected. The magnets and core-coils are so arranged that a current passing through the coils will increase the magnetism of the core on one side of the armature and decrease the magnetism of the core on the other side of the armature. A similar magnetic connection of the cores with the permanent magnets characterizes the circuit closer.

With the switches, *A*4 *B*4 (or one of them) on the grounding-plates, *O O'*, the current passes from the line, *A* (or *B*) to the binding-post, *A'* (*B'*), through the wires to the switch, *A*4 (*B*4) to the ground. This grounding connection could be used, for example, in detecting and locating a leak in the line or for connecting the line with the earth during thunder storms.

With the switch, *A*4 or *B*4, on the central contact, *M*, the current will pass from the line, *A*, for example, to the binding-post, *A'*, through the wires leading to the switch, *A*4, through contact, *M*, through the wire leading to binding-post, *H'*, and through wire, *H*, to any local instrument. This connection is of particular service upon lines where the same wire is used at times for telegraphing and at others for telephoning.

With the switch, *A*4, on the contact, *L*, the current will pass from the line, *A*, to the binding-post, *A'*, switch, *A*4, to the contacts, *L R'*, the key-lever, contact, *R*, the wire, *P*2, coils, *Q'*, wire, *P'*, coils, *Q*, wire, *P*, and to the earth at *O*. This will energize the coils, *Q Q'*, in consequence of which the armature, *Q*2, will leave the stop, *Q*3, and swing against the contact, *Q*4. This closes the following local circuit; from the battery, *C*, by wire, *D*, and binding-post, *D'*, to wire, *W*, armature, *Q*2, contact, *Q*4, binding-post, *S*2, coils, *S*6, coils, *S*7, binding-post, *S*3, binding-post, *E'*, and wire, *E*, back to the battery, *C*. The coils, *S*6 *S*7, being thus energized, will exert the peculiar, described attraction and repulsion on the circuit-closer armature to swing it into engagement with the contact, *U'*. This engagement does not close any circuit, but produces the customary click, this part of the apparatus acting as a sounder in the particular case under consideration. When the circuit is broken at the distant station, the armatures of the relay and circuit-closer will return to their original positions. This describes the action when the station illustrated receives the message. When the message is sent from the station shown, the action at the distant station will be as has just been described, while at the sending station the path of the current will be as follows when the key-lever is depressed to engage the contact, *R*2: From the ground-plate, *O'*, to the wire, *F*2, binding-post, *F'*, wire, *F*, line-battery, *C'*, wire, *D*, binding-post, *G'*, wires, *p*4 *P*4, contact, *R*2, key-lever, contact, *R'*, contact, *L*, switch, *A*4, binding-post, *A'*, and line, *A*.

With the switches, *A*4, *B*4, engaging the contacts, *K K'*, as shown, a message sent over the line, *A*, will be automatically repeated and forwarded over the line or *vice versa*.

Our article has been confined for lack of space to a description of the apparatus when sounders are employed. Mr. Cordovez has, however, devised a modified arrangement in which the local battery, *C*, is dispensed with and in which only one armature is used on each side of the apparatus. His apparatus has been very successfully used with stations forty miles distant on each side of a central station.

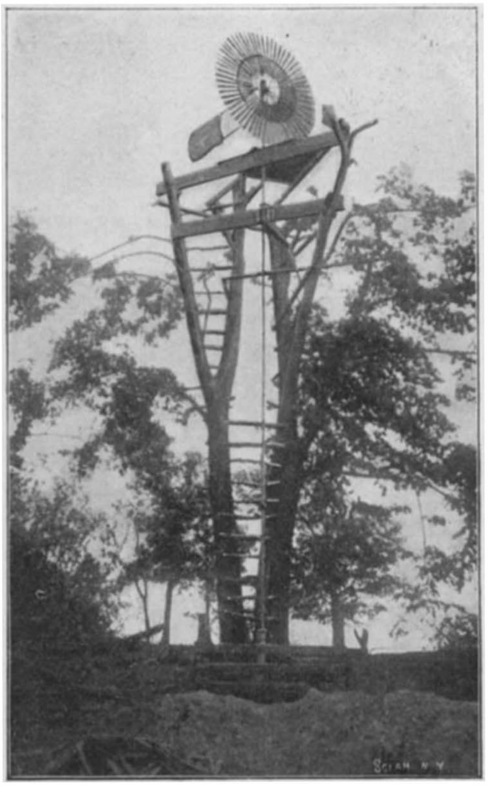
Population of Civilized Countries.

Within the last two or three years most of the civilized nations of the earth have made enumerations of their inhabitants, says Bradstreet's. The results of these censuses are beginning to appear, and comparisons of them with one another and with that of the United States are instructive. The following table shows the total population of a number of countries, as derived from recent censuses, with the rate of decennial increase and the density of population, expressed in terms of the number of inhabitants per square mile, the third column representing the percentage of increase for the decade, while the outside one shows the density of population per square mile:

Countries.	Date.	Population.		
United States	1900	76,303,387	21	26
England and Wales ...	1901	32,523,242	12	557
Germany	1900	56,345,014	14	269
France	1896	38,517,975	—	189
Spain	1900	18,078,497	3	92
Switzerland	1900	3,212,551	10	207
Norway	1900	2,231,395	12	18
Belgium	1900	6,744,532	11	593
Netherlands	1899	5,103,924	13	403
Austria	1900	26,107,304	9	225
Hungary	1900	19,200,000	11	153
Russia	1897	128,922,173	—	15
Sweden	1899	5,097,402	7	30
India	1901	294,266,701	2	188
Japan	1898	43,760,754	—	296
Chili	1895	2,712,145	7	9
Peru	1896	4,610,000	—	7
Denmark	1901	2,447,441	13	160

A CURIOUS WINDMILL.

A windmill is apt to be a very prosaic and ugly construction, but many attempts have been made with varying success to beautify these very useful and economical power producers. Our engraving illustrates how nature and mechanics are sometimes blended. The trees serve only as a support for the platform at the top, and as side rails of a ladder, it being necessary only to provide rounds. The trees serve also to stay the iron supports. The windmill, which was built by J. G. Benster, of Moline, Ill., is of peculiar construction, there being no gear wheels nor



A TREE WINDMILL.

crank, the power being transmitted by an involute wheel which is a part of the steel wheel to which the fans are attached. The surface of the involute is perfectly smooth, as is also that of the wheel attached to the pitman carrier, the one rolling upon the other. The mast is of tubing, the pitman being carried down inside. The wires for throwing the mill out of gear are attached to a thimble on the outside of the mast. From this it will be seen that the trees are not needed for actual support.

A number of these mills have been attached to trees and have been giving excellent results. It is also possible to carry the mills around on a wagon and set them to work at any part of a field.

Twentieth Annual Convention of the American Street Railway Association.

The twentieth annual convention of the Association was held in this city, October 9, 10, and 11, at the Madison Square Garden, and at the same time the fourth annual convention of the Street Railway Accountants' Association occurred. Various papers were read; among the most interesting was one on the standard form of convertible car adopted for transition from open to closed or *vice versa*. Another subject of interest was on interurban roads and their relations with city street railway systems. Still another paper described the advantages of having a motor on each car axle of a double-truck car because of the greater tractive power developed in starting and economy in the application of the current.

Probably the most interesting feature of the convention was the exhibits of various kinds connected with the construction of electric street and suburban cars and appliances connected therewith.

Numerous forms of fare registers were displayed along the entrance to the main exhibition room. Entering the main hall, the large exhibit by the General Electric Company of their controller for automatically operating in multiple several motors at a time in a train of electrically equipped cars was practically demonstrated; there were also examples of the type of motor that is to be used on the city elevated railways and the third-rail connections.

Adjoining this exhibit was a large exhibit by the Standard Traction Brake Company, under the supervision of the Westinghouse Company, the principal feature in which was a section of inclined track about one hundred feet long, over which ran a large double-truck car every few minutes, equipped with the Newell magnetic brake, which demonstrated practically its effectiveness in quickly stopping the car. The brake was illustrated in the SCIENTIFIC AMERICAN of July 27 last. A special generator is run from the car axles which energizes the electro-magnet over the sliding shoes, causing them to be strongly attracted to the rail at the time of stopping. It has the effect of preventing the flattening of wheel treads due to the sliding of clamped wheels on the rails. Ranged along the railway were examples of air-brake motors, electric, and those connected to car axles, and styles of motors to be used on the New York underground Rapid Transit System. There was also an attractive exhibit of the Nernst lamp, models of the lamp in section and parts illustrating the method of disconnecting the heating circuit automatically when the light electrode becomes incandescent. Several working lamps (arranged in the form of a canopy) of from 50 to 300 C.P. were on exhibition and gave a very brilliant, pleasing light.

The entire eastern end of the hall was occupied with exhibits of the J. G. Brill Company covering their improved forms of car trucks hung with additional springs arranged to counteract the well-known side jolts of trolley cars. They also exhibited examples of wholly convertible cars (from open to closed) very ingeniously constructed, in which the glass windows and flexible side panel are pushed upward and stored in the car ceiling. Even with this there is space provided for the usual open car weather canvas curtain. An example of their semi-convertible car, by which the glass sashes are stored in the ceiling and large seating capacity is provided, was also shown. The cross-seat center aisle system seems to be the favorite plan of interior construction. We noticed a fine example of this type of car on exhibition by the John Stephenson Car Company, in Madison Avenue, wherein the semi-convertible feature consisted in pushing the upper sash into the roof and dropping the large lower sash into the panel below.

There were a number of exhibits of special air brakes for street cars and a very large exhibit of car fenders by the Providence Car Fender Company.

A beautiful working model of the Robins ore or coal conveyer was on exhibition, illustrating a rapid and economical method of distribution.

Numerous forms of electric car heaters were displayed, that called the "Bay State" being perhaps the most novel. It consists of a coil of resistance wire located at one end of the car through which a current of air is passed by means of an electric fan; the warmed air is thus propelled forward from the hot coil through a distribution pipe along the lower part of the car, much the same as hot air from a furnace.

We noticed an exhibit of the Gould storage battery used as an auxiliary in trolley roads. The battery is built up of specially spun lead plates, the active material being formed thereon by the electric current.

An exhibit, part of which was popular with railroad employes, was of various styles of coats, caps and wearing apparel.

There was an example of a snowplow trolley car and electric track sweepers. Several kinds of single and double car trucks were shown. Taken as a whole, the exhibition was most instructive and interesting.

Experiments have been carried out by the Ordnance Board of the British War Office in connection with the new 9-inch wire-wound breech-loading quick-firing guns mounted at Dover to determine the possible maximum rapidity of fire and the life of the weapon. One of the guns was selected for the experiment. Theoretically the life of such a gun is about 80 rounds, but 161 rounds were discharged from this weapon. Heavy projectiles were employed, in some instances weighing 450 pounds. After several rounds had been fired the rifling of the gun was seriously impaired by corrosion, so that the projectiles would not fit. A special mechanism, which the Ordnance engineers have devised for use in connection with worn guns, was then requisitioned, and by its means the shells were fired with the same precision and unerring accuracy which characterized the firing when the gun was first employed. In fact, it was proved that without the mechanism it would be absolutely impossible to shoot straight with a worn gun. The speed records were very satisfactory. The best result was five rounds from the 9-inch guns in 80 seconds. The range of the weapons is 11 miles.

Correspondence.

Home Refrigerating Plant Wanted.

To the Editor of the SCIENTIFIC AMERICAN:

I noticed recently in the SCIENTIFIC AMERICAN an inquiry for a small ice or cold-storage plant, for dwellings or other isolated places, where a small cold-producing plant would be of great use.

I have often thought that windmills might be used for compressing air in reservoirs, just as they are used for pumping water into elevated tanks, and that after cooling the air it might be used for refrigeration.

I have understood that this method of refrigeration was not economical, or that the efficiency was low, but have never seen any figures on the subject. It would be interesting to have an article from your Mr. Alton D. Adams on this subject, written in his usual thorough manner.

I think the mechanical arrangements could be made without much difficulty, but whether the mechanism would accomplish the desired result economically is the problem on which reliable information would be welcome. These windmill refrigeration plants would be of immense benefit in cooling rooms for the storage of perishable stuff, the manufacture of ice being really a secondary matter to most persons.

I hope that you will be able to give us some articles in the SCIENTIFIC AMERICAN on the subject of refrigeration and the means of accomplishing it on a small and comparatively cheap scale. STANLEY PIKE.

Greenfield, Ohio, October 2, 1901.

[We shall be pleased to hear from any of our correspondents, who may have made experiments in this direction.—ED.]

The Great Shower of Shooting Stars.

To the Editor of the SCIENTIFIC AMERICAN:

This wonderful display, which startled the northern hemisphere in the month of November of the years 1799, 1833 and 1867, was announced by some English astronomers as due to reappear in November, 1899. But the watchers were disappointed; and the cause assigned for this disappointment was that the swarm of meteors from which the shower falls had been either diverted from its usual source, or had been wholly scattered by the influence of some of the large planets. The probability is, however, that we shall behold this grand display again, about November 15, 1901. One of our leading astronomical publications, referring to this subject, uses the following language:

"Some astronomers have expressed opinions with more or less assurance that the path of the Leonid streams of meteors has been so changed that we may no longer hope for such grand showers as were seen in 1866, and notably in 1833. Although no remarkable shower is reported as seen anywhere in 1900, it is evident that the stream of Leonids has not been diverted from its former course far enough to miss the earth;" considerable numbers of the Leonids having been seen at various points on the night of November 15, 1900.

The explanation of the mistaken prediction is to be found in the hasty and careless examination made of the records of past appearances of these meteors, and which ended in the deduction of a period of thirty-three and a quarter years. Prof. McClune, of Philadelphia, however, with Prof. Herrick, of Yale, and a few others correctly estimated the period in 1867, putting it at 34 years and 1 day, or to be more accurate 12,419 days. Thus, the first recorded shower was witnessed on the night of November 11-12, 1799; the next on that of November 12-13, 1833; the following one occurring on November 13-14, 1867; so that the next becomes due on the night of November 14-15, 1901—in a few weeks hence.

It has been found that this stream of meteors takes three years to pass the point where the earth meets it in each November of those three years to plunge through it in five or six hours. The first year of these encounters the head of the stream is met, where the swarm is thin and the display consequently not so great as that of the second year when the earth goes through the dense portion, to be followed in the third year by a still lighter shower. The records show that the displays of the first year have been visible in the Eastern Hemisphere, but not on this continent, whereas the reverse has been the case with those of the second years—or the great showers, so called. As the display of the first year 1866 series was quite brilliant—seen only, however, in the Old World—the 33 years that had elapsed from the grand shower of 1833 seem to have been taken as the period of return; and this no doubt led to the mistaken prediction which assigned 1899 for the reappearance of this magnificent sight. But the shower of 1867 was by far the grandest of that time, or rather series. And reckoning from the previous corresponding display, 1833, the period was exactly 34 years and 1 day, as stated already. The same reckoning holds good in the preceding cases.

A notable circumstance in connection with the visits of the Leonid meteors is that the weather of the Northern Hemisphere has experienced remarkable vicissitudes at each of the recurring periods. The sudden and violent change in the temperature (observed in 1799 by United States Commissioner Ellicott, off the coast of Florida) was noted again in 1833, the thermometer having run down 20 deg. in this vicinity (at other points as much as 30 deg.) from a few hours before the appearance of the meteors until sunrise of the 13th of November. And the fall in the temperature continued until the 21st, at which time the daily mean had fallen from 54 deg. on the 12th to 27 deg. A similar perturbation occurred in 1867; and if a rapid decline should occur within a few hours after sunset on the evening of November 14 next it will probably indicate the close proximity of the earth to the approaching meteoric swarm.

So, too, the rainy character of those years is remarkable. No records on this score are obtainable for 1799. But in 1833, in this vicinity generally, the rainfall was in excess of from 4 to 7 inches above the mean of a quarter-century. The summer of 1867 was noted for its heavy, incessant rains: there fell in the month of June 10.33 inches, and in July 6 inches, or an aggregate for the first seven months of the year of 30.05 inches—the annual average being about 43 inches. The month of August was an unusually rainy one, a single downpour in the middle of that month having lasted 42 hours, with but a few hours of abatement. September and October were pleasant, but November and December, with their rain and snow, carried the year's record to about 57 inches, the highest ever known in this vicinity. The year 1867 was also, like the other periodic years, remarkable for snows and thunderstorms out of season and other phenomena of an extraordinary character. In the first week of November great tornadoes occurred in the West Indies, violent gales on our Great Lakes, and a remarkable thunderstorm in Montreal; while in this vicinity the thermometer dropped, on the morning of the 7th, to 30 deg. and immediately began to run up again until it reached 57 deg. shortly after midnight. On November 11 the day at Washington, D. C., was unusually warm, ending in a violent thunderstorm at night, followed immediately by a very high and cold wind and at noon a fall of snow.

The present year, 1901, has been just such a rainy one as those which have heretofore marked the Leonid periods. At the end of last August the rain and snowfall footed up for this vicinity about 36.4 inches, or about 6 inches more than the average of the first eight months during a period of 32 years. The extraordinary phenomena noted this year are precisely those which characterized the previous periodical years. So that there seems sufficient reason to look forward with confidence to a reappearance of the great Leonid shower this fall. A remarkable circumstance was noted at Kinderhook, N. Y., on the 11th of November, 1833, two days before the great shower. Phosphorescent lights were seen on the tops of sticks, posts and other pointed objects, some of those lights being as large as the flame of a candle, and having a dim white light pointing upward. At the same time the atmosphere appeared unusually red. This and many other phenomena that especially characterized the periodic years lead not unreasonably to the conjecture that the passage of meteoric swarms and of comets, either close to or into the earth's orbit, affects seriously the atmosphere, the temperature and the weather of our planet. F. MACBENNETT.

Long Island City, N. Y.

Stuttgart Gives an Ichthyosaurus.

The American Museum of Natural History has just received as a gift from the Museum of Stuttgart, Würtemberg, a perfectly preserved example of the species *Ichthyosaurus quadricissus*. It comes through Prof. Eberhard Fraas, who made a long tour of exploration in the fossil beds of the Rocky Mountain region with Prof. Osborn last spring. The fossil is from Jurassic of Holsmaden, a little town not far from Stuttgart, which is famous for its ichthyosaur quarry.

The specimen, says The Evening Post, is on a slab 9 feet 3 inches in length, by 2 feet 5 inches in breadth, and is perfectly preserved. Ichthyosaurs have been found in abundance, both in Germany and England, but what renders this fossil unique is the fact that it contains seven young animals within the body cavity of the mother, thus giving a demonstration of the fact that ichthyosaurs were viviparous, bringing forth their young alive. These young animals are surprisingly large, the heads measuring 9½ inches; the backbone and paddles are well developed, and prove that the young were abundantly able to take care of themselves, and to swim immediately after birth. The ancestors of the ichthyosaur undoubtedly lived on the land, and were oviparous; but as they became more and more seafaring in habit there was a gradual retention of the young in the abdominal cavity to a later and later period of development, until finally, like some of the sharks and snakes, they became completely viviparous.

The external form of the ichthyosaurs, as partly prophesied by the English anatomist, Richard Owen, has been realized in the Holzmade quarry by the discovery of four or five specimens in which the integument is preserved. In general, it is smooth, and resembles that of the dolphin, but it is so excessively thin that it has to be worked out with the utmost delicacy with a fine scalpel under a lens. Very few of these perfect specimens have been discovered. One is in Stuttgart, another in Berlin, and the third and finest of all in Budapest. Through the kindness of Prof. Fraas, the museum has secured the promise that the next ichthyosaur showing the fins and integument will come here for exhibition upon what will be known as the "ichthyosaur panel" of the marine reptile corridor. American ichthyosaurs are very rare, but the explorers for the museum two years ago secured one fine specimen in the Como region of Wyoming, along the line of the Union Pacific Railroad, which will soon be worked out and placed with its European relatives. It represents the last of the race, in which the swimming paddles are very much modified and the teeth have almost disappeared. This genus was called Baptanodon by Prof. Marsh.

Science Notes.

According to experiments made by A. Nabokich, chiefly on *Zea mays*, the growth of the higher plants does not, in most cases, cease when they are entirely deprived of oxygen, nor do they become altogether insensitive to external irritations. The formation of chlorophyl is, however, entirely suspended, even in the light. It is probable that some seeds can germinate without oxygen, but this does not appear to be the case with the spores of fungi.—Ber. Deutsch. Bot. Gesell. 29, 222.

Prof. Hartog, of Cork, has discovered that the movement of the frog's tongue is not the result of direct muscular action, but to the injection of lymph into the bag-like tongue. Ordinarily the tongue lies with its tip in the throat, and when the frog darts it out it is doubled forward with lightning rapidity and returned with as great celerity to its normal position. The professor, to illustrate his discovery more comprehensively, has constructed a small model in which the movements are shown.

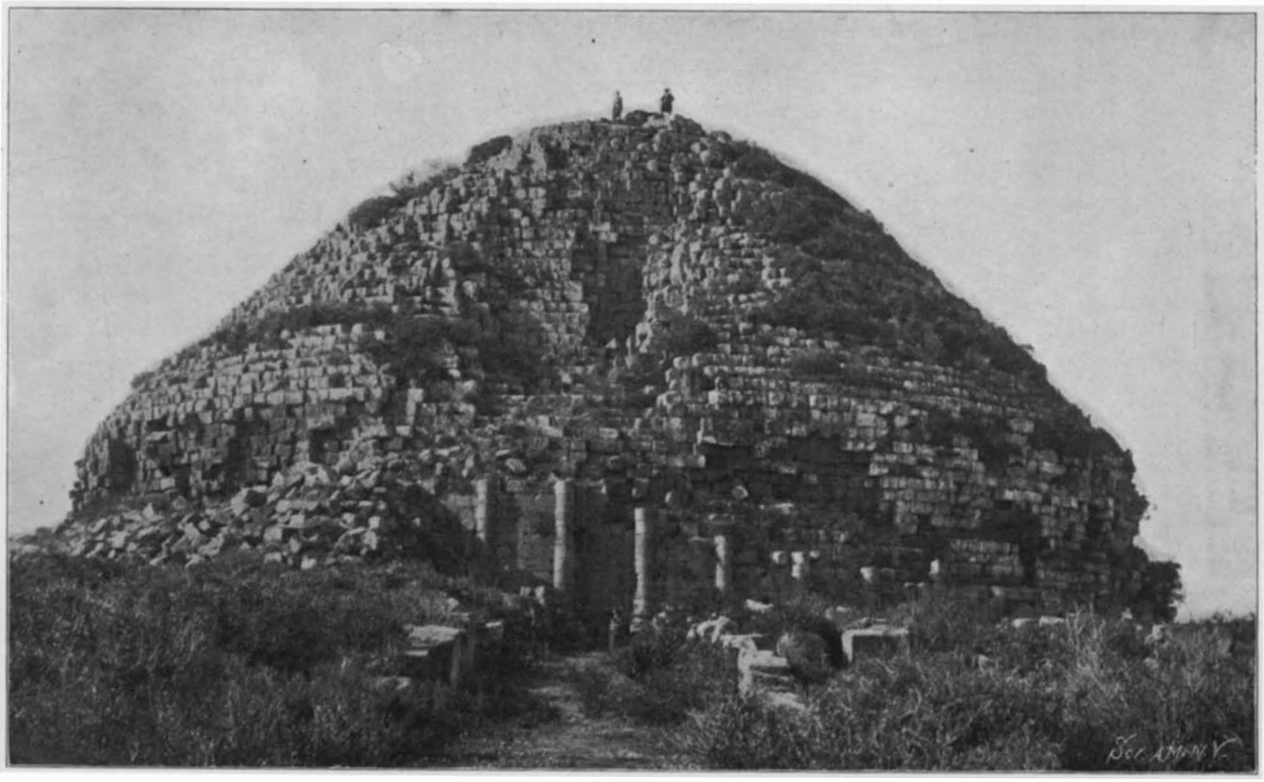
The date for the Archæological Congress has been fixed for April, 1903, at Athens. This decision is probably influenced by the current belief that the Olympian games will also be held there about the same time. The Congress will convene for fifteen days, the first five of which will be given to discussions in convention and the last ten to excursions among the various places of archæological interest in Greece. The subjects for general discussion have not yet been made public. Invitations will be extended to universities and colleges and to the heads of governments.

A factory has been started near Aix-la-Chapelle for the manufacture of cotton to resemble silk by a new process. It is a distinct improvement upon the old "mercerized cotton," while another important consideration is the extreme simplicity of the invention. Four hundred hands are to be employed, but as skilled labor is unnecessary, the major part of the employes will be boys and girls, which will considerably cheapen the cost of production. The silk produced by this process is extremely brilliant in color and finish and possesses great textile strength. The thread consists of ten or twenty fibers twisted into one, but it can also be made of any thickness that may be desired. A thread known as "horsehair artificial silk" may also be produced. This cotton silk is 40 per cent cheaper than the real article. The patent manufacturing rights have been disposed of in France by the inventor for $300,000.

In German sugar refineries molasses is being used in the preparation of food for cattle. According to information furnished to the Société d'Agriculture, and translated for The Literary Digest, the molasses is first "heated to 90 deg. and then introduced in a steady stream into a mechanical mixer. At the same time the forage with which the molasses is to be incorporated is also fed into the machine. There issues from the mixture a warm, moist, coarse-grained mass, which is left in a pile for several hours with certain precautions. In a short time there is thus obtained a homogeneous dry product that can be easily transported and preserved. The materials employed are of many kinds, including wheat, chaff, cut straw, turf, sesame, peanuts, rice, corn, etc. According to their nature these are previously crushed, ground or flattened by machines similar to those used on farms. The whole plant for the preparation of the food, except the boiler for working the molasses pump and the vats for heating the molasses, are placed in a corner of the refinery. It occupies little space and can be quickly taken down and removed. The expense is slight, and the production is 30,000 to 40,000 kilogrammes (33 to 44 tons) of forage daily."

BURIAL MONUMENTS OF NORTH AFRICA.

In North Africa are found two great burial tumuli or mausoleums, which date even before the Roman occupation, and were, no doubt, built by the native kings of Mauretania and Numidia. The first of these, shown in the engraving, it situated near the coast of the Mediterranean, about thirty miles from Algiers, and was at that period near the ancient port of Cæsarea (now Cherchell). It stands upon a high hill in the narrowest part of the Sahel range, and thus dominates the surrounding country. Its form is that of an enormous cylinder resting upon a square foundation and surmounted by a cone-shaped part which is built up of a series of steps reaching to the summit. At the base it measures 197 feet in diameter, and its present height is 102 feet, but it must have been over 120 feet high originally. For the construction, cut stone of large dimensions is used—disposed in symmetrical order and united by tenons of lead. The lower part is ornamented with sixty semi-circular pilasters, which appear to be applied against the wall, but really form part of it. The pilasters had Ionic capitals and supported a cornice of simple profile. At the four cardinal points were four ornamental panels or false doors, whose moldings imitated by their disposition a great cross inclosed in a frame. Before the eastern panel, and perhaps attached to the body, was an exterior structure or portico of rectangular shape, of which only the base remains. This monument remained an enigma for a long period. The Arabs called it Kbour-Roumia, or Tomb of the Christian, on account of the cross upon the northern panel, which was still preserved, and their imagination invented many legends in which were associated buried treasure, fairies and sorcerers. In the sixteenth century these legends were added to under the Spanish dominion, and it was assigned as the burial place of different important personages, but all without the slightest foundation. These legends excited the Pacha Salah-Raïs (1552-1556) to try to find the hidden treasure, and he had the monument cannonaded; but, although he made a large breach in the western side, he was not able to lay bare the chamber containing the riches. Later on, Baba Mohammed ben Otsman, pacha of Algiers (1766-1791), demolished the revetment wall on the east side in the same way, but without any better result. What was more destructive to the monument than the cannonading was the removal of the lead tenons to make bullets, and thus a great number of the stones were overthrown.

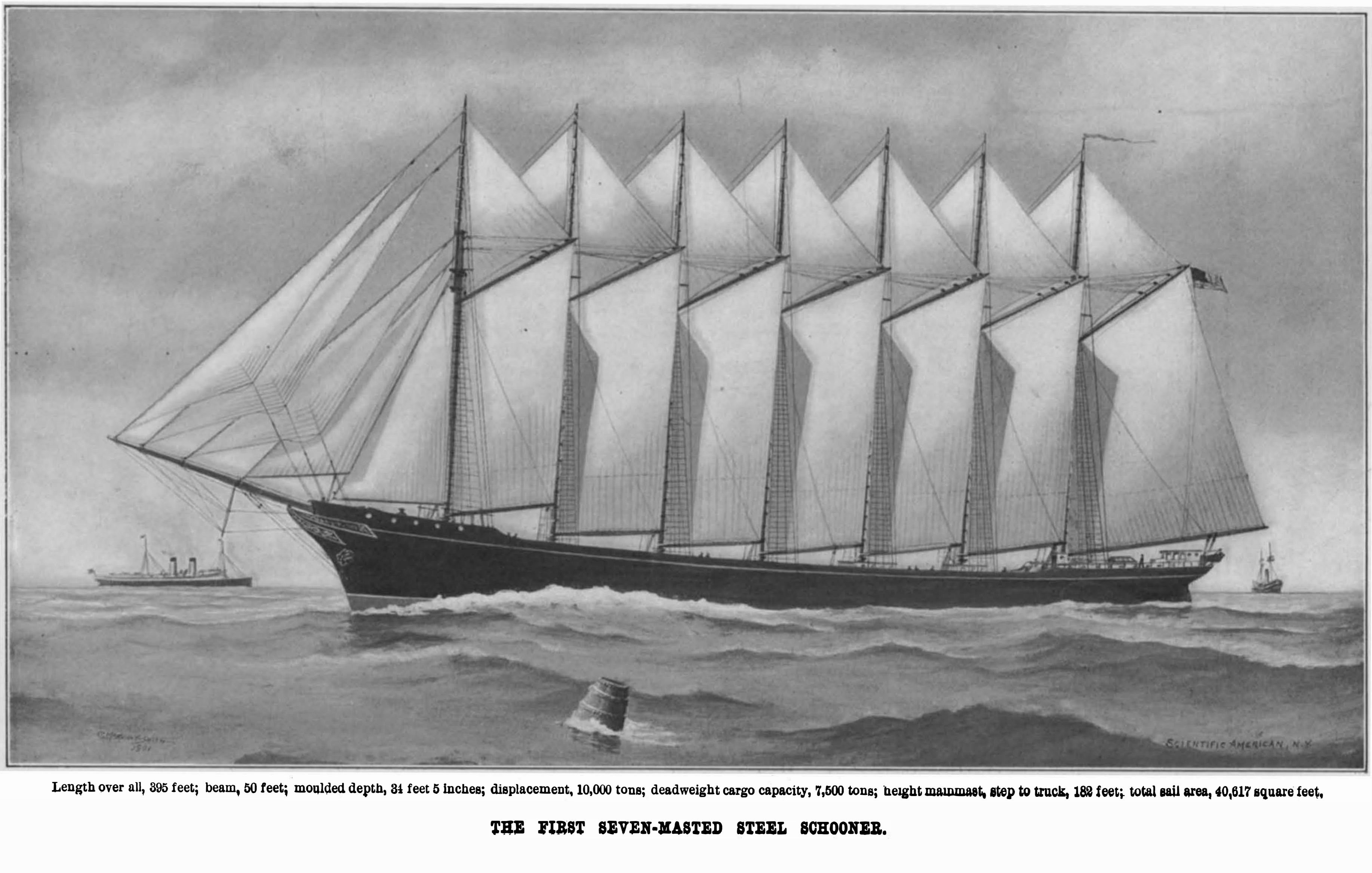


SO-CALLED TOMB OF THE CHRISTIAN, SUPPOSED TO BE THAT OF JUBA II., LOCATED 30 MILES FROM ALGIERS.

The first regular excavations were made in 1865-66 by Berbrugger and McCarthy under Napoleon III. They cleared away a part of the outer wall, and made soundings to find an internal cavity, but it was only after four months that it was found. By a tunnel under the south panel they arrived in a vast gallery, admirably preserved, and thus discovered the internal arrangement of the structure. The entry is a low, rectangular opening below the ground and in the foundation masonry, in the rear of the rectangular structure previously mentioned. It was closed by three stones which were flush with the rest of the masonry. Beyond the entrance is a sliding door formed by a flat stone moving up and down in grooves, which could be held up by posts. After a short and low corridor, another such door leads into a vaulted chamber 16½ feet long, 8 feet wide and 11 feet high. On the right-hand partition are sculptured in rather primitive fashion a lion and lioness facing each other above a second corridor. The latter is also closed by a stone door. At a short distance a stairway of seven steps leads up to the main gallery, which is on a level with the ground. This gallery is 6 feet wide and 7½ high, and was lighted by lamps placed every 10 feet in niches, and traces of the smoke may still be seen. After making almost the entire circuit, the gallery turns abruptly and comes to the center, reaching a narrower corridor with a sliding door like the first. Beyond this is a small vaulted chamber 12½ by 4½ feet. A few beads of precious stone and pieces of jewelry in a vitrified material were found here. Another corridor with sliding door leads into the main chamber in the center of the monument measuring 10 by 12½ feet. The three walls opposite the door have each a small niche. Unfortunately, nothing whatever was found in this vault. The gallery, chambers and corridors are paved with large flags and built of well-cut stone. The body of the monument is solid, and consists of rough stone and tufa blocks, irregularly placed and joined by a mortar of red or yellow earth. It was found that the monument had been entered once, or perhaps several times, for the purpose of pillage. The stone doors were broken, and whatever objects it contained were carried off long ago.

A SEVEN-MASTED STEEL SCHOONER.

The development of the multi-masted merchant schooner, which has advanced with such rapid strides during the past few years, is one of the most remarkable features in the shipbuilding industry of the Atlantic Coast. The fore-and-aft schooner has always been a favorite type of ship in the American merchant trade, whether coasting or deep-sea, and the great breadth of hull and length of spars of such craft have rendered them an easily recognized type



Length over all, 395 feet; beam, 50 feet; moulded depth, 34 feet 5 inches; displacement, 10,000 tons; deadweight cargo capacity, 7,500 tons; height mainmast, step to truck, 182 feet; total sail area, 40,617 square feet.

THE FIRST SEVEN-MASTED STEEL SCHOONER.

the world over. As compared with the square-rigged vessels of the schooner, brig, brigantine, or bark type, the American fore-and-after has the advantage of being a better craft when sailing close-hauled and of requiring fewer men to man it. In an earlier day of the development of our merchant marine in the coasting trade, the two-masted schooner was the common type; then came the three-masted schooner, and this was followed by vessels of four, five, six, and now seven masts. The carrying capacity of these schooners, the largest of which are engaged almost entirely in the coal-carrying trade, is exceedingly large. Thus, the five-masted schooner constructed at Camden, Me., in 1899, is 318 feet in length, 44 feet beam, and 21½ feet in depth. The vessel will carry 4,000 tons of coal on her maximum draft. Work on this vessel had scarcely been completed before Capt. Crowley, of Taunton, Mass., had given orders for the construction of a six-masted schooner. This vessel is 330 feet in length, 48 feet in beam, and has 22 feet depth of hold. On her maximum draft of 24 feet she will carry 5,500 tons of cargo. Her lower masts are each 116 feet in length, and her topmasts 58 feet.

The latest of these giant schooners is the great seven-masted vessel shown in our accompanying illustration. It has been built from designs by B. B. Crowninshield, of Boston, the designer of many small and very successful racing craft, and of the 90-footer "Independence." Unlike her predecessors, the new schooner is to be constructed throughout of steel. There will be a bar keel of forged steel 3½ inches in width by 12 inches in depth, which will extend from stem to sternpost. There will be a cellular double bottom with a continuous, single, vertical, keel plate weighing 22.5 pounds to the square foot. The upper bilge-strakes will be of 28¾-pound plate for two-thirds of the length. The middle bilge-strakes will be 30 pounds weight for the same distance and the lower bilge-strakes 25 pounds. The bottom strake will be 20-pound plate, while the garboard strake will be 29-pound plate for two-thirds of the length. All of the plating reduces to 18¾ pounds at the ends of the vessel, except in the case of the garboard strake, which will reduce to 25 pounds at the ends. There are three complete decks, which will be of steel plating, the upper deck, forecastle and poop-deck being wood-covered. A collision bulkhead will be worked in at a suitable distance from the stem.

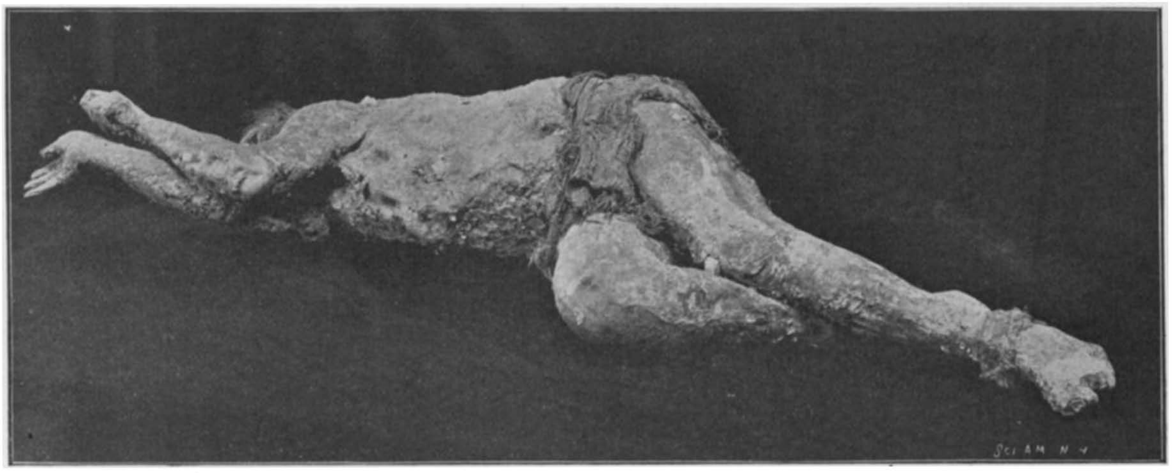
The lower masts throughout the vessel will be built of steel, with lapped edges, flush butts, and stiffening angles extending inside for the full length. The plates will be single-riveted at the edges and double-riveted at the butts. The plating will be double at the mast partners and at the hounds. The masts are all 135 feet in length from the mast step to the top of the upper band, and they have a uniform diameter throughout of 32 inches. The topmasts will be of Oregon pine. They will be 58 feet in length over all, tapering from 18 inches in diameter to 10 inches, except the foremast, which will be 64 feet in length and 20 inches at its point of greatest diameter. The booms of the first five masts will be 45 feet in length by 14 inches in diameter, the spanker boom being 75 feet in length by 18 inches in diameter. The total sail area of the lower sails and topsails will be 40,617 square feet. All of the standing rigging, and in special cases the running rigging for the lower sails, will be of a high quality of wire rope. Although this vessel is to be propelled entirely by sails, she will carry quite a considerable installment of machinery, including one 9-inch by 10-inch Hyde double-cylinder ship engine, and five 6-inch by 8-inch Hyde hoisting engines. There will be two vertical boilers 56 inches in diameter by 90 inches high, one in the forward house and one in the after house. The boilers will be built for a working pressure of 100 pounds to the square inch. There will be two 8-inch by 4-inch by 6-inch duplex pumps and two direct-acting steam pumps, with steam and water cylinder, each 12 inches in diameter by 12 inches stroke.

As the result of the installation of steam power on board for the purpose of hoisting anchors and sails the number of hands necessary to work this large vessel is considerably reduced, the total number required being only nineteen men. The total cost of the vessel delivered will be about $250,000.

We are informed by Mr. Frank N. Tandy, of Boston, who was recently associated with Mr. Crowninshield, that so great is the confidence in the success of this vessel that preliminary steps are being taken by him and others toward the construction of a second seven-masted schooner.

A CURIOUS EXAMPLE OF PETRIFACTION.

In the Chilean Department at the Pan-American Exposition there is on view the semi-fossilized remains of an Indian woman. The specimen has just been submitted to examination by Dr. John A. Miller, who states that it is the body of an Indian woman, supposed to be about five hundred years old. She was found buried in an old copper mine in the Andes, near Colama, which was a part of the territory subjugated by Pizarro and taken from Peru by Chile. It is supposed that while working with stone implements used for extracting copper there was a cave-in which caused the death of the woman. Being at an altitude of 11,000 feet, the rarefied atmosphere and the dryness of the mine, combined with the peculiar metallic qualities of the earth about her, served to preserve the body as it is seen to-day. It weighs less than fifty pounds and is in a half-mummified, half-fossilized condition. There are small stones embedded in the flesh at many points, and the blood which was forced from the ears is still to be seen in the matted hair, which has kept its dark reddish-black color. Several portions of the body are crushed, including the shoulder, the chest and the lower limbs. Around the hips is a cloth of ancient weave, and the tools used and found with the remains make it possible that she was a miner in the realm of the Incas. The sledge-hammer and other hammers are most interesting, as they are still attached by strips of hide to their handles, which are pieces of wood bent in the middle. The stone is placed in the joint, so that both ends were grasped, one in each hand.



PETRIFIED PERUVIAN INDIAN WOMAN EXHIBITED AT THE PAN-AMERICAN EXPOSITION.

The discovery was made in a mine which was opened to take out small pieces of ore. The body was covered by about seven feet of loose earth.

PHOTOGRAPHING THE ELECTRIC ARC.

BY PROF. A. C. SCOTT.

The purpose of this article is to notice briefly some points concerning arc light carbons in operation, as indicated by direct photographs of the arc itself.

It is conceded that the classic demonstration in the Royal Institution of Great Britain in 1810, by Sir Humphry Davy, when the voltaic arc was first exhibited, presented the beginning of a world-famed era in artificial illumination. It needs but a glance at the history of artificial lighting to see that some of the greatest minds have been concerned in the final production of that most powerful of artificial illuminants, the electric arc. Though progress in its development was slowly going on during the first half of the century, the last three decades have witnessed by far the most phenomenal results, such results being made possible only after Gramme had, in 1870, opened the way by the invention of the dynamo-electric machine.

Attention is frequently called to the almost innumerable devices and improvements used upon the arc light, along the lines of controlling mechanisms for various purposes, with lamps used on both continuous and alternating-current systems, together with discussions on the substitution of the modern inclosed arc for the open arc, and allied subjects. The question of the carbons, however, does not, and at present need not, receive quite so much attention.

For our purpose it is necessary to consider for a moment a bit of the history in arc light carbon production. The water-quenched charcoal pencils employed by Davy had soon to give way to a harder form of carbon, in order to obtain even moderately satisfactory results with the arc. Gas-retort carbon was subsequently used for some years, and though it was sufficiently hard, it contained impurities, of which silica was a very important one. The effect of such impurities was to produce a constant hissing, and frequent blowouts as well. It is evidently with this class of carbons that the illustrations of the arc so frequently seen in textbooks of physics and electricity have been made. It may be more accurate to say that drawings made of the arc, when carbons containing large quantities of impurities were in use, have been copied and recopied from an early date in the history of the arc down to the present time. One of the commonest of these representations seems to have been handed down from an early drawing, and is shown in Fig. 1. It exhibits a number of globules or wart-like forms of matter on the negative carbon, which are very large in comparison with the carbon pencil itself. It does not seem just to doubt the correctness of this representation,

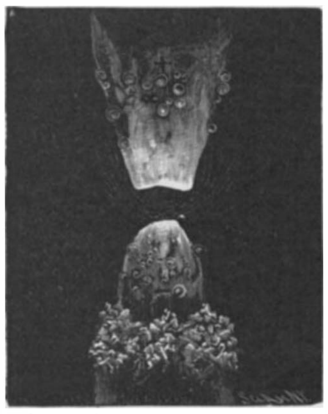
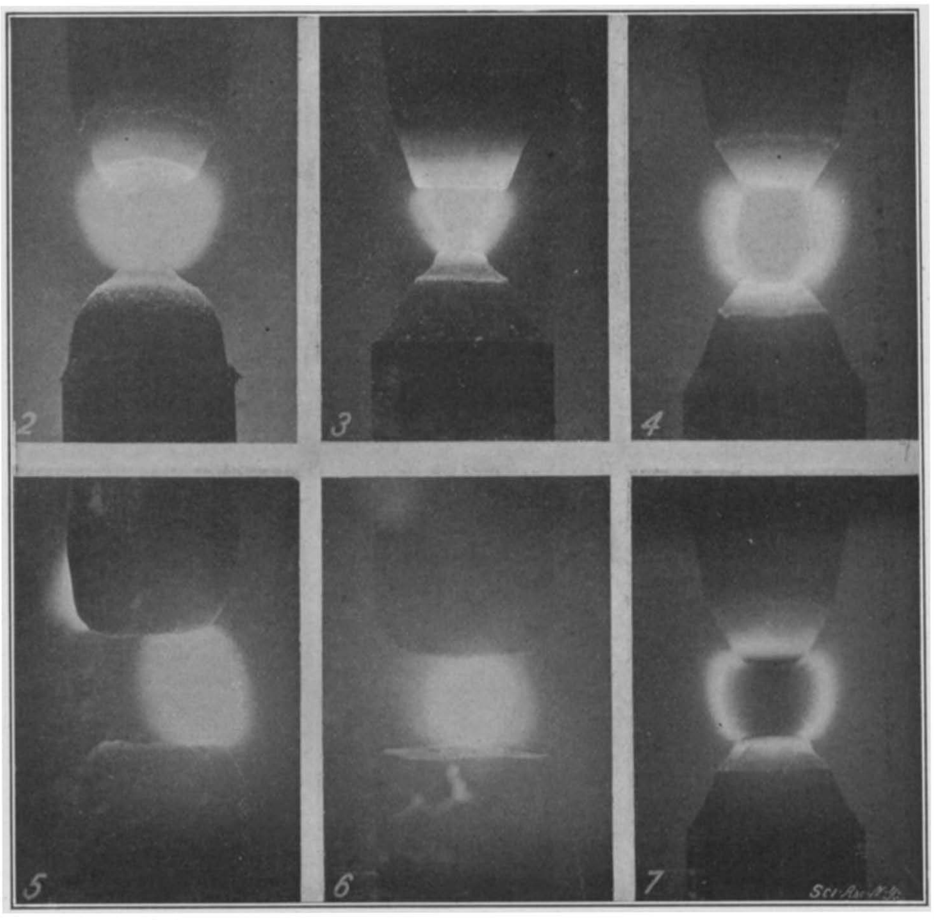


Fig. 1.



1. Conventional picture of the arc. 2. Continuous current open arc after burning seventy minutes. 3. The same after burning two hours. 4. Alternating current arc after burning two hours. 5. and 6. Inclosed arcs. 7. From reversed negative.

PHOTOGRAPHING THE ELECTRIC ARC UNDER VARIOUS CONDITIONS.

for in all probability it was made when the carbons contained impurities to such an extent as to give this peculiar appearance.

It is interesting to-day, when the manufacture of carbons has reached such a state of perfection that the carbons are homogeneous in texture and almost entirely free from impurities, to consider the vast difference in their appearance when in operation, in comparison with the earlier forms. This comparison is facilitated by the science of photography, which has reached its present development during practically the same period as electricity. This makes it possible for the arc to now tell its own story, and we have from direct photographs the exact appearance of the arc in operation. No retouching of the negatives, or changes in them to the least extent, have influenced the character of the prints for the half-tone cuts herewith shown. Fig. 2 illustrates a continuous-current open arc after operating for seventy minutes at 110 volts and 25 amperes. This should be compared with Fig. 1 to show the superiority of the present carbons; and also particularly to exhibit the characteristic bridge of incandescent carbon particles which is always present between the poles. The upper carbon shows the crater whence the major part of the light from the continuous current arc emanates, and the appearance of this positive carbon also indicates in an imperfect way the doubly rapid rate of its disintegration compared with the negative. Fig. 3 is another illustration of an open arc after two hours' operation at 110 volts with 25 amperes. The arc is purposely made a little shorter than in Fig. 2 and the crater is less prominent, the photograph being taken with the carbons in an exactly vertical position. A good deal of trouble was experienced in photographing the arc so as to have both carbon pencils show distinctly, as well as the arc itself, because of the hot gases rising about the upper carbon and obscuring it. This difficulty was finally overcome by placing a second arc in such a position as to have its light focused by a lens upon the carbons of the light to be photographed, and then giving either a preliminary or subsequent exposure of the carbons, when the arc was not in operation, to that given upon the burning arc. The exposure of the cold carbons was of course several thousand times that of the arc. No color screen was employed for any of the work, as it seemed better for many reasons to avoid using one, if possible.

Fig. 4 shows an alternating-current open arc after sixty minutes' continuous operation at 108 volts and 30 amperes. It will be noticed that the upper carbon appears to diminish in size a trifle faster than the lower, due to the hot gases passing upward around that pole and assisting disintegration.

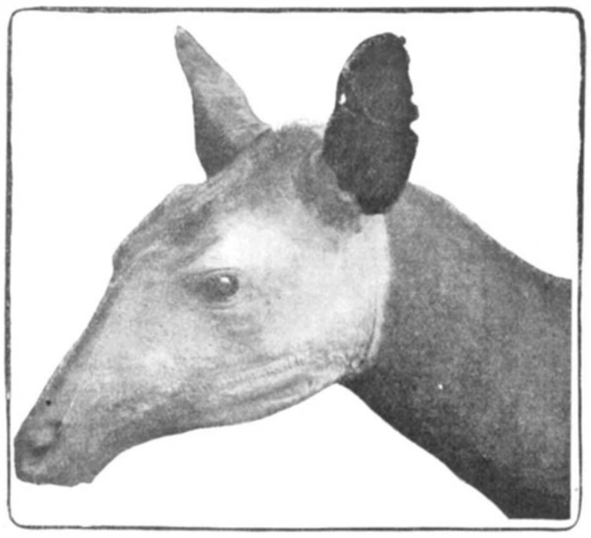
Photographs taken respectively of alternating and continuous-current inclosed arcs are shown in Figs. 5 and 6. These pictures were of course made through the inner cylinder, which immediately incloses the arc, and so are less distinct than those of the open arcs. Fig. 5 illustrates the disposition of the alternating inclosed arc to wander. Fig. 6 does not indicate such a disposition, though it is doubtless present to some extent in the continuous as well as the alternating-current light. It seemed, however, at the time of photographing that the tendency of the alternating arc to wander was much greater than that of the continuous-current arc. The results thus shown in Figs. 5 and 6 were obtained on lamps which had been in operation for a sufficient number of hours to give the carbons a normal, typical appearance, yet the photographs are quite unsatisfactory in some respects, and it is the intention of the writer to improve upon them in the near future.

Fig. 7 is only of interest in so far as it shows a good reversal picture produced by the alternating arc when the exposure is properly timed to obtain this effect. The work of photographing the arc thus described was undertaken by the writer, at the University of Wisconsin, for the purpose of obtaining, if possible, a suitable illustration of the arc to be used in a new book on Electricity and Magnetism, by Profs. D. C. and J. P. Jackson.

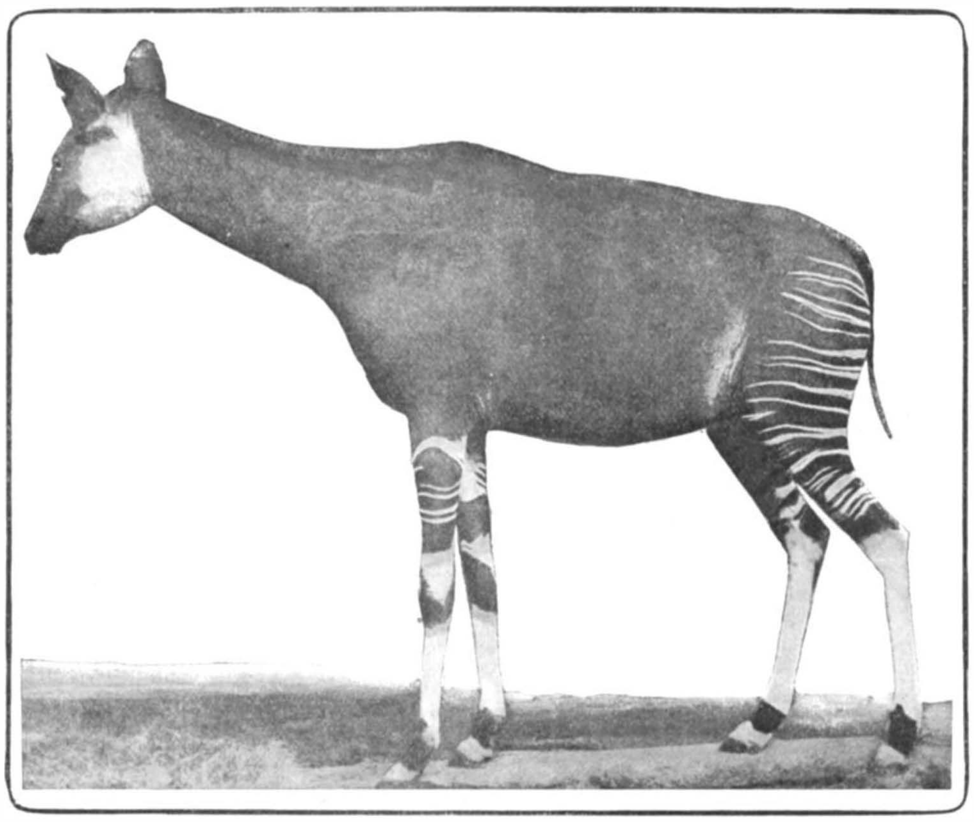
In conclusion, it may be noted that it does not seem necessary to attempt to picture the arc in modern books on physics and electricity by such an antiquated illustration as is commonly used. It is not to be objected to so much, of course, on the ground of ancient history considerations, as upon that of incompleteness and incorrectness. It seems of much importance that new books should exhibit, so far as possible, new and original illustrations. Such illustrations appeal to the eye of the student more readily, assist in elucidating points in the text, and enhance the value of a book.

THE OKAPI—A NEWLY-DISCOVERED ANIMAL.

In the heart of Africa, near the River Semliki, by which Lake Edward and Albert Nyanza are connected and British East Africa (Uganda) and the Congo Free State separated from each other, a new animal has been discovered which has attracted unusual attention among zoölogists. Stanley, at the time of his second journey in this region, had heard from the natives of a peculiar striped animal that was neither antelope nor zebra, and yet as large as a horse. He never had an opportunity of seeing this creature, a fact that he ascribed to his caravan, which was so large that a wild animal would flee before it. Sir Harry Johnston, the British plenipotentiary in Uganda, was more fortunate. He received from the natives two dark-brown striped hides, which he sent to England. Mr. Philip L. Slater, the well-known secretary of the London Zoölogical Society, gave it as his opinion that the animal might be considered a new species of zebra and christened it accordingly Johnston's zebra (*Equus Johnstoni*). Soon after Johnston received from an officer named Ericsson, stationed in the Congo Free State, not far from the Semliki River, a complete hide with the hoofs, together with two skulls. With this material it was finally ascertained that the new animal was a ruminant related, perhaps, to the giraffe, but still more closely related to the Tertiary genera of *Halladotherium* and *Samotherium Boissiori*. The giraffe family, of which these fossil animals and the newly-discovered creature are members, is distinguished from all extinct and living ruminants in so far as the space between the eye tooth and the first molar is greater than the similar space in any other animal, and that the eye tooth is provided, not with a single, but with a double crown. Eye teeth and incisors are found only in the lower jaws in most ruminants. Moreover, all camelopards have an elongated neck and long forelegs and somewhat shorter hind legs, so that the spinal column slopes down sharply to the tail. The Okapi is perhaps one-third the size of the giraffe. At least this would seem to be the relative size from the hides sent by Johnston to London. From the occiput to the first caudal vertebra the animal measures 2.25 m. The height from the ground to the top of the head is 1.83 m. The English zoölogist Ray Lancaster is of the opinion that old bucks would probably attain a length of 3.05 m. and a height of 2.44 m. The hair of the Okapi is short and straight, as in the horse. Nowhere is the hair very long, with the possible exception of the forehead, where it projects in the form of a short, bushy growth over each eye. The neck, the hind-quarters and the crown of the head are a dark chestnut brown; the face is white and has a fox-red stripe on each cheek. The deer-like ears are a bright reddish brown, fringed with blue-black. The tail is also dark brown, moderately long and tuftless. The forelegs from the carpus to the shoulder are ringed with white. The rear members are similarly marked, but the stripes are extended up the hind-quarters to the very tail itself.



HEAD OF THE OKAPI.



THE OKAPI—A NEWLY DISCOVERED ANIMAL.

The sex of the animal whose hide was sent to London has not been determined. Ray Lancaster, for reasons which he has not given, believes that the animal was a male.

Johnston estimates the number of the Okapi in the forest of Semliki at 2,000 or 3,000. The animals have an elongated upper lip, which may possibly serve as a means of prehension, since the food taken consists of foliage of trees and bushes. The animal is beyond a doubt a surviving species of an old extinct genus closely related to the *Halladotherium* and *Samotherium* of the middle Tertiary, and may possibly be related to the now extinct many-toed ancestors of the horse.

For these particulars and our illustrations we are indebted to our German contemporary, Illustrirte Zeitung.

The Building Edition for October.

It is a rare treat to turn over the pages of the October issue of the building edition. This number is filled with exquisite illustrations of houses of varying prices, and in addition there are two pages of engravings of Mr. P. A. B. Widener's residence near Philadelphia, and also a page devoted to modern colonial porches. The subject of the editorial is "Heating the House," and is one of the technical articles which have proved so popular to readers of the Building Edition. Prof. Warren Powers Laird, of the University of Pennsylvania, talks interestingly on the "Town Beautiful." Those who are reading regularly the "Talks With Architects" find them both interesting and helpful. "Monthly Comment" and the departments, such as "Household Notes," "Legal Decisions" and "New Building Patents" are published as usual.

The Current Supplement.

The current SUPPLEMENT, No. 1346, has for the leading article an account of the train de luxe of the Cape to Cairo Railway, every modern convenience being offered to travelers through the heart of the African continent. "German Fire Engines" describes in detail a number of the leading types of fire engines. The Inaugural Address to the British Association by Prof. Arthur W. Rücker is continued. "Pig-Iron Casting Machines" describes a unique method of doing away with sand-molds. "Asia, Cradle of Humanity," is by W. J. McGee. "A Simple Method of Light Wave Measurement" is by L. H. Horner and is adequately illustrated. "Further Discoveries in Crete" gives an account of Hogarth's recent discoveries. The usual "Trade Suggestions from United States Consuls" and "Trade Notes and Receipts" are published. The engineers' report on the Brooklyn Bridge is also given.

Contents.

(Illustrated articles are marked with an asterisk.)

RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

BAND-CUTTER FOR SELF-FEEDERS.—CORNELIUS R. VOTH, Lehigh, Kans. The band-cutters are so arranged that the self-feeder of a threshing-machine is enabled to tear the bundles without danger of choking the machine or the cylinder. The knives or cutting teeth cannot warp at any time. The cutters are in the form of knife-carrying disks arranged in co-acting pairs, the disks of a pair being driven at different speeds. With headed grain, the slow-speeded disks are run faster than ordinarily, so as not to cut the grain too much, and in order to feed it rapidly. The speed of the band-cutters, as well as their height, can be regulated.

FERTILIZER - DISTRIBUTER. — JOHN A. LARSON, Hayfield, Minn. The fertilizer-distributer consists of a vehicle having a body-portion, toward the rear end of which the fertilizer is moved. At the rear end, the fertilizer is discharged by an ejector, a horizontal cross-formed rotary spreader being used for the purpose of distributing the fertilizer. By this apparatus the fertilizer is cast to a great distance at each side.

POTATO-GATHERER.—AUGUST H. W. EIKMEIER, Manning, Iowa. The purpose of this invention is to provide a device for gathering potatoes. The action is such that the potatoes are raked from loose dirt in a hill and directed to a receptacle having means for discharging any dirt that may enter. The device is light and durable.

Mechanical Devices.

PADDLE-WHEEL.—HENRY S. KLINE, McKeesport, Pa. The paddle-wheel is to be used at the stern or at the side of a vessel and is caused to assume a vertical position upon leaving the water, thus releasing the great weight of water usually carried upward by the ordinary fixed paddles, and therefore using the whole effective power of the wheel in propelling the vessel.

BANDING-ROLLING MACHINE.—WILLIAM D. KILBOURN, Pueblo, Colo. In bandage-rolling machines it was hitherto necessary to remove the adjustable head in order to rove the bandage between the guide-bars. It is the purpose of this invention so to arrange the guide-bars that the material can be readily placed between them without removing the adjustable head.

VENDING-MACHINE.—MILBERT F. PRICE, Iowa City, Iowa. This apparatus is especially adapted for selling collar-buttons. The collar-buttons are mounted on a strip, and mechanism is provided for cutting the strips of material into separate lengths to deliver the collar-buttons individually. The invention can be used in connection with coin-controlled operating devices.

VENDING APPARATUS. — MILBERT F. PRICE, Iowa City, Iowa. Like the foregoing machine, this apparatus is designed to sell collar-buttons by means of coin-controlled mechanism. A tape or ribbon, to which the buttons are removably attached, is fed progressively. Devices are provided for automatically detaching the buttons from the tape and separately delivering them to the purchaser.

CIGAR-WRAPPER CUTTING MACHINE.—WILLIAM S. GLEIM, Lancaster, Pa. This improved machine is of a class wherein exhaustion of air is produced below a cutter, shaped on its edge like the margin of a properly cut cigar-wrapper. The wrapper material is held by air pressure over the hollow cutter or die. A swinging-lever carrying one or more rollers is also provided, which lever is passed over the cutting die after a leaf of wrapper material is placed over the die. Thus the die is made to cut the wrapper. The improvements greatly facilitate the proper operation of the machine.

Special Tools and Implements.

POLISH-ROD GRIP.—LEROY E. and ERWIN JORDAN, Bolivar, N. Y. To raise or lower valves in oil and gas wells a special implement called a polish-rod grip is used. This invention is an improved polish-rod grip, which can be used while the pumping machinery is in operation, and therefore with a great saving in time and labor. The device dispenses with the rope and derrick ordinarily used when it is required to pull out the valves. The grip is also of service in place of the two-bolt clamp heretofore used, which must be threaded by hand.

STRAIGHT - EDGE AND CLAMP FOR PAPER-HANGERS' USE.—FRANK W. GRUNDEN, Emlenton, Pa. The invention is a means for holding wall-paper or window-shades in position for trimming their side-edges straight and of a desired width. The means comprise a novel, simple device adapted to clamp one or more sheets of paper and cut a straight edge readily adjustable to give a wide or narrow margin. This margin is to be trimmed from the paper. The device can be adjusted for guiding a trimming-knife to cut a sloping edge on a sheet of paper.

SAW-SHARPENING DEVICE.—IRA L. BULSON, Jacksonville, Fla. This device embodies a means for deepening the cut or changing the pitch of the saw-teeth. An arching section is provided at its ends with longitudinal slots. Oppositely-disposed members are located in the slots for engaging the ends of a file, and adjustable longitudinally in the slot for the purpose of governing the depth of cut. Clamping mechanism holds the oppositely-disposed members.

Apparatus for Special Purposes.

APPARATUS FOR TREATING LEG DEFECTS.—WENDELIN EMGE, Hohentengen, Würtemberg, Germany. The apparatus is designed for the treatment of broken bones. The proper position is given to the injured member so that local defects can be treated without altering the position. Absolute rest is insured for the injured limb. The apparatus is mainly designed to prevent the bending of injured bones, which so frequently happens in fractures. Hence the injured limb is not shortened or deformed.

STERILIZER. — JOSEPH SCHOETTL and CHRISTIAN JAEGER, Brooklyn, New York city. This apparatus sterilizes by means of superheated steam. A boiler is used, from the upper portion of which a pipe passes downward and away from the boiler. A three-way cock controls the pipe and also controls a communication between the pipe and the lower portion of the boiler.

CARBURETER.—BENJAMIN A. GUY, Paris, France. The processes hitherto known for producing the constant mixture of air and the vapor of volatile liquids have all the disadvantages of providing a mixture that varies according to the temperature, discharge of gas, and duration of the process. The present invention overcomes these difficulties in carbureters. The hydrocarbon is not placed in the apparatus itself in the usual manner; but in its stead water is used, which is less corroding. The composition of gas can be determined at will. The employment of a hydrocarbon reservoir of special construction is unnecessary. An ordinary gasolene vessel of any shape can serve as a reservoir. This obviates the necessity of any manipulation of the hydrocarbon.

ATTACHMENT FOR ORE-SAMPLING MACHINES.—ALBERT C. CALKINS, Los Angeles, Cal. In a former invention of Mr. Calkins a peculiar construction was provided, comprising an arrangement of buckets with radial partitions and gears for rotating them in opposite directions. A hopper and agitator was used to feed the material. The present invention comprises a simple attachment to be combined with these elements, whereby the agitation of the hopper can be controlled independently of the rotation of the buckets, which was not the case in the former invention.

Vehicles and Their Accessories.

CAR-SEAT.—LOUIS JANSON, Brooklyn, New York city. The frame of a car-seat is provided with spring-supported shaping plates consisting of two or more sections having sliding connection. When a cover is stretched over the frame and the seat sustains a weight, the tension is equally distributed over the entire upper face of the seat. When the weight is removed the cover is automatically and smoothly stretched throughout its length, the cover sustaining but little of the tension due to the weight.

TIRE.—WILLIAM J. WITTMANN, Rochester, N. Y. Mr. Wittmann has devised a new and improved single-tube tire, which is simple and durable in construction, puncture-proof, and sufficiently elastic to insure convenient and easy riding, without undue jolting or jarring. An annular stay extends outwardly and radially from the surface of the tube. Side pieces fit opposite sides of the stay and the adjacent parallel portion of the tube.

WHEEL - WRENCH. — LEVI BLUNK, 1232 North Market Street, Louisville, Ky. The wrench is an improved means for removing the nut on the end of the spindle. An improved construction is provided, whereby the nut can be removed by turning the wheel backwardly, the wrench having means for engagement with the spokes, so that the turning of the wheel will operate the wrench in both applying and removing the nut.

WAGON - BRAKE. — JOHN F. STONE, SR., Dixie, Ind. This improved vehicle-brake is simply and easily operated and can be applied to the brake-bars now in use. An arrangement with springs is provided, which operates to throw the brake-shoes a considerable distance from the brake-wheels.

Railway Contrivances.

CROSSING - GATE. — WILLIAM E. JENKINS and JOHN D. SMITH, Goldsboro, N. C. The invention is a gate for railway-crossings; and the object is to provide a gate with an actuating mechanism of simple construction, not liable to get out of order and adapted to be controlled by a train passing over a track. The services of a man are dispensed with.

CROSS - TIE. — FREDERICK W. DUNNELL, Springfield, Mass. Waste material is utilized, such as leather scraps and worn-out footgear, in the manufacture of railroad cross-ties. It is claimed for the improved cross-tie that it is moderate in cost, durable, and sufficiently elastic to afford efficient service.

Miscellaneous Inventions.

PORTABLE TABLE.—JOHN M. FLEMISTER, Vigan, Luzon, Philippine Islands. The table is adapted for use as a mess-table in armies, for outings, and similar purposes. The several parts of the table can be folded or rolled together in a comparatively small space for packing and transportation. When set up for use the table is rigid and strong, yet light.

CARTRIDGE FOR GUNS.—DR. WILLIAM F. COLE, Provident Building, Waco, Tex. In guns of the Mauser and Krag-Jorgensen type it is necessary so to construct the cartridge proper and to provide the gun reach with guides to insure the presentation of the projectile for insertion so that jamming will be prevented. Dr. Cole has invented an improvement in guns embodying guides of this character, and the present invention relates to a cartridge adapted for use therewith. The cartridge has its reduced end twisted and formed as an ellipse in cross-section and its flanged head provided with flat sides.

ADJUSTABLE SCREEN.—EDWARD C. LINCK, St. Louis, Mo. The screen is of the kind that can be adjusted to fit windows of varying width. The frame sections are formed of sheet metal, to render them substantial, and can be readily manufactured by ordinary sheet metal forming and cutting tools. The frames, moreover, are far more durable than those of wood.

SAD-IRON.—KARL A. KAISER, Long Island City, Queens, New York city. The invention is a gas-heated sad-iron. The construction is such that a uniform heating of the base of the sad-iron is secured, and overheating the point of the iron prevented.

STRING - FASTENER FOR MUSICAL INSTRUMENTS. — GEORGE HOLT, Dixfield, Me. The invention provides a device by which a supplementary string, as the E-string of a violin, can be held in readiness for immediate use in case the original string should break.

EDUCATIONAL MEDIUM. — HELEN B. FROEHLICH, Manhattan, New York city. The object of the invention is to provide an improvement in educational devices whereby words, as they appear in books, charts, and the like, appeal strikingly to the eye of the pupil to facilitate and simplify the study of words. Two or more colors are used to define each syllable in a word, as many colors being selected as there are syllables in a word and as many distinct colors employed as there are unaccented syllables in a word. Black is the preferable color for the unaccented syllables.

PROCESS OF MAKING PAPER PULP.—THOMAS C. X. A. BERGET, Paris, France. This improved process consists essentially in starting fermentation through the combined influence of an alternating current and the heat developed by it in its passage through the substance, and then finally allowing the fermentation to terminate spontaneously, without the further application of an electric current. If necessary, the fermentation is facilitated by a medium varying according to the nature of the substance under treatment.

DETECTOR DEVICE FOR BOTTLES, JARS OR CANS.—EDWIN J. BROWN, Oneida, N. Y. Mr. Brown has devised a means for preventing the refilling of glass bottles and the like. Ordinarily such devices are part of bottles, jars, and cans, and require some change in shape in the can, or render the receptacle unfit for use again. The present invention is entirely independent of the bottle or jar.

FILE OR DRAWER LOCK.—DEAN A. BECKWITH, Manhattan, New York city. This lock is arranged securely to lock all the files or drawers in a casing at the same time, or to unlock all the files or drawers for their convenient removal at once to give access to their contents. A U-shaped lock-bar is hung on pivots and arranged to receive in its channel upward catches on the removable files or shelves. Mechanism is provided for swinging the lock-bar on its pivots.

NON-REFILLABLE BOTTLE. — PETER LESCH, Manhattan, New York city. In carrying out the invention, a novel arrangement of valve devices and auxiliary parts, together with an improved float in the form of a buoyant bulb, is employed. The bulb closes the valve against the inflowing liquor, should the bottle be inverted and the air exhausted in the effort to refill the bottle. The bottle-neck and its closure devices are given a form to defeat an attempt to dislodge the closure devices by means of a wire or the like.

POCKET PARTITION FOR BOXES.—LEON HIRSCHFELD, Manhattan, New York city. The pocket partition for boxes is intended to contain chocolate drops. The partition is constructed in a number of sections having guides upon which they slide. Each section is independent of the other and has independent movement whereby the sections can be so arranged that when in given positions with respect to each other they will form a series of pockets, each adapted to contain a piece of confectionery. Each piece is separately contained in a pocket, and one piece is prevented from touching another.

FOOT-WARMER.—FRANK H. GOTSCHE, San Francisco, Cal. The foot-warmer comprises a frame in which a roller covered with a rubbing material, such as flannel, fur or hair, is mounted. A foot-rest is connected with the frame, and gearing is provided to impart an oscillating motion to the roller. The feet are placed upon the foot-rest so as to touch the rubbing material. Upon oscillating the roller the sole of the foot is thoroughly rubbed, and a certain amount of static electricity is generated to impart warmth to the foot.

TOY.—ART H. KILPATRICK, Little Rock, Ark. This toy is a doll having a head provided in its under side with a seat for the finger, so that the head can be manipulated by the forefinger of the hand. The second finger and the thumb can be operated within a drapery suspended from the head to represent a dress, in such a manner as to present the appearance of arms. By reason of this illusory effect, the doll can be made apparently to wipe its face, scratch its head, and perform other like actions.

CALENDAR-WATCHCASE.—JOHN M. BIGGS, Glasgow, Ky. A special case construction is provided for use as a calendar, which construction includes movable sections that can be set to indicate the month, the days in the month, and the weekday of any day in the month.

DOUBLE - PILE FABRIC. — HOVCEP SARAFIAN, Titusville, Pa. The invention relates to textile fabrics, such as oriental rugs. In this new rug the pile stands up straight, having no tendency to lie down, as in an ordinary oriental rug. The fabric can be readily and quickly woven without the aid of skilled labor and without the waste of any material.

Designs.

PUZZLE-BOARD.—ALEXANDER J. GUTTMAN and JACOB R. AIMS, Manhattan, New York city. The design consists of a pan-shaped receptacle having a handle with a buffalo's head in relief, the receptacle having in its bottom a central depression and ribs radiating from the depression. The puzzle-board is evidently a Pan-American souvenir.

REIN - HOLDER. — JAMES A. WATTERSON, Aredale, Iowa. The leading features of the design consist of shanks, loops and a bar, all co-acting to hold the reins.

WASHBOARD. — WILLIAM W. JARRETT, Maysville, Alabama. The leading features of the design consist of a front concavity for the washboard. The feet at the bottom of this concave board incline rearwardly and downwardly. The box-receptacle at the top is open at the front, and has a back inclined upwardly and rearwardly.

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.

NEW BOOKS, ETC.

THE ORGANIZATION AND MANAGEMENT OF A BUSINESS CORPORATION WITH ESPECIAL REFERENCE TO THE LAWS OF NEW YORK, NEW JERSEY, DELAWARE, AND WEST VIRGINIA. By Thomas Comyngton. New York: The Ronald Press. 1900. 8vo. Pp. 203.

The present volume treats of the methods whereby interests and forces in themselves widely divergent are brought together and combined in one easily handled, marvelously effective legal entity—a corporation. It shows the ready adaptability of its methods for smaller business enterprises. The book clearly outlines the preliminary procedure and shows how its advantages can best be utilized and its dangers avoided. The arrangement permits of a ready understanding of the subject.

HAND-BOOK OF PRACTICAL HYGIENE. By D. H. Bergey, A.M., M.D. Easton, Pa.: The Chemical Publishing Company. 1899. 12mo. Pp. 164. Price $1.50.

The lack of a convenient hand-book for the guidance of students in the sanitary analysis of air, water, soil, and the principal food materials and in testing the ventilation of buildings is the author's apology for the preparation of this little work. The subject is explained in a very lucid manner to enable the students to grasp the principles as well as the processes of analysis. The book deals with meteorology, analysis of air, analysis of water, soil, the sanitary analysis of food, and ventilating and heating are touched upon.

A PRIMER OF POLITICAL ECONOMY. By S. T. Wood. New York: The Macmillan Company. London: Macmillan & Co., Ltd. 1901. Pp. 149.

Mr. Wood has written a delightful little book on the first principles of political economy, and has presented the subject so attractively that he must surely interest the novice for whom his book is intended. The book is a continuous story of what the purchase of a pair of shoes entails, and how that purchase typifies the action of economic laws.

ANNUAL AND ANALYTICAL CYCLOPEDIA OF PRACTICAL MEDICINE. By Charles E. de M. Sajous, M.D. Philadelphia, Pa.: F. A. Davis Company. 1901. Vol. VI. 8vo. Pp. 1,043.

Dr. Sajous is to be congratulated upon the completion of the sixth volume of his Annual and Cyclopedia. It is an exhaustive work, and the references to medical literature are very full. Some of the most eminent surgeons and physicians in the world are contributors to the sixth volume, which is the last of the first series. The general index is very full.

UEBER STEREOSKOPISCHE LUPEN UND BRILLEN. Von Dr. Emil Berger, Sonder-Abdruck aus der Zeitschrift für Psychologie und Physiologie der Sinnesorgane. Herausgegeben von H. Ebbinghaus und A. König. Bd. 25. Leipzig: 1901. Johann Ambrosius Barth. Pp. 77.

Business and Personal Wants.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(8386) S. C. M. writes: In attempting to make the electric motor described in "Experimental Science," I ran up against a difficulty in that part described on page 501, where it tells you to space off the armature core into *twelve equal divisions*, etc. Now, if you use in each coil 8 convolutions of No. 18 cotton-covered copper wire, each coil will be ½ inch in width. Now I inclose diagram showing that if the coils touch each other on the inner circle of the armature you cannot get but 9 coils on the armature, the remaining space being not quite large enough for the tenth one. As the book is copyrighted by you I thought I would refer the matter to you and ask for explanation of the difficulty. A. The motor which you are building from plans in "Experimental Science" was built exactly as described before the book was printed, as was all the apparatus described in the book. And the number of coils were put upon the armature which the book calls for. You should wind 19½ turns of No. 18 cotton-covered wire to the inch instead of 16, as you state. The difficulty is that you have not wound the coils with sufficient skill.

(8387) H. S. asks: 1. Will you kindly explain in Notes and Queries how the dynamo of SUPPLEMENT No. 600 can give a 10-ampere current, as stated, when the armature is wound with No. 20 wire, which, according to the rule of 520 square mils per ampere, would carry a little in excess of 3 amperes only? A. S. P. Thompson, in "Dynamo-Electric Machinery," says: "Modern practice allows from 2,000 to 3,000 amperes per square inch, in conductors of ring armatures, and even up to 4,000 amperes per square inch in those of drum armatures. But in the magnet coils only about 2,000 amperes per square inch." This will increase your 3 amperes to about 5 amperes on each side of the armature, or 10 amperes in all. 2. In following Sloane's rules for designing armatures for a machine to charge a 10-volt storage battery I get an induction of 1 volt per 8 feet 4 inches with a core 3 inches by 4 inches. This is so low as compared with Hering's assumption of 1-1.4 volts per foot, both of these conditions being with a field (assumed) of 20,000 lines per square inch. Is it explainable simply by the difference of size of machines? A. Different types of machines have different lengths per volt. We have seen one well-known machine given at 12 feet 4 inches, and another at 1 foot 7 inches per volt. 3. I have a motor built for use for centrifugal sedimentation work, field wound with No. 13, armature with No. 16. This machine on 10 volts runs 1,400 t. per m. I wish to increase the speed to 2,000. Can I do so by winding the armature with coarser wire? As it is now at 1,400 t. per m. it consumes about 2 amperes. A. Try the motor with more pressure. It may speed up without over-heating. Try it with a resistance in shunt across the poles so as to increase the current, which it will take at the same pressure. If neither method succeeds in bringing the speed up to what you wish you will have to rewind with coarser wire.

(8388) U. S. W. asks: 1. Will the motor illustrated under Fig. 485 in "Experimental Science" and run by a plunge battery such as Fig. 394 be capable of furnishing power for an automobile on a small scale that will carry a person weighing not more than 125 pounds? A. No. Motor cycles are provided with motors with from 2 to 4 horse power. This gives power for ascending a steep grade. 2. What determines a man power, and how is it measured? A. A man power is not a definite quantity as a horse power is. It is variously estimated at from 1-10th to 1-7th of a horse power. The rate at which a man lifts his weight up a flight of stairs will give one mode of estimating a man power. A man lifting weights or shoveling will furnish another mode.

(8389) R. W. S. asks: 1. What is the voltage of a Ruhmkorff induction coil giving ½-inch spark? A. The voltage required to force a spark ½ inch long through air varies with the form of the terminal. A longer spark can be thrown between points than between balls. From 16,000 to 18,000 volts may be given as a probable mean value of voltage for ½-inch spark. 2. What is the proper number of cells for such a coil to produce a spark ½ inch long, and how should they be arranged? A. Two or three bichromate cells will work such a coil. They should be arranged in series. A proportionately larger number of cells of another sort, according to the voltage of the cells, is required.

(8390) J. A. R. writes: I have a 16-light 110-volt shunt-wound dynamo that ran for two months, giving good service. I started it up one night after standing idle for two or three weeks. After running for ten minutes carrying 8 amperes at 110 volts and the lamps at apparently full candle power, the voltage commenced to fall gradually until it reached zero, since which time the machine has been as dead as the traditional "door nail." Resorting to short-circuiting or "tickling" fails to energize. Exploring the field with a compass shows absolutely no polarity, the north pole of the needle being feebly attracted alike to both poles of the machine. With an 8-light machine (your SUPPLEMENT No. 600) as an "exciter" I can raise the lamps to about ½ candle power, but it will not excite its field from the shunt. With the assistance of a friend who built the 8-light machine and who has also rebuilt an Edison 3-kilowatt machine that had been destroyed in a fire, both of which have been doing good work for several years, I have been trying to solve the problem, but have failed. Can you suggest a remedy through your "Answers to Correspondents" column? A. Your machine behaves as if there were a break in the field circuit; but there are many other causes of failure to generate. They are fully stated, with the remedy, in Crocker and Wheeler's "Dynamo Tender's Hand-Book," price $1 by mail.

(8391) C. H. L. asks: 1. I am making a small electric motor to run with battery. Armature is of drum type, having 12 segments, and is 2 inches diameter and 2½ inches long. Fields are bi-polar, and "end on" toward armature. What size and how much wire must I use on each to make the motor safe to connect to an ordinary 110-volt light socket? I want to put two layers of wire on the armature. A. You cannot wind a motor to run with a battery and also connect with the 110-volt lighting circuit. You would better wind it for one use only. 2. How shall I charge a bichromate battery having a 1-gallon cell, carbon cylinder and porous cup? How much current will such a battery give, and for how long? A. The cell will have 1.8 volts pressure when freshly charged. The number of amperes it will give depends upon the resistance of the external circuit. It will give about six hours of rather heavy use. Our SUPPLEMENT No. 792, price ten cents, gives all particulars for this battery.

(8392) A. S. C. asks: 1. Would like to know whether there is any formula for determining the proportion of the total number of lines of force found within a given distance from center of the magnetic field in the case of bar electromagnets; and if there is such formula, where it can be found. A. These are matters of importance in designing dynamos and motors and are treated in books upon that subject. Among the best is Thompson's "Dynamo-Electric Machinery," price $6; with American Supplement, $7. 2. Would also like to know what primary current, volts and amperes is generally calculated to be used to produce a 1-inch spark from coil? A. To throw a spark through the air one inch requires from 28,000 to 30,000 volts. The amperes are inappreciable, or at least a fraction of one ampere. 3. Also, what size wire and how much and what current will make the strongest electromagnet with a core of annealed iron stovepipe wire, 1 inch in diameter and eight inches long? A. Wind eight layers of No. 12 B. & S. cotton-covered copper magnet wire upon the core. Shellac each layer well. Eight cells of bichromate plunge battery will bring it to its full power. For battery and its construction, see SUPPLEMENT 792, price ten cents.

(8393) J. B. J. asks: I have a fan motor which I wish to run on 10 or 12 sal-ammoniac cells. The motor is ⅛ H. P.; it is designed to run on 110 volts, 1 ampere, 2,000 R. P. M. It is of the shunt-wound Riker type. I wish to know if the windings should be changed. The field coils are of No. 38 wire, and the armature coils (24 in number) are of No. 34 or No. 36 wire. A. The motor will require to be rewound to run with a battery. You would better refer to the builders as to the changes to be made.

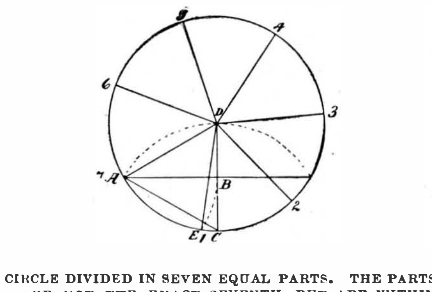
(8394) A. W. asks: How can I tell when Babbitt metal is hot enough to pour, when it is heated, to pour small boxes, also large boxes? A. Babbitt metal should be poured just when it is perfectly fluid, which may be known by gently shaking the ladle or stirring with a stick. It should not be red hot, as then it shrinks and is liable to make blowholes. If it is to be poured on a wooden core in place of an iron or steel core or journal, it should not be hotter than will run freely. The different grades of Babbitt metal do not melt at the same temperature, so that a little experience is required in using the different grades.

(8395) J. W. S. writes: Some four years ago I conceived the idea of restoring the vacuum to Crookes tubes without repumping. Knowing at the time that heat applied, especially at the cathode terminal, would facilitate the discharge of the current through the tube, I could not see why prolonged heat would not further reduce the vacuum, and perhaps permanently reduce it. I took my tubes, which were entirely beyond my control, and placed them in a hot oven, mounting them on wooden supports. I left them in the oven for 15 or 20 minutes, and found on removing them that the vacuum was so very much reduced that it took several hours' continuous running to render them effective. Since then I have used this method continuously. I have taken tubes that have been rejected as worthless, and brought the vacuum so low that it required much running to bring them back to effective work. Care must be used in placing the tubes in the oven; also in removing them.

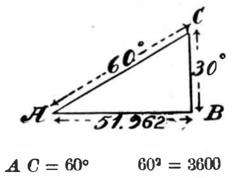
(8396) G. S. writes: 1. I have a few questions here which I wish you would answer in the SCIENTIFIC AMERICAN for September 7, 1901. A. Your letter was received September 3. The issue for September 7 was in print at that time, else you could not receive your number on its date. An answer to an inquiry should not be expected under two or three weeks. 2. Have you a SUPPLEMENT telling how to make a simple-construction yet effective 110-volt dynamo, with illustrations of the work, and telling how to wind the magnets and the armature? A. SUPPLEMENT No. 865 gives plans for a 110-volt dynamo; price ten cents. 3. Can you run incandescent lamps on the same circuit with an electric furnace? A. Yes. 4. How many volts does it take to run an electric stove? A. One can be operated upon a current with any number of volts. 5. If a dynamo gives 6 volts running it steady, how many amperes and ohms would it have. A. No one can tell. The amperes must be measured by an ampere meter. 6. Please name and explain the different ways in which dynamos are wound? A. Series, shunt and compound wound. In the first the entire current passes through the field coils on its way to the external circuit. In the second the current is divided, a small part going to magnetize the field and the rest going to the external circuit. The third is a combination of the other two. 7. How many volts does it take to run a 1 horse power motor? A. Volts are only one factor of power. Power is measured by volts multiplied by amperes, which are watts; 746 watts are 1 horse power. 8. Could you run an automobile at a good rate of speed with a 1 horse power motor? A. No. 9. How many volts does it take to make a watt? A. A watt is one ampere flowing at a pressure of one volt.

(8397) E. P. H. asks: 1. Can a steel electromagnet be made as strong, or stronger, than a soft iron electromagnet of equal size, current the same? A. The soft wrought-iron core will be the stronger. 2. What per cent of magnetism can a steel electromagnet be made to retain? A. The same amount which the same steel would retain as a permanent magnet. The strength of a permanent magnet varies greatly with different sorts of steel. 3. Could a permanent field dynamo be made more effective by putting a coil on fields? A. Yes. 4. If a solid steel ring be magnetized by placing a coil continuously around it, would any given point be + or — to an adjacent point? A. There would be little or no external magnetism. The magnetic flux would traverse the ring and would not emerge into the air. 5. Could a solid ring be magnetized in sections alternately + and — ? A. Yes. A dynamo with coils and pole pieces around a ring is such an arrangement. 6. What is the action by which an iron bar is driven out of a helix? A. It is repelled by the currents which are set up in the bar by the action of the main current. 7. Must the helix have a hollow iron core to get this "popgun" action? A. No. See SUPPLEMENT 762 and 763, price ten cents each, for valuable articles upon this and similar experiments. 8. In a double-expansion rotary steam engine can the cylinders be so proportioned as to each utilize 50 per cent of the available energy of steam? Or what is the nearest to equalization possible, and how should cylinders be proportioned to obtain it? A. For an equal division of the power of a two-cylinder rotary engine the expansion area of each cylinder should be in proportion to the initial and expansion areas of a theoretical indicator card for any given pressure and cut-off. This may be obtained by dividing an indicator card diagram into two parts of equal area; when the position of the dividing line will represent the proportional areas of the primary and secondary cylinders. 9. Why does a chicken bob its head while walking? A. The thighs of a bird's legs are within the skin of the body and are held very closely to its sides. Practically the only motion of its legs is one parallel to its backbone. The longer axis of its body is horizontal and swings sidewise as the bird walks. This gives a jerking motion to its neck in the other direction in order to preserve the equilibrium as much as possible. In birds with long bodies and short legs like the goose this waddling gait is very apparent. A man can imitate it by swinging the arms with the legs in walking. Swing the right arm forward when the right leg is advanced and the left side in the same manner. A man then waddles like a duck. 10. Why does it peck corn from alternate sides? A. Because the corn is on both sides. The hen has a flexible neck and a quick eye on each side of its head to detect food. You may be sure she does not pick up corn on each side alternately unless the grains attract her attention in that way. We do not think any rule can be laid down for the hen on this point. She just goes ahead and picks up the best grain she can see, even if the last kernel was on the same side as this. 11. What number or numbers of SCIENTIFIC AMERICAN or SUPPLEMENT contain articles on liquid air? A. We can send you 22 numbers, at ten cents each, containing articles upon liquid air. 12. What other up-to-date literature can I get on the subject of scientific nature? A. Hardin's "Liquefaction of Gases," price $1.50; Sloane's "Liquid Air," price $2.50, both by mail. 13. In constructing an acetylene lamp, what should be the relative sizes of water and carbide chambers? A. For the chemical action 64 parts of carbide by weight require 18 parts of water also by weight. If you would keep the gas reasonably cool, a much larger proportion of water must be used.

(8398) P. H. T. writes: I send you a drawing of a circle divided into seven nearly equal parts. A professor of mechanical drawing, to whom I submitted it, said that as far as he knew it had never been done before. At the suggestion of friends I send you the drawing for insertion in the SCIENTIFIC AMERICAN, if you see fit to do so. The accompanying calculations show its accuracy within 0.5340, thus making it practically correct as far as mechanical drawing is concerned. My age is 13 years.



A CIRCLE DIVIDED IN SEVEN EQUAL PARTS. THE PARTS ARE NOT THE EXACT SEVENTH, BUT ARE WITHIN 0.53° OF BEING EXACT.



$A\,C = 60° \qquad 60^2 = 3600$

$B\,C = 30° \qquad 30^2 = \underline{900}$

2700

$\sqrt{2700} = 51.962+$

$\frac{1}{7} \times 360 = \underline{51.428+}$

$0.534°$

$A\,B$ is within 0.534+° of being the exact seventh of the circle.

A. We think your work very creditable to you considering your age. It is a new discovery for you, even if other may have found the same method of approximately dividing a circumference into seven parts.

(8399) B. R. asks: 1. The quickest and most accurate methods of preparing a normal sulphuric and a normal caustic soda solution? A. To form a normal solution of sulphuric acid add 98 milligrammes of the acid to a cubic centimeter of water. For caustic soda solution add 40 milligrammes of the sodic hydrate to a cubic centimeter of water. 2. Also kindly inform me what the desirable qualities of a lithographic stone are? A. No person can tell the quality of a lithographic stone without an actual trial. No lithographic stone of any importance has been found in this country. Consult a practical lithographer. 3. Kindly recommend a book on physiology and one on hygiene. A. Foster's Physiology, price $4.50. A good school textbook would perhaps meet your needs, such as Blaisdell's, price $1.50.

(8400) W. McE. asks: Would you kindly give me, through your paper, a receipt or idea how the paste in storage cells is mixed, and if the paste in the positive is black lead or plumbago, and in the negative red lead, and are the plates connected with wire, or is the wire simply connected on one end to the positive and on the other end to the negative, or is each plate positive or negative connected by wire, or does the lacquer make the circuit between the positive and negative plates, and is the lacquer made out of sulphuric acid and water and bichromate of potash, and are the lead plates ordinary lead or chemically cured lead? A. The plates of a storage cell are made of ordinary lead cast into such a form as is desired. The paste is dilute sulphuric acid, 1 part acid and about 9 of distilled water and lead oxide, which is pressed into the openings in the lead plate usually with hydraulic pressure. The liquor of the cell is dilute sulphuric acid. The cell is now formed and put to use. The internal circuit is from the positive plate to the negative plate; thence out through the wire, through the external circuit and back to the negative pole of the battery. All this and much more can be learned from Salomon's "Accumulators," price $1.50 by mail.

(8401) S. E. W. asks: 1. Could not a 16-cell caustic potash battery composed of the large cells shown in "Experimental Science" be used to run the "simple motor" described in the same work? A. Yes. 2. Would not a battery of this kind last longer and be more economical than the bichromate battery? A. We do not think so. 3. Is the potash sold for making soap, under the name of lye, suitable for charging this battery? A. It will probably answer the purpose. 4. If so, what would be the formula for the solution, by weight? A. Sixty parts by weight in 100 parts of water. 5. What size wire should be used on the field and armature of the "simple motor" to adapt it to a 110-volt current? A. Use No. 28 B. and S. on field and No. 30 on armature.

(8402) J. G. von H. asks: Is the induced current in an induction coil direct or alternate? A holds it is alternate by relying on his galvanometer. I claim it is direct, but intermittent, because if it were alternate it would be impossible to charge a Leyden jar. Who is right? A. When a condenser is used, the induction coil gives an intermittent discharge, always in the same direction. The discharge in the reverse direction is suppressed. It is in this way that X-ray tubes have an anode and a cathode with a coil. If the current were alternating, these terms would not apply. You are right.

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