SCIENTIFIC AMERICAN

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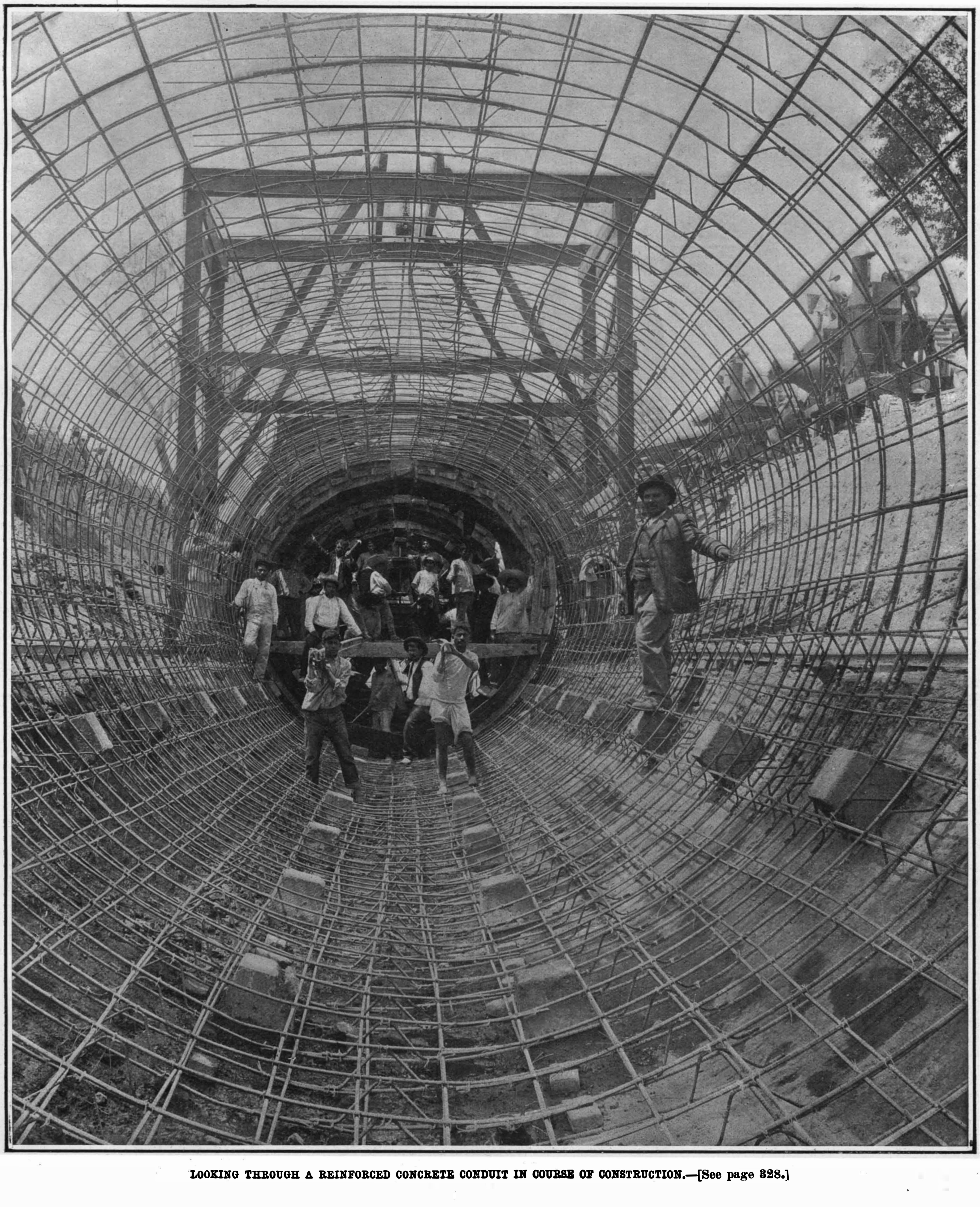

LOOKING THROUGH A REINFORCED CONCRETE CONDUIT IN COURSE OF CONSTRUCTION.—[See page 328.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, NOVEMBER 6th, 1909.

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

THE AMERICA'S CUP.

Securely locked away in some safe deposit vault in this city is a curious old silver cup, which shows in the fantastic crudity of its design all the earmarks of that Victorian age in which it was fashioned. Its cash value is stated to be five hundred dollars; which may be taken to be its probable value if melted up for the silver that is in it. Of no worth as an object of art, the cup is to-day probably the best known, as it was once the most eagerly sought-after prize in the world of international sport. Won over half a century ago by the epoch-making schooner "America," it has been the object of most strenuous competition, and has caused the expenditure of millions of dollars by yachtsmen on both sides of the Atlantic. With a persistency which is characteristic of the race, the British have sailed yacht after yacht over the ocean, in the hope of taking the "America's" cup back to English waters, and transferring the scene of future contests to those shores off which the "America" won her famous victory.

The effect of the "America" cup contests on the development of the sailing yacht, particularly in the later years, has been to produce a craft of such extreme proportions—vast sail spread, fragile hull and spars, and excessive draft—as to render her useless for ordinary cruising, and fit only for the marine "graveyard" and the junk pile. Truly a most amazing statement; but fully guaranteed by the fact that during the past decade no less than six challengers and defenders for the cup, costing altogether probably not less than a million and a half dollars, have been broken up and sold for old metal.

As far as the records of this half century of contests go, they have consisted of an unbroken string of victories for the American yacht; and the British must get what consolation they can out of the fact that the American designers, in their efforts to hold the cup, have had to forego the characteristic centerboard-hull and sloop rig, and come over to the English deep-keel and the cutter rig. The successive defeats of recent years have convinced the English yacht designers that they must abandon all hope of outbuilding and outsailing the American defending yacht, so long at least as there is no restriction upon lightness of hull and size of sail spread.

Some years ago our own yachtsmen and those of France, Germany, and England came to the conclusion that the time was ripe for making such changes in the rules of measurement as would modify, or control, those extremes of construction which have rendered the racing yacht an unseaworthy, unwieldy, and outrageously expensive craft to build and maintain in commission. Both here and abroad new rules have been adopted, which have resulted in the production of yachts that are in average weather as fast as the "freak" boats, and at the same time are suited for the average summer cruising. Sir Thomas Lipton, the most persistent of all contestants for the "America's" cup, has been told by the English designers that they are unable to build a yacht under the old rule for which they can give an assurance of any likelihood of success in the contests off Sandy Hook. They claim that a boat built of sufficient staunchness to take the chances of a stormy Atlantic crossing cannot compete with a craft which during her season's sailing never has to venture out of sight of land, and does most of her racing in the sheltered waters of Long Island Sound and within a few hours' sail of the yard in which she was built. To this the reply has been made that, since the English yacht is towed across, carrying a reduced rig, the danger of her foundering in heavy weather is eliminated.

The writer once put it squarely to Mr. William Fife, designer of two of the challengers, whether he considered the ocean crossing to be a handicap. After a few moments' thought he replied, "Theoretically, no; but actually, yes; and this for the reason that, however keen a yacht designer may be in his desire to cut down weights, his humanitarian instincts will remind him that the lives of over a score of men are to be committed to that shell, to take the chances of a three weeks' crossing of the Atlantic." Be that as it may, the fact remains that the British have frankly acknowledged themselves beaten, under the present rules, in contests between yachts of unrestricted lightness, and Sir Thomas Lipton is in our midst to-day requesting that the New York Yacht Club sanction an "America" cup contest under their own new rule, under which for some years their regattas have been held.

The New York Yacht Club contends that, since the "America" cup stands for the fastest yacht that can be built, and since it has been proved that the fastest yacht can be built under the old rule; therefore for "America" cup contests the old rule is the proper one to sail under—and there can be no doubt that technically the attitude of the Club is correct. At the same time, we believe that under the present Deed of Gift the challengers and defenders may mutually agree to make certain changes in conditions if they so wish. All the same, we would suggest that, since racing for the "America" cup under existing conditions is at an end; and since, after all, the cup is merely an emblem of the sport, and it is the sport and not the cup that is the ultimate object of yacht racing, it might be as well to make a sufficient modification of the old rule to encourage the yachtsman, not merely of Great Britain but of that other great yachting nation, Germany, to make a try for the famous old trophy.

DOVER'S GREAT ARTIFICIAL HARBOR.

The opening of Dover naval port marks the completion of the greatest artificial harbor ever built entirely in the open sea. The scheme includes an extension of the Admiralty pier for two thousand feet; the formation of reclamation works for the protection of the shore at the eastern end of Dover town, extending in the direction of St. Margaret's Bay for three thousand nine hundred feet; a protecting arm extending from the eastern end of the reclamation for a distance of two thousand nine hundred feet into the open sea; and an island breakwater approximately parallel with the shore line end extending from the end of the Admiralty pier extension on the west to the end of the easterly pier already referred to, with wide entrance openings between the heads of the several breakwaters. If we include the eighty acres which constitute the present commercial harbor, there is inclosed by these works a total area at low water of six hundred and ninety acres of deep-water harbor, capable of floating the largest of modern battleships and ocean liners. This is the largest area of the open sea ever inclosed by solid masonry protecting works.

Although that portion of the inclosing breakwaters which is visible at high water gives an impression of their great length and of the wide extent of the harbor, it is a fact that the visible masonry represents only a small proportion of the work actually done. The total length of the sea works is two and a half miles, two miles of which are in exceptionally deep water. Thus, the two-thousand-foot extension of the Admiralty pier measures from the top of the parapet to the foundation nearly one hundred feet in height and the eastern pier has a total height above foundations of eighty-seven feet. The total width at the base of the piers is over fifty feet and at the top forty-seven feet six inches.

It is an interesting historical fact that it was Sir Walter Raleigh who first drew attention to the strategical and commercial importance of Dover, speaking of it as "situated on a promontory next fronting a puissant foreign king and in the very straight passage and intercourse of almost all the shipping in Christendom." It was as far back as the year 1840 that a Royal Commission recommended a scheme of harbor construction at a cost of ten million dollars. Out of the deliberations of this and subsequent commissions came the decision to construct the Admiralty Pier, so well known to Americans who visit or return from the Continent by way of England, for which a contract was let in 1847, but which did not reach completion until twenty years later. It was not until the year 1895 that the plans for the present fine harbor took definite shape; the contract was let in 1897, and active construction commenced shortly afterward. The fears which have been expressed that this, like other harbors won from the open sea, might be subjected to shoaling up by drifting sands have not been verified, the depth remaining practically constant.

IMPROVEMENTS IN NEW YORK'S HIGH-PRESSURE FIRE SERVICE.

A recent order of the New York Fire Department relieves the fire engines of the various companies in the district protected by the high-pressure water service from responding to alarms of fires, and may be considered as a practical and official indorsement of the complete success of the system. Soon after the high-pressure was installed the right of way in going to a fire was given to the hose wagons over the engines, and while the latter answered alarms they were held in reserve or used merely for washing down after the high-pressure lines had extinguished the fire.

The successful and intelligent use of the high-pressure by the Fire Department was accompanied by a careful study of the actual workings of the system by the engineers of the water department with a view to detecting any possible defects. As a result the new extension, now beginning to be installed and aggregating some twenty-one miles of mains, represents a marked improvement over the part at present in use, which, as the largest and most complete plant of the kind, is serving as a model for other cities. The most important improvement is a duplicate arrangement of mains so that in case of a break or other failure one-half of the system can be cut out immediately without impairing the efficiency of the other half in any way. This is secured by gridironing the territory with two independent systems whose mains are laid in alternate streets. Thus in the case of a break in a main supplying a hydrant on a certain street, that half of the system to which it belongs can be shut off at once and the firemen only have to stretch their hose from a hydrant connected with the other set of mains, usually to be found on the next street. The two systems and their hydrants, which will probably be painted a different color or otherwise marked, are so arranged that a hydrant of the second system is never over 500 feet from any given point, just as under normal working conditions there is a hydrant within at least 200 feet of any possible fire.

The desirability of such an arrangement was apparent to the water department engineers at a fire on December 16th, 1908, at Grand and Mulberry Streets, when the high-pressure service had its only failure and was temporarily out of service. This was due to a break caused by the giving way of a temporary end of a main in an excavation for the Centre Street subway, where the supports for the main had been cut away by the subway contractors.

While it is possible to locate and cut out any section where a break occurs by means of valves located at street intersections, yet this process may require considerable valuable time when the water is seriously needed at the fire. The valves themselves are ponderous affairs moved by hand, and to close the two, three, or four required to cut out a broken section may consume from twenty minutes to half an hour. Accordingly after studies by the engineering staff of the high-pressure division of the water department it was decided to install an independent system of two mains as outlined.

Normally, both systems will intercommunicate and connect with the present system so that there will be a complete circulation of water, supplied at any desired pressure from the pumping stations at Gansevoort and West Streets and at Oliver Street and East River. Now, in case of a sudden break the gage at the Oliver Street station connected with the outlet of the half of the system involved will be immediately apparent and that portion can be shut off at the station. This is accomplished by closing the appropriate valves on the outlets at the station and two distant controlled valves at the Bowery and Houston Street or at New Chambers and Cherry Streets, depending on the part involved. All of these valves are electrically worked and can be operated simultaneously so that one system or the other can be isolated in less than a minute. This increased measure of safety, the importance of which cannot be overestimated, is rendered desirable not through any inherent defect in the high-pressure system but largely on account of the conditions under which it must be installed and operated in a city like New York, where frequent excavations and gas explosions are likely to damage the mains or produce weakness that only service conditions may develop. If the break is detected in season it is of course possible to isolate the crippled section and notify the firemen accordingly, but failure in service is a serious matter which the new duplex system will render much less dangerous.

Few pieces of municipal engineering have been better planned, constructed and operated than New York's high-pressure service, and that it is capable of still further improvement would indicate that when this form of fire protection is provided for the entire city it will eliminate the possibility of a large conflagration, which Chief Croker states is no longer to be feared in their present protected district. Further extensions besides the one under way are contemplated in the near future, and additional pumps will be installed.

ENGINEERING.

At the close of the month of September the halfway mark had been reached in the huge job of excavation at the Panama Canal. By that time 87,172,058 cubic yards, or about one-half of the total excavation, had been removed. The grand total for September was 2,836,385 cubic yards, which is 1,043,952 cubic yards less than the highest record, which was made in March, 1909.

The State Department has been informed that the President of Guatemala has directed a bronze bust of Robert Fulton to be placed in Estrada Cabrera Park in Guatemala city in recognition of Fulton's genius. The government of the United States has directed the American Minister at Guatemala city to express its appreciation to the Guatemalan government for the honor thus done to the memory of a distinguished American.

The Examiner of Patents has decided in favor of Commander Cleland Davis, U. S. N., in the interference proceedings that have been pending for many months past against his application for patent on his projectile-carrying torpedo. One witness testified that in the spring of 1903 Davis drew a diagram of his device upon a napkin and explained that his idea was to insert in a torpedo a gun which would discharge a high explosive shell through the armored bottom of a ship and enable it to explode within the vessel.

The inauguration of railway travel through the tubes of the Pennsylvania Railroad Company between New Jersey and Long Island took place recently without any demonstration and under very prosaic conditions. The first trip was made by a train of dump cars hauled by an ordinary switch engine, which passed from Jersey City beneath the North River, Manhattan Island and the East River to Long Island City. The formal opening of this great work will probably take place within the next few months.

According to a dispatch from Quebec, the Harland & Wolff shipbuilding firm of Belfast, Ireland, working in conjunction with the Canadian Pacific Railway, have acquired a large area of land at Levis, at which drydock, ship repairing, and building plants will be built this spring for the purpose of building Canada's navy. Sir Thomas Shaugnhessey, president of the Canadian Pacific Railway, refuses to discuss the rumor. It is said that he personally conducted the negotiations between the shipbuilders and the government.

The largest scrap heap in the world is in San Francisco, a relic of the great fire which followed the earthquake of April, 1906. It is 40 feet high, 100 feet square and contains 20,000 tons, all cut in equal lengths of eighteen inches, and piled in one solid mass, with the sides as plumb and true as a brick wall. This is the only one of four heaps of equal size and proportions which remains intact in its original size and shape, the other three having been drawn upon as the material was needed.

An extraordinary accident happened at Durban, South Africa, to an immense traveling coal unloader, mounted on four trucks and traveling on two pairs of standard-gage rails 30 feet apart, which can pick up and dump an ordinary railroad car full of coal. It was blown along the track by a gale until it left the metals, when in spite of the stability due to its large wheel base as compared with its height, it fell over on its side. As it has booms 190 feet long and is nearly 100 feet high, the task of re-erecting it calls for considerable ingenuity.

That the submarine bell is valuable in preventing delay of ocean liners by fog has recently been proved in the case of the "Lucania" and the "Kaiser Wilhelm der Grosse." The former vessel, while approaching New York, was enabled to make the light vessel by submarine bell signals, these being her sole guide. The captain of the "Kaiser Wilhelm der Grosse" when on an eastern passage was shut in by dense fog near Fire Island light vessel. He was able to hear the submarine bell and direct his course accordingly, although, as it subsequently transpired, he was twelve nautical miles distant from the signal station. It is significant that at the same time the fog horn of the lightship was quite inaudible.

A breakwater which, when completed, will be some 10,000 feet in length, is now in course of construction at Hilo, in the Island of Hawaii, to protect shipping from the heavy seas that sweep from the northeast. At present some 400 feet have been completed, and under the existing contract it is estimated that by the middle of next year a length of some 3,000 feet will be in position. The material used for construction is a basalt rock resembling heavy granite, which is quarried some 25 miles away, and transported to the works under contract with the Hilo Railway Company. According to the specifications, from a depth of 3 feet below the water-line to the top, bowlders of not less than 8 tons in weight are to be used. The contractors are confident that the rock in question, which weighs 165 pounds to the cubic foot, without the use of cement, will resist any action of the waves.

ELECTRICITY.

The chief engineer of the British Post Office Department, Major Walter O'Meara, is visiting this country for the purpose of studying our telephone systems. The British government is to take charge of the entire telephone system of Great Britain in 1911. It will be operated as is the telegraph system, by the Post Office Department.

The contract has just been let for the huge dam across the Conchos River in Mexico. This dam will form a reservoir of 1,840,000,000 cubic meters capacity. The hydro-electric plant which will obtain power from this source has a capacity of 25,000 horse-power, which will be used at a number of large mines within two hundred miles of the generating station.

An electric railway has just been completed running from Ville Franche to Bourg-Madame. The line is thirty-four miles long and it has a schedule of three trains a day in each direction. Starting from Ville Franche at 1,407 feet above the sea the line rises to 5,220 feet and then drops to 3,750 feet at Bourg-Madame. The motor cars are each equipped with four 50-horse-power motors. The third rail system is used and energy is supplied at about 800 volts.

A circular has just been issued by the Bureau of Standards discussing electrical measuring instruments in general, describing the various types of instruments, pointing to the sources of error and explaining methods of checking them. The Bureau undertakes to test any instruments sent to it for this purpose, making a small charge for the work involved. The circular contains the regulations governing these tests, and a schedule of the fees charged.

The city of Liverpool is at present experimenting with flaming arcs and tungsten lamps for street lighting. A row of flaming arcs is set on posts in the middle of one of the principal streets. The arcs are 20 feet above the ground, and 10 feet below each is a circle of 35-watt tung ten lamps. At midnight the arc lamps are extinguished and the filament lamps are used in place of them. On one of the narrower streets clusters of tungsten lamps are hung over the center of the street from wires strung across from the buildings at opposite sides, thus avoiding the use of poles.

A series of lectures has been given before the Fire Insurance Club of Chicago by Mr. B. E. Blanchard, who is the Chief Electrical Inspector of the Chicago Board of Underwriters. The subjects so far discussed are "Electricity," "The Electrical Inspector," "Outside Work—Systems and Voltages," and "Inside Work." The remaining two lectures will deal with "Low Potential Systems" and "High Potential Systems." These lectures have been found very instructive because the subjects are explained in simple non-technical language, so that the insurance men readily understand them.

The Committee on Units and Symbols of the German Association of Electrical Engineers has just published a report suggesting uniform symbols for alternating-current units. There has been some criticism of these recommendations, because the letters used represent German words and differ materially from the symbols common in other countries. While standardizing of symbols is to be highly recommended, it is pointed out that the symbols should be such that they may be adopted by other countries as well so that eventually we can have an international set of standard symbols and thus avoid some of the confusion that now exists in electrical literature.

Evidently carbon filament lamps are still receiving considerable attention in England. Two patents have recently been issued on the subject, one aiming to regenerate the filament, and the other to prevent the blackening of the glass bulb. In the first case the bulb is opened, and after being cleaned hydrocarbon is introduced. Then on heating the lamp the hydrocarbon is decomposed and the carbon is deposited on the filament. In the second case the inventor believes that the blackening of the glass may be obviated by removing the mercury vapor which enters therein while the bulb is being evacuated. Therefore he proposes to coat the stem which holds the filament with silver, so as to absorb the mercury vapor.

A recent article in the Electrical World contains the following data relative to the utilization of the energy from Niagara Falls. Of the 5,000,000 horse-power represented by Niagara Falls, only about 5.5 per cent is being utilized. Of this, 126,800 horse-power is employed in electro-chemical processes, 56,200 horse-power for railway service, 36,400 horse-power for lighting, 45,540 horse-power for various industrial services; 12,300 horse-power is transmitted over more than one hundred miles, 33,500 horse-power between seventy-five miles and one hundred miles, 3,100 horse-power fifty miles, 79,640 horse-power between ten and thirty miles, while 145,400 horse-power is used locally, showing that many industries have been attracted to Niagara Falls because of the favorable electric power conditions to be found there.

SCIENCE.

Halley's comet appears to be growing brighter somewhat rapidly. It was seen without difficulty at Harvard on October 17th by Prof. Wendell with the 15-inch equatorial, and by Mr. L. Campbell with the 24-inch reflector.

Leon Guillet's and Ch. Griffiths's experiments on the cementation of iron by pure carbon show there is no cementation if precautions are taken to prevent the presence of gases, but it takes place if contact is insured. Moreover, it increases with the pressure, but always occurs extremely slowly.

The American Machinist states that the methods of race-track gamblers, who dope horses in order to make them win races, have been copied by unscrupulous owners of gasoline racing boats. The gasoline is doped with picric acid or some other high explosive, and with the increased power thus obtained the boats are able to win races they would lose if ordinary straight gasoline were used. On the race track there are stories of plugs which have been overdoped and died, and it is said there are also gasoline engines which have been unable to withstand an overdose of picric acid and have gone heavenward.

Samples of air at a height of nearly nine miles have been recently obtained and examined for the presence of the rare gases. The collecting apparatus, carried by a large balloon, is a series of vacuum tubes, each drawn out to a fine point at one end. At the desired height, an electro-magnetic device, connected with each tube and operated by a barometer, breaks off the point of the tube, admitting the air. A few minutes later, a second contact sends a current through a platinum wire around the broken end, melting the glass and sealing the tube. All the samples obtained show argon and neon, but no helium was found in air from above six miles.

A 40-inch mirror is almost completed by Clark for Prof. Percival Lowell, at Flagstaff, Arizona. The mirror is to be thicker than usual to avoid flexure, and is to have a focal length of 18 feet 4 inches. A series of zinc blocks between the iron supporting ring and the edge of the mirror avoid strains on the glass with changes of temperature. When arranged for planetary work, secondary mirrors are to be provided which will transform the instrument into a Cassegrainian reflector of either 154 feet or 75 feet focal length. For photographing nebulæ and stars a plane mirror will be used as secondary, giving the images at the principal focus.

Harvard College Observatory issues a bulletin stating that Prof. E. E. Barnard, of the Yerkes Observatory, obtained visual observations of Halley's comet on the 17th and 19th of October. On these two dates Prof. Barnard found that the comet was not fainter than the 13½ magnitude, having a diameter of 15 seconds, and, while it exhibited no elongation, it was "less indefinite and brightening in the middle." In summarizing the late European observations of Halley's comet, Nature points out that the date of the comet's perihelion passage must be advanced 3.4 days, thereby making it April 20, 1910. The comet is at present distant about two hundred and eighty million miles from the sun and two hundred and thirty million miles from the earth.

A French investigator, M. de Wegrier, recently described an apparatus designed to prevent the formation of hail. A similar apparatus was invented by Beckensteiner fifty years ago, and was described under the name "géomagnetifére" in his "Etude sur l'Elctricite." To the top of a pole about 65 feet high, made of the trunk of a resinous tree and painted with oil in order to make it a non-conductor, was attached a mass of gilded copper, with five points, connected to earth by a magnetized (?) galvanized-iron wire. The apparatus also included a large metallic net or grating, buried in the earth. Dr. Frestier has repeated and extended Beckensteiner's experiments and has obtained conclusive proof of the efficacy of the apparatus as a preventive of hail.

The method of forcing plants by treatment with ether, as first suggested by Johannsen, is now extensively used on a commercial scale for the purpose of securing out-of-season flowers and fruit. This process, however, will in all probability soon be replaced by the equally effective and less expensive method just described by Prof. Molisch in a pamphlet called "Das Warmbad." The only treatment required is that of immersing the shoots, by inversion, in water at 30 to 35 deg. C., for nine or twelve hours, and afterward keeping the plants in a dark moist chamber at a temperature of about 25 deg. until the leaves commence to appear, after which the plants are grown under ordinary greenhouse conditions. Lilacs, azaleas, spiræas, etc., treated as above during the middle of November were in bloom at Christmas or early in January, whereas untreated plants of the same kind had not commenced to move. Fuller methods of treatment, and the duration and temperature of the bath for different kinds of plants, are contained in the pamphlet.

A REMARKABLE MEXICAN CONCRETE CONDUIT AT GUADALAJARA.

BY FRANK C. PERKINS.

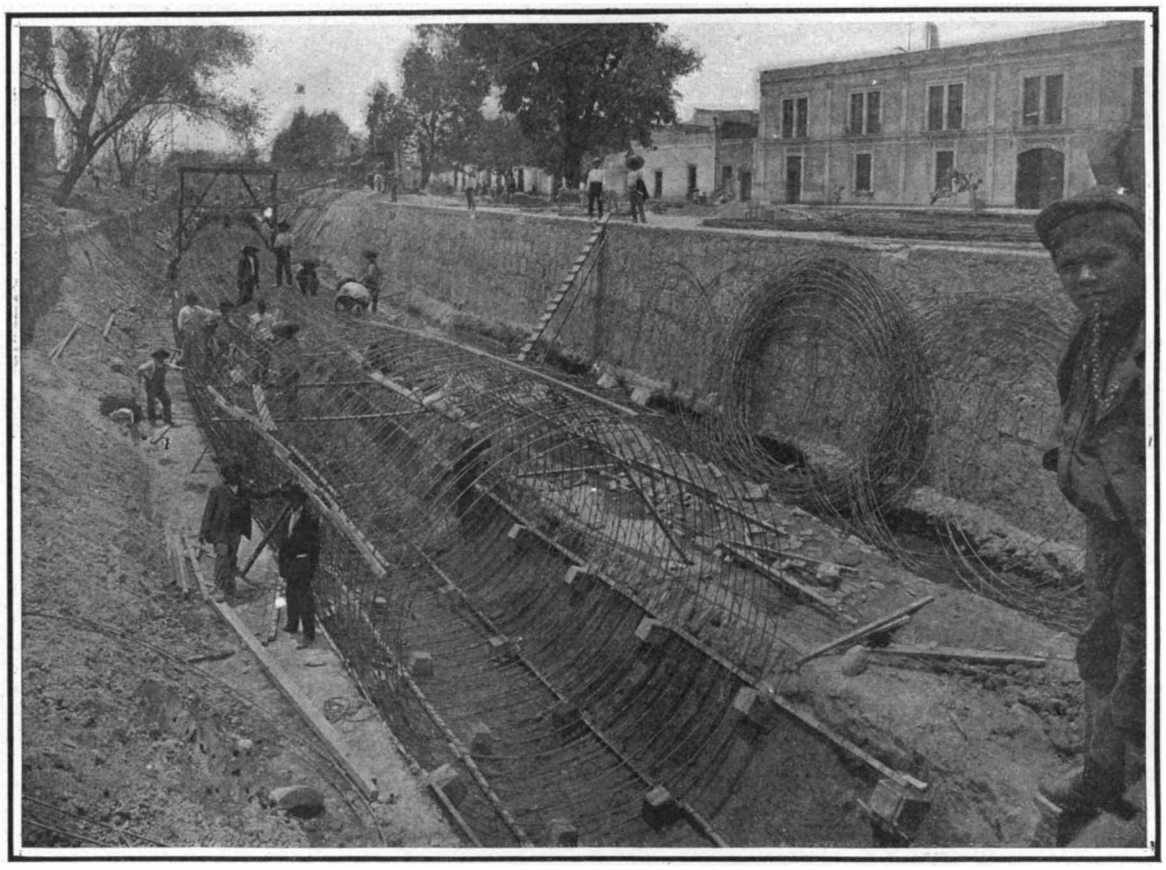
In the Rio San Juan Ravine, which passes through the heart of the city of Guadalajara in Mexico, a circular concrete conduit has been constructed to serve as a storm water drain. This reinforced concrete conduit is of novel construction, and on account of its design and size is of special interest. It is somewhat over 13 feet in diameter and is circular in form for most of its length, the upstream section, however, being flattened in order to avoid a large amount of excavation in rock.

This Mexican concrete conduit is nearly a mile in length. It passes to one side of the center of the city for about a mile, and drains nearly 17,000 acres. It has a grade of 4 feet per thousand feet, and has a thickness of 10 inches of concrete, reinforced by double rings or round corrugated bars. These bars are placed one foot apart longitudinally, in two circles, the inner and outer bars alternately. The bars each measure one-half inch in diameter.

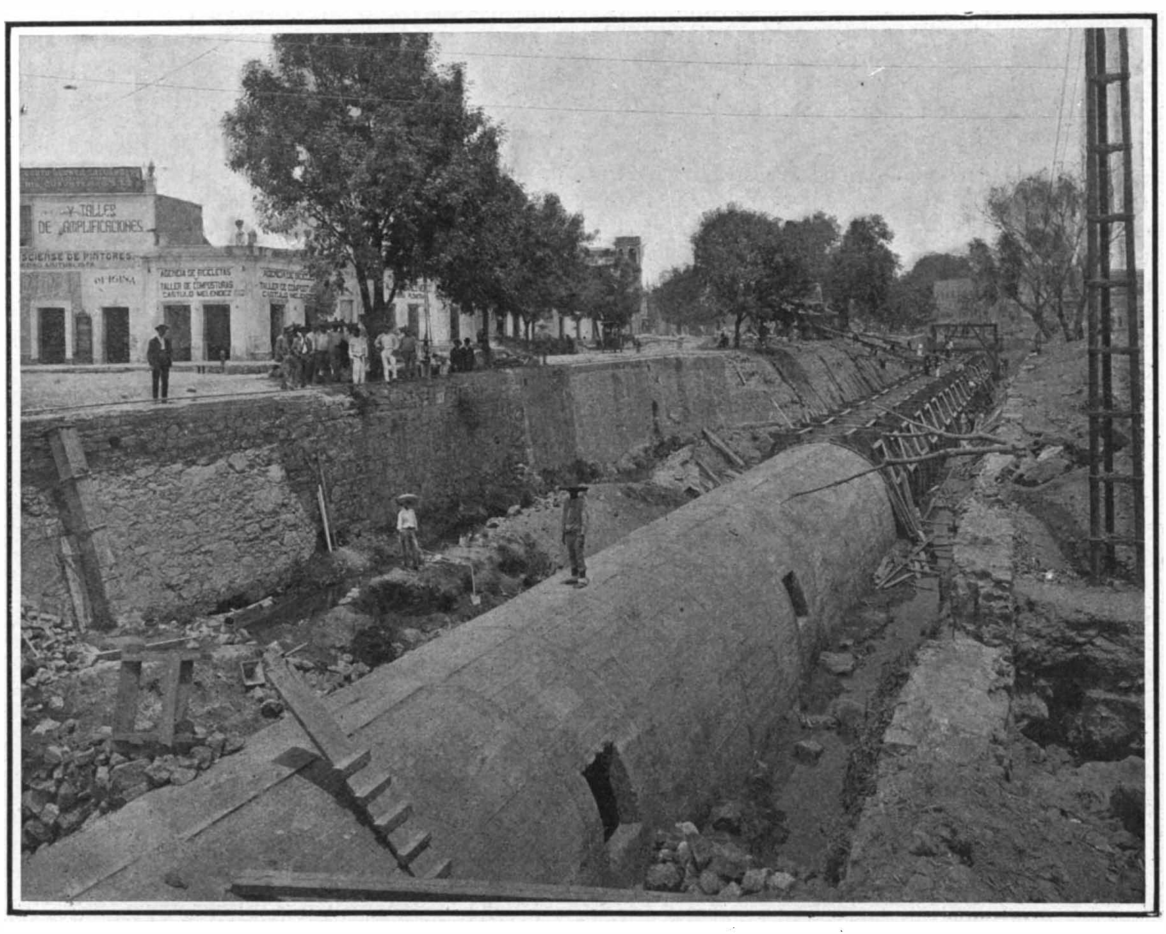
It is stated that the total concrete in the conduit measures 13,000 cubic yards, the steel used for reinforcing weighing 300,000 pounds. In the construction of this conduit, 40 per cent of river sand was utilized and 60 per cent of sand made from crushed rock. Three parts of this sand are used with three of crushed rock and one of cement, the latter being of the Hidalgo brand, made at Monterey, Nuevo Leon, which is said to be about the only factory producing Portland cement in Mexico.

One of the accompanying illustrations shows a portion of the completed conduit and the moving of the high exterior forms by means of traveling gallows frames. This system of molds and the apparatus for shifting them is simple and very efficient.

Other illustrations show the erecting of forms inside of the reinforcement, which is supported on concrete blocks, as well as the method of placing the reinforcing bars in position. There was a test made of the strength of the conduit about 25 feet in length when a week old by passing a roller weighing 32,000 pounds over it, and also by allowing the roller to stand upon it for 120 minutes. After this severe test it was found that no crack developed, the earth filling over the top of the conduit in the test being about three feet in depth.



How the reinforcing members are placed in position.



Part of the completed conduit.

A REMARKABLE MEXICAN CONCRETE CONDUIT AT GUADALAJARA.

Cultivation of Edible Fungi in Forests.

In many districts of Perigord, in southern France, the black truffle (*Tuber melanosperum*), the most highly-prized species, is artificially propagated. For this purpose the tubers are dried, cut into small pieces, mixed with water, and ground to a thin paste, small quantities of which are spread upon green hazel or oak leaves, which are buried in the earth under oak trees. The first truffles appear five or six years afterward. In Germany the black truffle is found only in the west. The truffles which grow in central Germany are of inferior species, hence Prof. Mayr recommends the artificial propagation of black truffles, according to the Perigord system, in the warmer parts of Germany, especially where oaks abound, as the production of truffles is dependent upon the presence of deciduous and particularly of oak forests. The mushroom also grows well in the forest, but its artificial culture is usually carried on elsewhere. Experiments made by Mayr for the purpose of colonizing the mushroom in localities in the forest where it does not grow naturally have met with no success, although they have been continued for five years. The attempt at colonizing was made by taking up the mushrooms immediately before the ripening of the spores, and transplanting them to the desired spot, on which the spores necessarily fell. On the other hand, Schroeder, in a recent article, has described his success in transplanting the craterelle (*Craterellus nucleatus*), which in flavor is surpassed only by the Perigord truffle. Selected spots in the forest planted with spores of this fungus bore abundantly.

In Japan, Mayr has had opportunity to observe the artificial propagation of the most delicious of all Japanese fungi, the *Agaricus shitake*. The cultivation of this fungus is the only form of forestry practised in extensive districts in Japan. Young trees of various deciduous species, or boughs as big as a man's arm or leg, are cut immediately after the fall of the leaf, allowed to lie about one hundred days in the forest, and then sawn into logs three or four feet long, in which deep incisions are made. The spores of the fungus, which are present everywhere in these districts, penetrate the incisions, and develop a mycelium which converts the wood into a white brittle mass. The mushrooms begin to appear upon the surface of the logs in the following autumn, but appear more abundantly from the second to the fifth year, growing both from the incisions and from the unwounded bark. Mayr has recommended the cultivation of the Japanese mushroom in Germany, and has made experiments by inserting bits of mushroom-bearing wood, brought from Japan, into holes bored in boughs cut from deciduous trees. The experiments proved that the beech, the hornbeam, and the birch are best suited for the culture of the fungus, but that the young cultures are greatly injured by snails, and also by the competition of native fungi.—Prometheus.

Ammonia from Atmospheric Nitrogen.

A new process for producing ammonia from atmospheric nitrogen has been developed from experiments in the synthesis of hydrocyanic acid, which were made by Waltereck and Eschweiler, of Hanover.

In these experiments, in which a dry mixture of hydrogen and nitrogen was passed over iron at a dull red heat (about 900 deg. F.), a small quantity of ammonia was always formed. This result was subsequently confirmed by Sir William Ramsay. Ammonia was formed only at the beginning of the reaction, but it was found that larger quantities of ammonia could be obtained by passing a mixture of air and coal gas over oxide of iron, and this result led to a series of experiments with various oxides of nickel, cobalt, copper, cadmium, silver, lead, bismuth, chromium, and iron. The most interesting results were obtained with oxides of bismuth, chromium, and iron. The oxide was inclosed at first in an ordinary combustion tube, afterward in an iron tube. The mixture of equal volumes of air and coal gas was moistened by passing through distilled water heated to 176 deg. F., as a certain quantity of moisture was found advantageous. The yield of ammonia varied greatly with the temperature, the best results being obtained between 570 and 660 deg. F.

It was observed, however, that the production of ammonia diminished as the oxidation of the iron increased, so that it was necessary to reduce the iron from time to time by passing hydrogen or carbon monoxide through the tube at a high temperature.

Experiments were then made for the purpose of finding some other sufficiently cheap substance, the oxidation of which would produce the same result, without requiring repeated reduction. Coke, wood charcoal, peat, and lignite were found to satisfy these requirements fairly well. With coke the process is very slow; much more satisfactory results are obtained with peat. One specimen of peat, containing 26 per cent of water and little more than 1 per cent of nitrogen, furnished 8 per cent by weight of sulphate of ammonia. In a large number of experiments made with a horizontal iron retort, such as used in the analysis of coal, 10 per cent of sulphate of ammonia was obtained. As this was more than the nitrogen of the peat could furnish it was inferred that part of it must have been derived from the nitrogen of the air. This conclusion was confirmed by experiments with carbonized sugar, which contained no nitrogen. In the experiments with peat and other forms of carbon the air was mixed, not with coal gas but with steam.

TERRIFIC BOILER EXPLOSION IN MILWAUKEE.

The scene of absolute destruction depicted in the two accompanying engravings might well be supposed to represent the effects of the detonation of a large amount of high explosive, so complete is the demolition of the building, and so thoroughly have its contents been disrupted and scattered. As a matter of fact the damage was entirely due to the explosion of a single boiler.

At first sight it would seem impossible that the amount of steam contained in a boiler at the instant of explosion should be sufficient to work the seemingly disproportionate amount of damage that generally ensues—disproportionate, that is to say, in the wide extent and violent effects produced as compared with the cause. Everyone who is familiar with boiler firing knows how quickly the reserve of steam in the boiler is used up in the cylinders of the engine, if the firing be not faithfully attended to.

The explanation of the great damage resulting from an explosion is to be found in the fact that the boiling point of water varies with the temperature and the pressure to which it is subjected. If the pressure be suddenly reduced, a rapid ebullition of the water ensues with the emission of great volumes of steam. Consequently, when the whole of the pressure upon the highly heated water in a boiler is suddenly removed by the rupture of the boiler shell, the whole mass flashes at once into steam with a practically explosive effect, which shows itself in the lifting of roofs, the blowing out of walls, and the hurling, as is frequently the case, of the shell of the boiler to distances of several hundred yards.

The boiler which exploded was one of four which were erected in one of the boiler houses at the Pabst Works, Milwaukee, Wis. The most sensational result—the one which gives a vivid idea of the energy of the expanding steam—was the fact that a big malt elevator, 60 feet high, adjacent to the boiler plant was moved four feet from its foundation. This effect will be noticed by examining one of the accompanying engravings, in which it can be seen that the remaining portions of the wall, although they are strictly parallel with each other, are out of line by about the four feet which it is estimated that the building was moved.

The wall of a machine shop, lying to the north, was blown in. Every window in this machine shop and most of the glass in the buildings surrounding the plant were broken, as was most of the glass in stores and houses within a radius of two blocks of the explosion. Tenth Street, adjoining the building, was buried under tons of debris, which in some places was piled to a height of from six to eight feet. Flues, boiler pipes, and various fragments of the boiler were scattered over the street and some of them were curled up into fantastic forms.

It frequently happens in a boiler explosion, particularly if one end be torn off and the main body of the boiler be left intact, that the water, flashing suddenly into steam and rushing out through the unclosed end, reacts against the air with a violent rocket-like effect, and the mass of the boiler is driven to great distances. In the present case, a large section of the boiler went hurtling through the air across Tenth Street and fell upon the roof of a storehouse sixty feet in height, where it remained imbedded. Strange to say, a lofty brick chimney over two hundred feet high, which formed a part of the plant and stood over the rear portion of the boiler room, received not the slightest damage.

SOME PRINCIPLES OF BALL-BEARING DESIGN.

BY J. F. SPRINGER.

The old but constantly recurring question as to whether the top of a wagon wheel actually moves faster than the bottom is really involved in the ball-bearing problem. There is one fundamental fact implied in all questions of rolling which when once thoroughly mastered will have great effect in clearing up dark places. In rolling there is a progressive contact of one body with another of such character that there is no sliding. That is to say, at the point of contact there is absolutely no movement of the one body past the other. In Fig. 1, the wheel is rolling upon the ground *G* in the direction *C*. At the present moment, the point of contact is *A*. If the motion is a rolling one, then at the point *A* there is no slip or slide. This means that the point of the wheel touching the ground at *A* has absolutely no motion. But this point on the tire of the wheel enjoys this absolute rest for the instant only. The next infinitesimal portion of time there is a different particle absolutely at rest. And so on, as the wheel rolls along, every point of the circumference in succession becomes for one instant only an absolutely quiescent point. What is moving is the position of the point of rest.

This is true whether the rolling body rolls along a straight line or not. If the line rolled upon, however, has any motion of its own, then the contacting

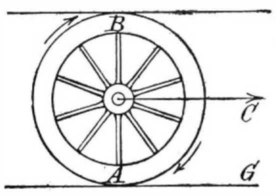


Fig. 1.

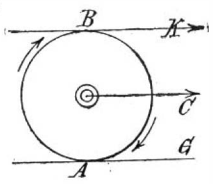


Fig. 2.

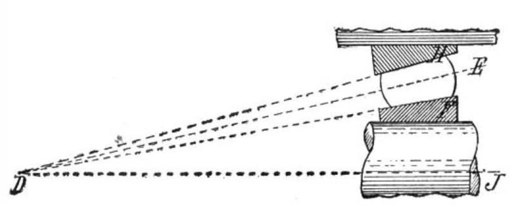


Fig. 3.

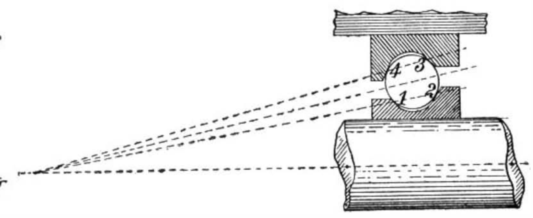
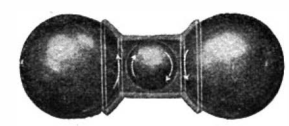
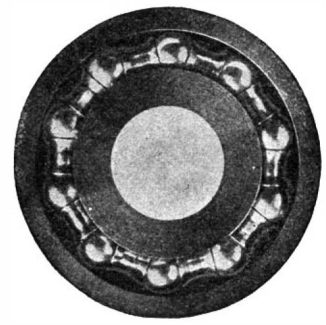


Fig. 4.





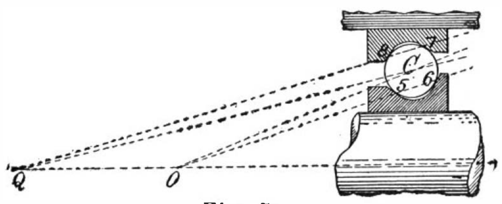


Fig. 5.

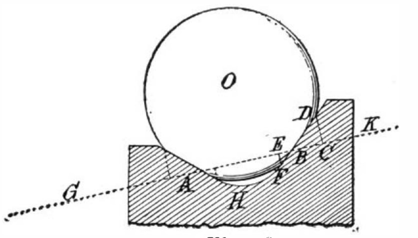


Fig. 6

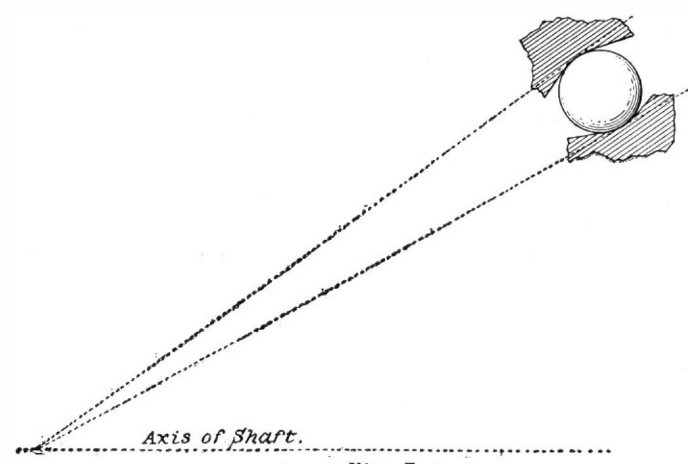


Fig. 7.

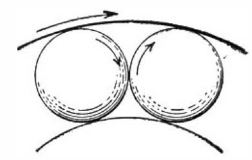


Fig. 8.

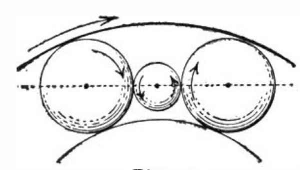


Fig. 9.

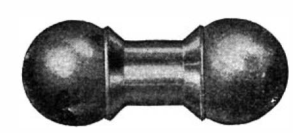
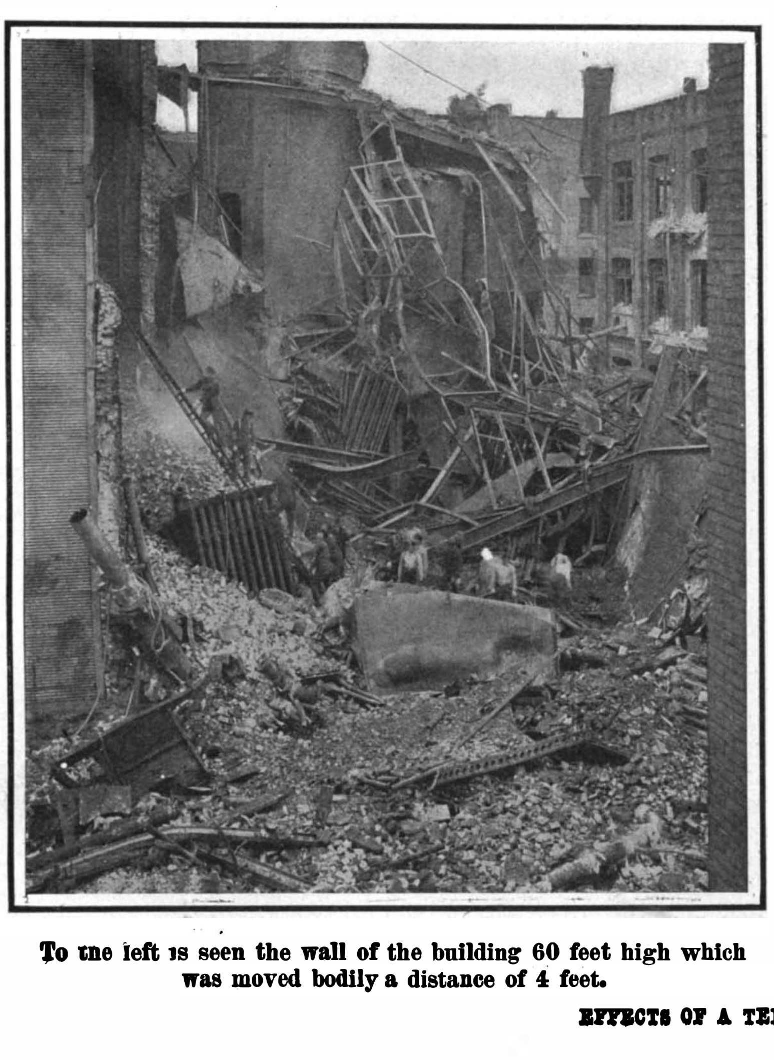
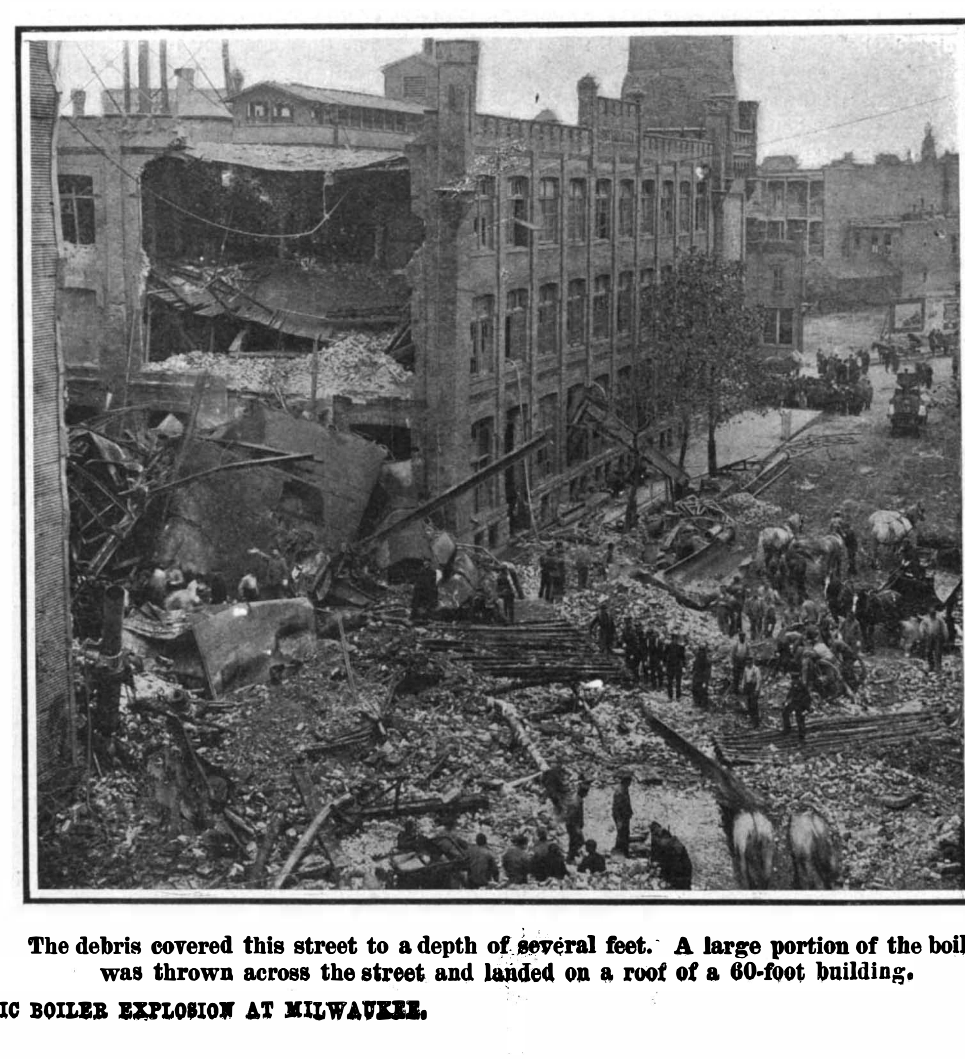


Fig. 10.

SOME PRINCIPLES OF BALL-BEARING DESIGN


To the left is seen the wall of the building 60 feet high which was moved bodily a distance of 4 feet.


The debris covered this street to a depth of several feet. A large portion of the boiler was thrown across the street and landed on a roof of a 60-foot building.

EFFECTS OF A TERRIFIC BOILER EXPLOSION AT MILWAUKEE.

point of the rolling body is at rest only with reference to this moving line. As one stands aside and views both, the contacting has precisely the same motion as the moving line. But if on the moving line, then he sees the lowest point of the wheel absolutely at rest for its instant of contact.

But suppose that one takes his position at the center of the wheel. The highest point of the wheel will appear to be moving forward in the direction C, while the lowest point will seem to be moving in the opposite direction. In fact, *with reference to the center* the particles of the wheel will have a movement of rotation.

There are thus two rotations going on all the time. The entire rolling body rotates *for the instant of contact* about the point of contact. This center of rotation is constantly changing, however. The central particle of the rolling body, on the other hand, always remains a center of rotation.

Further, if there is a second contacting surface, as in Fig. 2—this second surface effecting the driving of the circle—then *relatively to this moving surface* there is for the moment of contact a center of rotation. This instantaneous center of rotation—the upper point of contact—moves backward relatively to the driving surface.

Much the same may be said in reference to straight and tapered rollers in a roller-bearing. There is a central line consisting always of the same particles, and relatively to which all the remaining particles rotate as about an axis. It is the *axis of rotation*. Then, diametrically opposite each other, are two lines of contact. Each of these is an instantaneous axis of rotation, quiescent for the moment of contact but immediately succeeded by another. Thus in Fig. 3, the line DE is the axis of rotation. In the body of the roller, the particles of material along this axis are such that, if they be regarded as quiescent, every other particle will be seen to rotate about their line of distribution. The lines of contact of the roller with the race ways are the two instantaneous axes of rotation.

The motion of each of the particles of the wheel, Fig. 1, is the compound of two distinct movements—(1) motion in a direct line, given by the arrow C, and (2) motion of the point as it rotates about the center of the wheel. Both uniform, we see that at B both motions are in the same direction, while at A the directions are the opposite. Further, as learned, there is no motion of a particle at the moment of rolling contact. So, then, at A the velocities of the contrary motions must be the same in order to produce this quiescence. We have now arrived at a most important principle—the forward velocity of a rolling body is just equal to its peripheral velocity. And, further, since at B both are in the same direction, we have the principle that the velocity of the point of the periphery furthest removed from the point of contact is just double the forward velocity. So that (Fig. 2) the velocity of the driving surface K is double the forward velocity of the driven circle. These are most important propositions, and are true whether the plane of rolling is perpendicular or inclined to the surface upon which the rolling is done.

Without going into the mathematical proof, it may be stated that, in consequence of principles already enunciated the axis of rotation and the two instantaneous axes of rotation are three lines meeting in a point. Further, if the rolling bodies are balls or rollers revolving about a shaft, then the axis of this shaft must pass through this point of intersection. Thus, in Fig. 3, these four lines all meeting in one point are DH, DE, DF, DJ.

In ball and roller-bearing design, this requirement becomes of first-rate importance. Thus the four-point ball-bearing shown in longitudinal section in Fig. 4 is correct in design in so far as the convergence of these four lines are concerned. But some may have difficulty in seeing that a rolling ball has an instantaneous axis of rotation as well as a roller. Reflect, then, that both the points 1 and 2 of the ball in Fig. 4 are absolutely at rest for the infinitesimal moment of contact. They determine, therefore, a line of quiescence equally with a roller. Similarly, the points 3 and 4 are at rest relatively to the driving ball-race—and determine a second instantaneous axis of rotation.

In Fig. 5, the instantaneous axis of rotation determined by 5, 6, intersects the axis of the shaft at O. This gives OC for the axis of rotation. Similarly 7, 8 yield the line QC as the axis of rotation. We have, therefore, two conflicting axes of rotation. The design of the bearing is consequently incorrect.

The friction arising from compression is an important matter. In Fig. 6 GK is one of the instantaneous axes of rotation. The ball is flattened by compression at the points of contact, the one region of contact being represented by FD. At the instant of contact the ball is rotating on GK as an axis. This means that every point along FD is rotating in a plane perpendicular to GK. The result is that all along FD there is a sliding taking place relatively to the race way. The point D is moving in a circle whose center is C and radius DC. There is, then, sliding friction, effective over the whole area of compression. The pressure corresponding to the slide is in the direction GK. The seriousness of the friction, then, is dependent upon the pressure in this direction. The size of the compression is due to the pressure perpendicular to FD. By suitably designing the race ways, the pressure in the direction GK may be made small, although it may be unavoidable to keep large that in the direction perpendicular to FD. The way to do this is to diminish the angle DBC. A design such as that shown in this figure (6) is to be condemned on account of the large size of this angle between the race way and the instantaneous axis of rotation. In Fig. 7 a correct design is shown. If we observe in Fig. 6 that AHB is an isosceles triangle, we readily see that angle DBC is one-half the supplement of the angle of the groove AHB. Consequently, if we desire to make DBC small, we see to it that AHB is large. Thus, by making $AHB = 170$ deg., the angles between the instantaneous axis of rotation and the faces of this race way are reduced to 5 deg. each. For such angles the pressure in the direction of GK is well-nigh negligible. This means that the sliding friction due to compression is practically eliminated.

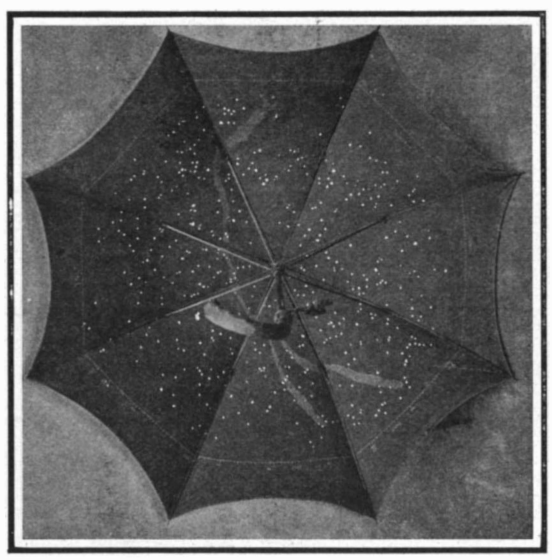
A further question that arises in designing ball and roller bearings relates to the use of separators. In Fig. 8, it will be readily seen that at the point of contact between two balls (or rollers) there is a slide, the surfaces in fact moving in opposite directions. The question arises: Should balls be prevented from mutual contact so as to eliminate this source of sliding friction? To answer this it is necessary to know whether the slide occurs under pressure. For, despite the slide, the friction would be negligible if there is little or no pressure from ball to ball. The writer has made a very complete mathematical inquiry and found that balls and rollers probably do press upon each other with a considerable percentage of the load, so that separators are to be regarded as advisable. If used, however, they should be rolling separators. The introduction of a non-rolling separator will not result in eliminating sliding friction. But by properly using a rolling body—a ball or roller—this friction may be avoided. Fig. 9 shows that the small separator ball is competent to partake of the contrary motions of the bearing balls.

The position of the separator should be noticed, as no other position seems allowable. The center of the separating ball should be in the straight line joining the centers of the bearing balls which it separates. For if it be located above or below, the pressure of the bearing balls will force it out or in. In either case, a new source of friction will arise from the rotation under pressure of this ball against parts of the bearing.

To hold the separator in place, some suitable means is required. The separating ball will of course rotate against the holder. But what is important is the fact that this rotation occurs without pressure. This is secured by the position of its center on the line of centers of the bearing balls.

There are a number of methods of retaining separator balls in position. Thus, in the double ball bearing, Fig. 10, there is a small tube in which the separator lies. This tube is funnel-shaped at each end. These funnels serve to compel the centering of the tube with the bearing balls. That is, when the bearing balls press against the two funnels, the axis of the tube is made to coincide with their line of centers, and this brings the center of the loosely held separator ball into its proper position.

In Fig. 10 is shown a radial bearing of the Chapman type. The tube with a funnel at each end may be clearly seen. Within the tube lies the separator ball, whose office it is to harmonize the contrary motions of the adjacent bearing balls. Of course, the adjustments of size in respect to the tube-funnel arrangement and the separator ball are such that when the bearing balls tend to crowd each other and so press upon the separator balls, the contact with the funnels is either slight or nothing at all. It is necessary, however, that the funnel and the bearing ball actually touch or approach each other fairly closely, as otherwise the centering of the tube with the line of centers of the bearing balls could not be counted upon to take place.



A CURIOUS STAR MAP.

Ostrich Farming in Australia.

The first attempt to raise ostriches in Australia was made by a Mr. Malcom, who in 1880 brought 100 young birds from South Africa to South Australia. In the following year the parliament of South Australia enacted a law which granted to the first person who should exhibit 250 ostriches, more than one year old, about 2,400 acres of land suitable for ostrich farming. The conditions were satisfied by the South Australian Ostrich Company, which was founded in 1886, with a capital of \$75,000. The company received land near Port Augusta on Spencer Bay, but in spite of this assistance the company has never paid a dividend, although it now possesses 1,100 ostriches, all of which were imported from South Africa. There is a still larger ostrich farm on the shore of Lake Albert, and smaller farms are scattered through the colony.

In New South Wales, ostrich farming was first attempted in 1897, by Barracluff, who imported six pairs of ostriches from northern Africa, and now possesses 84 birds.

Queensland and Victoria possess only small ostrich farms, which have not produced very encouraging results. In all, there are now about 2,000 ostriches in Australia. The inferior feathers are used at home, and the more valuable ones are exported chiefly to Germany.

A CURIOUS STAR MAP.

It would be more respectful to call this invention an "astronomical umbrella," but so many terms of humorous turn have been applied to the umbrella since the days of Jonas Hanway that it would be difficult for anybody except a boy scout to take this invention quite seriously.

The inventor, Mr. McEwan, is a Scotchman, and he has designed this apparatus for the study of the stars. The constellations and the Milky Way are all in their places, "ship-shape and Bristol fashion."

Just why an umbrella should have been used for this astronomical purpose surpasses our comprehension. In broad daylight such a chart would be obviously useless, and at night time nearly useless because of the difficulty of seeing the map at all.

Utility of Beekeeping.

Beekeeping is a valuable aid in the cultivation of fruit and seed crops. Insects which feed on nectar play an important part in the fertilization of flowers. Fertilization is effected in other ways, but the agency of insects is the more certain and efficacious, and no other insect is comparable with the honey bee in this respect. A strong hive contains 10,000 bees in February, 15,000 in March, 40,000 in April, and from 60,000 to 80,000 in May. It has been discovered by skillful observers that the average load of nectar carried to the hive by a bee is about 3/10 of a grain, so that the collection of one pound of nectar requires nearly 23,000 foraging excursions. By means of hives set on balances it has been found that the daily increase of weight in May averages 3.3 pounds. Occasionally, more than 11 pounds is gained in one day; and when the amount consumed by the bees and the loss of weight by evaporation are considered, it appears probable that the average daily quantity of nectar collected is not less than 11 pounds, which would load 250,000 bees. As a bee visits 10 flowers on the average in collecting a single load, some 2,500,000 flowers are visited in one day by the bees of a single hive. An additional large number of visits is required for the collection of pollen. These figures explain why many trees and plants bear small crops in the absence of bees.

The bee is charged with various imaginary crimes. Its sting is formidable, but chiefly to the imprudent. It is accused of ravaging fruit, but its tongue is formed exclusively for the extraction of sweet juices, and its mandibles are unable to pierce the skin of a fruit. Grapes have been taken intact from the interior of a hive in which they had been allowed to remain four days. A grape which had been smeared with honey was licked clean, but was not injured. The bees inserted their tongues in pinholes made in the skin of a grape, and extracted some of the juice, but they were unable to enlarge the holes. In some districts bees are menaced by insecticides intended for other insects. At Terricio, Italy, in 1907 all the bees were killed by spraying the olive trees with sodium arseniate mixed with molasses, for the purpose of destroying the olive fly.—Cosmos.

Correspondence.

THE SELDEN DECISION.

To the Editor of the Scientific American:

Your editorial in the Scientific American of September 25th on "The Selden Patent Case" interested me, as it seemed to me that the claim could be met without much trouble. Upon a cursory examination of my class of fire extinguishers, portable, wheeled, I find a patent to Bean, No. 75,348, March 10th, 1868, which shows every essential element of the claim in question, the single distinction in terms coming from the use of a steam engine instead of a gas engine. It would surely seem that this patent could not have been before the court as the decision would have been otherwise. A. S. Dennison.

U. S. Patent Office, Washington, D. C.

THE NUMBER OF OUR ANCESTORS.

To the Editor of the Scientific American:

In the discussion of the "Number of Our Ancestors" in these columns your correspondents have been misled by the use of the word "ancestor" where kinship is defined. Under the great theory of the origin of life in a single cell or protoplasm, all living creatures are kin, and the number to which each individual is related is the total number which have been born into the world at the moment of the computation. The number for the preceding moment was something less, and if we go back the length of time embraced in a generation of mankind, the number in the kinship of the human family is many thousands less. The further back we go toward the genesis of things the smaller the human family, and the number of one's ancestors certainly could not have been in an inverse ratio, as some of your correspondents have stated.

The term "ancestor," however, cannot and does not mean the same as "kinship"; nor, in its true sense, does it apply to more than the father and mother in each family. The line of descent is a single thread running back through all ages to the very beginning of life, and in the social system of the present day the line is accorded to the male, but it could be as true of the female; it cannot be accorded to both, however, else the tangle which would ensue would strain and break the thread. These threads of anthropological progression are best conceived as the branches of a tree, living beings of the present being somewhat as the innumerable leaves, and the main trunk somewhere in the dim beginning; but in its formation each thread is like a flowing river where, tracing backward, we find branch uniting with branch, and each branch made up of uniting branch and branch, smaller and smaller, until even the rain drop is reached.

So, with the infinite insight of the Creator we might start with any human being that ever lived, in any age, in any place, of any race or color, and by that single thread trace it back, back, back to the beginning previous to the first branching. And as we so trace each life thread we may count at each branch an ancestor for the direct descent and add one, the branch of the opposite sex there uniting—two in each generation—and no more; all else are but kin. Therefore the number of our ancestors resolves itself into the simple problem of the number of branches (generations) through which the individual has come multiplied by two. Charles Francis Adams.

Hampton, N. H.

Protection of Sown Crops from Crows.

Graminivorous birds exhibit, as experiments have proved, a marked aversion to foods of peculiar form and color, and also to certain aromatic and bitter substances. It has been found possible to give to seeds, without affecting their germinating qualities, flavors, odors, and colors which protect them from the attacks of crows, by the employment of cheap substances and simple methods of treatment. Suitable colors were found in Prussian blue, signal red, and anilin green. The pigments were strewn over the seed, which had been moistened with gum water. The seeds were then thoroughly mixed by shoveling and acquired a deep color. For the purpose of giving seeds a peculiar taste, pulverized alum and sodium sulphate, tobacco extrac and "fichtenin," an insecticide used for foliage, were tried, but none of these substances materially altered the flavor of the seeds. Good and lasting results were obtained only with pulverized aloes, which also changes the color of the seeds over which it is strewn. A repulsive and persistent odor was given to the seed, without affecting its ability to germinate, by a weak solution of creolin.

In one series of experiments crows were fed with equal quantities of pure seed and of seed contaminated with the pigments, etc., and the amount of seed left uneaten in each case was weighed. In another series, rows of treated and untreated seeds were sown in large cages in which the crows were confined. Experiments on the germination of the seeds were also made.

Although the results of the experiments cannot be directly applied to practice, the investigation proved that crows are influenced by color, taste and smell in their choice of food. Blue proved to be particularly repugnant, but green seeds were eaten very reluctantly, while red exerted a much slighter protective influence. The treatment with aloes was especially effective. Although it produced very little change in the appearance of the seed, the rows sown with seeds so treated were destroyed only in spots. The seeds treated with creolin were also avoided, but "fichtenin" proved wholly ineffective.

In continuing the experiments it will be especially advisable to try the effect of mordant dyeing on a large scale. Blue dyes appear the most promising, but the best results will probably be obtained with appropriate combinations of colors, flavors, and odorous substances.

Relation of Size to Speed in Ships.

BY SIDNEY G. KOON, M. M. E.

Mere size as an asset has considerable value, especially when it comes to a question of naval vessels. That this is so was strikingly illustrated a few years ago in a large shipyard, when it came to a question of the design of a fast cruiser to fulfill certain specified requirements. As a matter of fact, the cruiser was never built, but the calculations were made, based on a set of lines which gave good model results, and the comparisons herein instituted are the fruit of considerable careful thought along the lines of the conflicting elements entering into the design of the modern warship.

The original design embodies requirements that the vessel should carry a battery of two 8-inch and ten 5-inch guns, with four 3-inch automatic guns and two torpedo tubes, at a maximum speed of 23 knots. The coal carried on "normal" displacement was to be sufficient to carry the ship at 23 knots for a distance of 1,500 nautical miles. The hull was to be sufficiently strong to withstand at this speed the buffeting of a heavy sea.

The model test indicated an attainable admiralty coefficient of 240, based on shaft horse-power. The steaming radius was calculated on an assumed consumption of 1.6 pounds of coal per shaft horse-power per hour. The (turbine) machinery was designed and found to promise one shaft horse-power on 140 pounds, everything included. As worked out on this basis, the vessel was to have a length of 420 feet (waterline), a beam of 49 feet and a draft of 19 feet, the displacement, with block coefficient of 0.408, being 4,560 tons.

The horse-power required was computed by the usual admiralty formula

$$H = \frac{D^{2/3}\ V^3}{K}$$

where H is the horse-power; D is the displacement, 4,560 tons ($D^{2/3} = 275$); V is the speed, 23 knots ($V^3 = 12{,}167$), and K is the admiralty coefficient, 240. H thus becomes 14,000, and the weight of machinery 1,960,000 pounds, or 875 tons. The fuel required at full speed is 22,400 pounds (10 tons) per hour, or 649 tons for a run of 1,500 nautical miles at 23 knots.

Of the other weight, 40 per cent of the displacement was allotted to hull and fittings complete (1,824 tons); 10 per cent to full equipment and stores, including the officers and crew and effects (456 tons); another 10 per cent to a protective deck, the maximum thickness of which was 2¾ inches, while the remaining 300 tons took care of the battery, ammunition, and ordnance spares. The battery was practically without protection.

While this design was under completion the question of a higher speed was mooted, all other requirements as outlined above being fulfilled. A design was thus prepared, the main dimensions of which were: Length, 454 feet; beam, 53 feet; draft, 20 feet 16 inches; and displacement, 5,750 tons. The horse-power for 23 knots was found to be 16,300, which calls for 760 tons of coal to cover the stipulated radius of 1,500 miles.

The weights of hull and of equipment and stores bear, naturally, the same ratio to the displacement as with the parent ship. They are thus 2,300 tons and 575 tons, respectively. The protective deck, having the same thickness and general distribution as in the first case, weight 532 tons. The battery weights are constant at 300 tons. The sum of these five items gives a weight of 4,467 tons, which leaves 1,283 tons for machinery. On the basis of 140 pounds per horse-power, this allows for 20,500 horse-power.

Using the admiralty formula once more,

$$V^3 = \frac{HK}{D^{2/3}},$$

where H is 20,500, K is again 240, and $D^{2/3}$ is now 321. V^3 becomes 15,327, V is 24.84, or a speed of 24.84 knots may be expected to be realized. It is thus seen that an increase in displacement of some 25 per cent here permits an increase of nearly 2 knots in speed.

With the idea of determining to what extent further alterations in dimensions (while still preserving the original lines, proportions and general set of requirements) would affect the result, four other cases were briefly studied, two of vessels smaller than the first, and one much larger than the second. The general characteristics of these four (C, D, E, and F), as well as of A and B, are shown in the accompanying table, the calculations having been made in each case as outlined above. It will be seen that an increase in size to 8,900 tons (not quite double the original) brings the speed up to 27.9 knots, with 38,800 horse-power.

Weights.	A	B	C	D	E	F
Hull and fittings....	1,824	2,300	1,152	1,496	2,728	3,560
Equipment and stores	456	575	288	374	682	890
Protective deck	456	532	335	400	597	711
Battery and ammunition	300	300	300	300	300	300
Machinery and water	875	1,283	227	602	1,663	2,426
Fuel	649	760	478	568	850	1,013
Total displacement..	4,560	5,750	2,880	3,740	6,820	8,900
Total horse-power...	14,000	20,500	3,630	9,650	26,600	38,800
Horse-power for 23 knots	14,000	16,300	10,250	12,200	18,250	21,750
$D^{2/3}$	275	321	202	241	360	429
V^3	12,167	15,327	4,318	9,610	17,733	21,706
V, or speed in knots.	23.00	24.84	16.28	21.26	26.08	27.9
Length of water-line, feet	420	454	360	390	480	504
Beam, feet	49	53	42	46½	56	61¼
Draft of water, feet.	19	20½	16⅛	17⅜	21¾	23¾

It will be noted that, after satisfying all other requirements, the design marked *C* has left only 227 tons to devote to machinery, thus allowing for but 3,630 horse-power. This would make possible a speed of only 16.28 knots. Hence, the provision of covering 1,500 nautical miles at a speed of 23 knots is a manifest impossibility. To reach this speed, 10,250 horse-power is required, calling for 641 tons of machinery. If this speed is required of this ship, and all other demands be met except steaming radius, we find that we have left only 64 tons for coal, which would correspond with a radius of but 201 nautical miles. Similarly, with *D*, 23 knots calls for 12,200 horse-power and 763 tons of machinery. This reduces the coal supply to 407 tons, and the steaming radius at 23 knots to 1,075 miles.

This study of course neglects all variations in results which might accrue from variations in the conditions imposed. Thus, by reducing factors of safety, lower hull weights could be obtained, and this is frequently done, especially on the smaller ships. In the same way more power might be obtained from a given weight allotted to machinery. In this manner the smaller vessel might be made to accomplish the results here attained only by the larger. But such methods are obviously inadmissible where strictly comparative results are desired, and especially so where the effect of a mere change of size is to be determined.

The Current Supplement.

In a paper entitled "The Origin of Life," read by Prof. E. H. Starling before the British Association for the Advancement of Science, and published in the current Supplement, No. 1766, the broad ground is taken that a living organism may be regarded as a highly unstable chemical system which tends to increase itself continuously under the average conditions to which it is subject, but undergoes disintegration as a result of any variations from this average. The practical applications of the microscope are pointed out by J. E. Barnard. Some new safety devices for steam boilers are described. Of aeronautic interest is an article on experiments with models of airships and aeroplanes in the laboratory, and a continuation of last week's discussion of the Paris aviation meeting. The Loetschberg tunnel through the Bernese Alps is described by Dr. Alfred Gradenwitz. E. E. Carey contributes an excellent article on the electro-chemical age, in which he points out that the science of metallurgy is now entering a new era. The opening of the mounds of the great capital of Egypt is the largest enterprise yet started in that country. It will probably take twenty years to complete. The preliminary work of 1907-8 at Athribis is described in an article by Prof. W. Flinders-Petrie entitled "Memphis and Its Foreigners." Recent progress in chemistry is reviewed by Prof. H. E. Armstrong.

A committee of investigation has been appointed by the American Railway Association to report upon the railways which have adopted electrification. This committee is composed of officers of roads which have electrified portions of their lines or contemplate doing so. The railways represented on the committee are the Illinois Central, Union Pacific, Southern Pacific, Erie, Delaware and Hudson, and New York, New Haven & Hartford. A proposal is now before the New York Central lines to lay out considerably over $20,000,000 during the current year, largely for the continuation of the electrification work at the New York terminal. Another section of the West Shore road between Syracuse and Utica will be electrified, and some double tracking, elimination of level crossings, and gradient revision will be carried out around Rochester and Buffalo. A considerable amount of new equipment will be purchased.

THE 10,000-TON SUCTION DREDGER "LEVIATHAN" FOR USE ON THE MERSEY.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Owing to the increasing draft and tonnage of steamers frequenting the port of Liverpool, the maintenance of an open channel in the estuary is one of vital urgency. Dredging upon a vast scale has to be maintained continuously to remove the sand, which threatens to silt up the navigable channel; and in order to carry out this work most efficiently the Mersey Docks and Harbor Board found it necessary to undertake the construction of a special type of dredger. The task of evolving such a craft was intrusted to their engineer-in-chief, Mr. Anthony G. Lyster, M. I. C. E., who is familiar with the peculiar conditions prevailing at this port, and who designed the sand pump dredger "Coronation," which, built in 1903, was at that time the largest and most powerful dredger of its type afloat. This latter vessel, 332 feet long by 53 feet beam and 20.4 feet deep, with a gross tonnage of 3,943 tons and capable of dredging to a depth of 65 feet with a pump capacity of 4,500 tons per hour, proved eminently successful, and he decided to design a new craft upon the same broad lines.

The new vessel, the "Leviathan," has now been placed in service, and ranks as the largest and most powerful dredger that has yet been placed in operation in any part of the world. It has an over-all length of 487 feet, a beam of 69 feet, and a depth of 30 feet 7 inches, these large dimensions being necessary to afford the requisite capacity and strength to carry the designed enormous load of 10,000 tons of sand. It is of the twin-screw, self-propelling, sand-pump, hopper-dredger type, provided with twelve hoppers having a net total capacity of 180,000 cubic feet, and is fitted with pumps capable of dredging and filling itself with this load of clean Mersey sand in 50 minutes from a maximum depth of 70 feet, while the propelling machinery is sufficient to enable her to drive this load of 10,000 tons in her normal steaming trim, with coal bunkers and water tanks full, at the rate of 10 knots under ordinary working conditions, and to discharge this load very rapidly. The gross tonnage is about 8,000 tons, and the full load is carried on a mean draft of 23 feet. The fulfillment of these conditions insures the boat's possessing three times the power and capacity of any of the Harbor Board's existing dredgers, including the "Coronation," which is the next largest craft of this description in operation at Liverpool.

The vessel, constructed by Messrs. Cammel, Laird & Co., the well-known British armament manufacturers and naval shipbuilders, at their Birkenhead works, is built of steel to class 100 A 1 at Lloyds. It has a complete steel upper deck sheathed with wood, and is divided transversely by thirteen watertight bulkheads extending from keel to deck. There is a longitudinal center line bulkhead dividing the hoppers, pump rooms, and boiler rooms, as well as No. 2 buoyancy spaces on either side of the vessel. These subdivisions, taken in conjunction with the watertight hopper side bulkheads, divide the vessel into about thirty separate watertight compartments. The steel structure has been arranged to give special strength to the vessel, in view of the great strains developed in loading and unloading the hoppers.

The dredging plant, of the Gwynne type, comprises four sets of inverted vertical, triple-expansion, surface-condensing, direct-acting engines having a total indicated horse-power of 2,800, coupled direct to four independent sets of centrifugal suction pumps connected to their respective suction tubes, two on each side of the vessel, with hydraulic sluice valves on the inboard side. Each tube has an internal diameter of 42 inches, is 90 feet long, and is bolted to a heavy cast-steel swivel bend at the upper end and a strong nozzle of special design at the lower extremity. These nozzles are provided with a cast-steel grid, so as to exclude material of such a size as would foul the pump. The swivel bends work in vertical slide frames riveted to the vessel's side, with trunnions to permit the suction pipes to hinge about its center, and thus permit raising or lowering to conform with the state of the tide during dredging.

The suction pipes have an inclination of 45 degrees when dredging to their lowest limit of 70 feet below sea level. Each tube is lifted and lowered by two strongly built derricks of steel, one at each end of the tube, and stopped on seats at the upper deck complete with blocks and flexible steel wire ropes led on to drums of its respective hoisting winch.

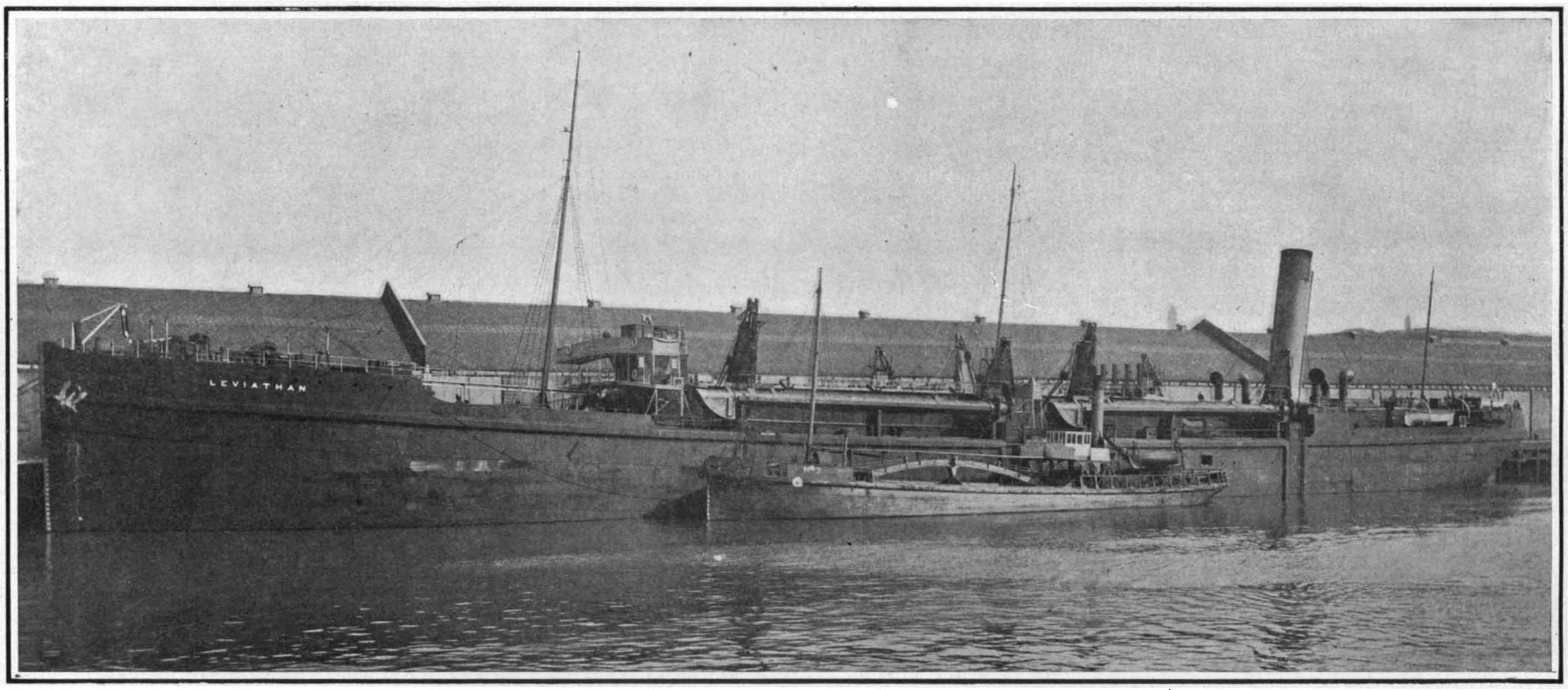
Fitted over each side frame are deck slides supported by strongly built seats on deck, to enable the suction pipes with swivel bend to be stowed inboard when not dredging. Each deck slide has a heavy cast-iron frame of the same section as the slide frame, and can be moved inboard or outboard by means of worm gear, the same being carefully adjusted so that it comes exactly in the same vertical plane as the slide frame when at its extreme outboard position, to permit the suction pipe to be lowered to its working position below the water level.

Emergency gear is fitted to each suction tube, so that in the event of an accident the suction tubes may be lifted by block and tackle led to the deck winches. Two of these winches are placed under the forecastle deck, and two on the poop deck. The four hoisting winches are inclosed in steel houses fitted with glass fronts, so that the winchman within has a clear and uninterrupted view of the derrick lifting and lowering gear. Each hoisting winch has four drums arranged in pairs, two for raising and lowering the suction pipes, and the other two for derricking in or outboard. These powerful winches are actuated by double-cylinder reversing steam engines.

The four dredging pumps are arranged to deliver the excavated material along pipes passing up through the deck into two landers, and at the point where they joint, hydraulic sluice valves are fitted. The landers are placed side by side with a center division, and run the full length of the hoppers. The lander valves worked by worm gear are placed over each hopper on the bottom of the landers, so that the discharge to any hopper can be controlled as desired. By these means the valves with control gear are also arranged in the steel division separating the two landers. The discharge of sand and water from any, or all, of the pumps can be controlled so as to trim the vessel as necessary.

The hoppers placed forward of the pumping-engine room are built in twelve separate compartments, six on each side of the center line bulkhead. Each is fitted with Lyster's patent valves, having an opening 5 feet 6 inches in diameter through the bottom of the vessel. The hopper bottom plating has a steel slope in the four directions down to the edges of the valve seat bottom casting for quick discharge of the sand.

(*Continued on page 339.*)



THE 10,000-TON DREDGER "LEVIATHAN," WITH A 500-TON SAND PUMP DREDGER ALONGSIDE.

SOME CURIOSITIES OF INVENTION.

From time to time we have collected in these columns instances of perverse mechanical ingenuity as well as misdirected efforts on the part of inventors, partly for the purpose of amusing the more soberminded, and partly as an instructive object lesson. On the opposite page will be found a number of such mechanical curiosities, some of them without any excuse whatever for their existence, others not without merit. We are indebted to the Illustrated London News for these examples.

The man who invented the padded chair and traveling carrier to prevent serious street-car accidents was evidently as much concerned with the comfort of the person to be saved, after collision, as with the mere act of saving. He has provided a fender which consists of a traveling belt and which serves the kindly purpose of conveying its human freight to a comfortable chair. It would seem from the illustration that the man to be saved is expected to be picked up in a sitting position facing forward so that he may be conveniently lodged in the padded seat. If he were picked up prostrate, he is presumably either dead or unable to sit, for not otherwise can we account for the chair.

The umbrella cap which emanates from the mind of another inventor certainly ought to serve its purpose of shielding the wearer from rain and sun if one may judge from the illustration. It is assuredly no uglier than the headgear in which civilized man now disports himself.

The method illustrated for arresting a runaway horse is certainly one of the wildest fancies which we have ever seen. The plan is nothing more or less than simply to lift the runaway horse bodily by using a derrick. Presumably the driver is to manipulate the derrick boom. Surely only a Titan could succeed in raising even the half-starved animal that is harnessed to the average tradesman's wagon.

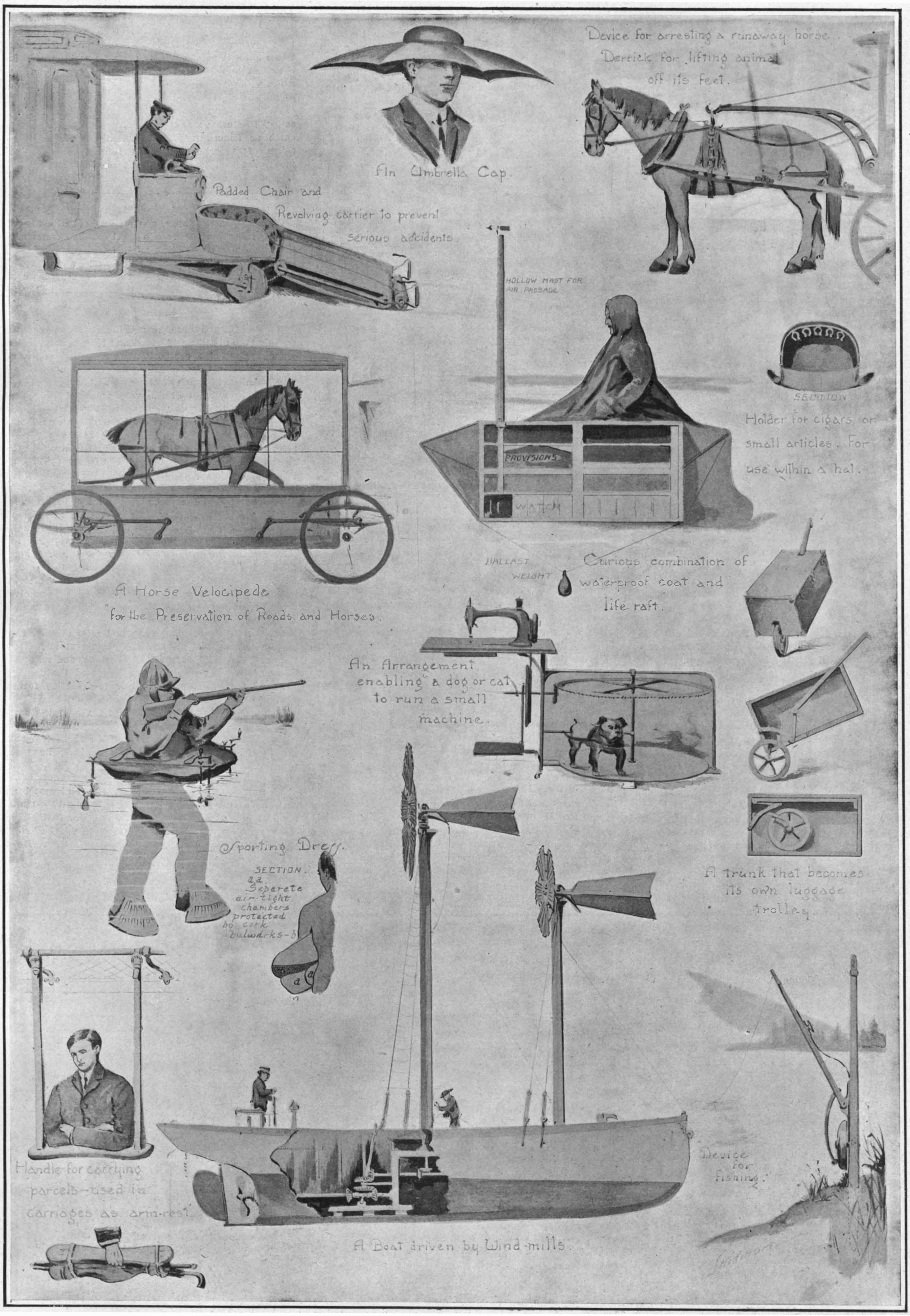
The inventor of the horse velocipede pictured was concerned chiefly with the preservation of roads and horses' shoes. He places his horse upon a kind of treadmill which is operatively connected by crank mechanism with the road wheels. Presumably this wheeled horse is to be used as a kind of locomotive to draw the car.

The many disasters at sea have, no doubt, inspired the inventor of the combined waterproof coat and life raft which is illustrated. A central hollow structure is connected with a waterproof coat into which the passenger crawls and thus makes himself literally part of the life raft. Inasmuch as a hollow mast is provided to supply air to the interior of the life raft and water and inasmuch as provisions are there stored, the man in the rubber coat must have access to the interior. A counter-weight is provided to enable him to keep the raft in proper trim.

The inventor of the cigar holder for hats, which is also to be numbered among these curiosities, seems to have been dismayed by the waste space in an ordinary "bowler" hat, for he has devised a means of utilizing the unoccupied space in a way which leaves one to infer that he never heard of pocket cigar cases.

We believe that something like the sporting dress here shown has actually been used, but certainly not equipped with the hand-operated screw propellers. As shown in the detailed view, separate air-tight chambers *a a* are employed, which are protected

(*Continued on page 340.*)



Redrawn from Illustrated London News.

SOME CURIOSITIES OF INVENTION.

THE ATTITUDE OF DIPLODOCUS.

Readers of the Scientific American are familiar with the prehistoric animal known as "Diplodocus," the largest of dinosaurs. To the American Museum of Natural History, and particularly to Prof. Henry Fairfield Osborn, president of the Museum, is due much credit not only for the arduous work of excavating the bones of this and other extinct creatures in the far West, but also for painstaking care in correctly mounting the skeletons.

The donation of a Diplodocus skeleton through the kindness of Mr. Carnegie to the Berliner Museum fuer Naturkunde has brought this extinct animal much into the public eye in Europe. Dr. Tornier is largely responsible for this increased popular interest in palæontology, because of the paper which he recently read before the Gesellschaft naturforschender Freunde on the structure of the Diplodocus skeleton in the Berliner Museum, a paper based largely upon the studies of Hay and therefore hardly the result of original investigation. The Berlin diplodocus is mounted in the attitude of a mammal, with extended legs. Tornier holds that its posture should have been more reptilian. We abstract from Umschau an account of Tornier's views. Dr. Tornier argues that four-footed lizard-like reptiles rise but little from the ground even when in active motion; that the humerus and the femur move in approximately horizontal planes, so that the animal crawls rather than walks. The Diplodocus was a reptile, a giant lizard in other words. Tornier holds that the skeleton has been incorrectly mounted and that its posture should have been that indicated in Fig. 1, rather than that indicated in Fig. 2. If the animal had been mounted as in Fig. 1, it would have walked somewhat like a crocodile, which, in Dr. Tornier's opinion, it did.

In the reconstruction of Diplodocus the hind feet rest flatly upon the ground, whereas the fore feet touch the ground with the toes only. Hatcher, who was one of the first to study the animal closely, thought that perhaps the fore feet were placed flatly upon the ground. Holland disputed this view. Dr. Tornier believes that Holland was right, because reptiles do not tip-toe with their fore feet, and because, so far as we know, there is no land animal which employs only the toes of its front feet and the soles of its hind feet in locomotion.

Dr. Tornier holds that the tail of Diplodocus was a far more important member than the mounters of the skeleton suspected. In the Berlin model only the end of the tail rests upon the ground, the remaining portion rising at a fairly sharp angle to join the lumbar vertebræ. He stated that in order to mount the tail in this manner and to produce the pronounced curve of the reconstruction, it was necessary to spread the vertebræ of the tail. He states that the caudal vertebræ of lizards are never separated in this fashion, but that they are more or less locked together. Inasmuch as the Diplodocus vertebræ are reptilian in form, he believes that here again an error was made, and that the tail did not curve up sharply from the ground, but that it projected rearwardly in a slightly curved line as in all reptiles. In the restoration only one-half of the tail rests upon the ground, the other half rising free into the air. If this were correct, the rear extremities of the animal would have been compelled to support an enormous load of bone which served no useful purpose. In typical four-footed lizards it is the function of the tail to guide the animal. As soon as the animal begins to move, the tail stiffens the spinal column, thereby enabling the animal to proceed rapidly along in a straight line. If the tails of such animals be cut away, they seem to be no longer able to move properly. It was the purpose of the tail of the Diplodocus to stiffen the lumbar vertebræ, as in the case of all lizards, when the animal was in motion. Moreover, it served to counterbalance the head of the creature and to prevent it from tipping over forward, particularly when it was traveling down an incline.

Dr. Tornier is of the opinion that Diplodocus did not hold its head horizontally, but that the neck was habitually curved in the form of an S. Holland also made this assumption and likened the head and neck of Diplodocus to the head and neck of an ostrich. The evidence for this attitude of the head is to be found in

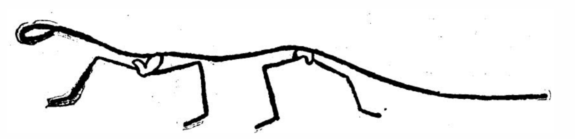


Fig. 1.—Tornier's conception of the true position of Diplodocus.

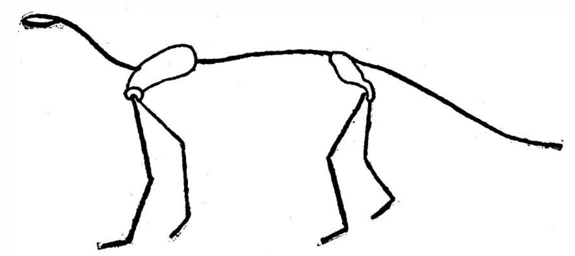


Fig. 2.—Present mounting of Diplodocus.

the peculiar ball-and-socket connection of the neck vertebræ. It was the object of this form of articulation to enable the neck to be extended to all sides as well as up and down.

It must not be assumed that Dr. Tornier's criticism of the mounting of Diplodocus meets with general European approval. Dr. Fritz Drevermann, curator of Senckenbergisches Museum, Frankfort-on-the-Main, believes that there is room for two opinions. He points out that Dr. Tornier's conception of the position of the legs of Diplodocus is based on Hay's view. If American students and particularly Prof. Osborn (under whose direction the Frankfort Diplodocus was mounted), Hatcher, Holland, and the Viennese Abel regard the present position as correct, it is not likely that Tornier is right. It is inconceivable that the palæontologists of the American Museum of Natural History, who have mounted Dinosaurs by the dozen, are ignorant of reptilian skeletons.

Marcellin Boule, professor of palæontology at the Museum d'Histoire Naturelle, Paris, agrees with Drevermann. He too argues that American authorities are fairly in accord on Dinosaur reconstruction and that the few disagreements affect only minor details. Inasmuch as Americans alone have had an opportunity of finding Dinosaurs in any number, and therefore have had the best opportunity of studying them, their opinion must be accepted as authoritative. He quotes B. P. Hay, who does not agree with most American students and who seems to have inspired Tornier. Prof. Boule contends that Tornier is wrong in holding that mammals have one form of locomotion and reptiles another. The conclusion that because Diplodocus is a reptile it must crawl is not necessarily valid. Locomotion is dependent upon external conditions. As a matter of fact there was once a time in the history of the earth when reptiles were lords of widely different elements. They dominated the water as Ichthyosaurs, Plesiosaurs and Mosasaurs; they roamed the earth as Dinosaurs and navigated the air as Pterosaurs. If present reptiles are limited to a crawling movement that is by no means conclusive proof that they always crawled.

Chartreuse Liqueur Decision.

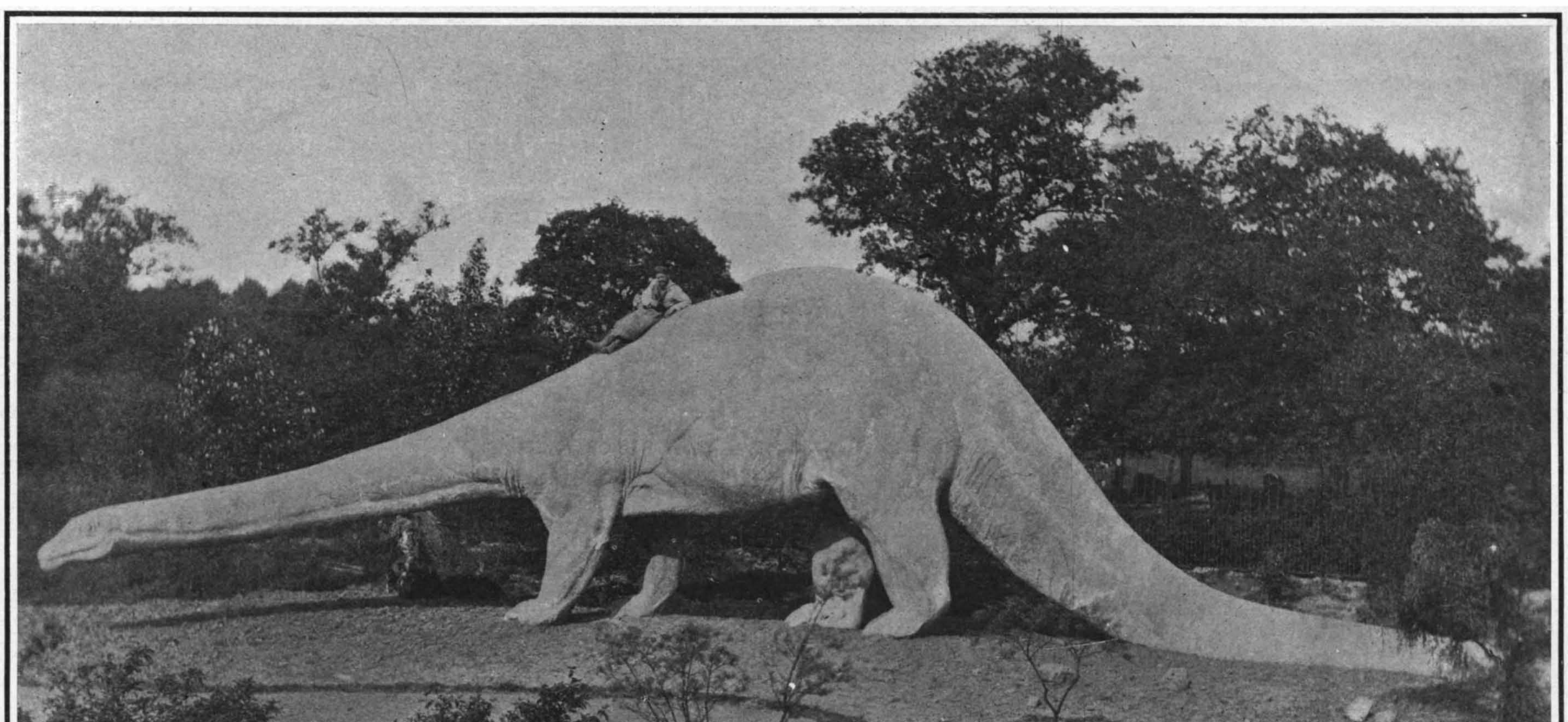
Consul C. P. H. Nason, of Grenoble, submits the following report on the French legal decision concerning the name "Chartreuse" as applied to liqueurs:

The court of appeals at Grenoble on June 22nd rendered a decision in the long-discussed case turning upon the rights involved in the public sale and use in France of the trade-mark "Chartreuse." After the expulsion in 1903 of the Carthusian monks from their convent, La Grande Chartreuse, the making of the well-known liqueur (the distilling of which and the aromatic plants entering into its composition were claimed to be known) was intrusted on the part of the state receiver to a prominent French distiller. The latter, as against the sale by auction of the very valuable trade-mark under which the liqueur was universally known, made a written advance offer, on the basis of which the bids were to begin at 1,500,000 francs ($289,500). Thereafter came forward a second party and guaranteed the receiver an auction offer of 5,000,000 francs ($965,000), but this was finally reduced to 3,000,000 francs ($579,000).

This agreement the second party failed to keep; he withdrew the offer, and, as a consequence, at a forced sale to the highest bidder, the right to the trade-mark was sold to a company formed by the first party for the sacrifice sum of 502,000 francs ($96,886). Whereupon the receiver brought suit against the second party for breach of contract, and the latter, after a strongly contested trial, was condemned by the civil court of Grenoble to pay the former for non-execution of contract 1,094,000 francs ($211,142). An appeal was taken from this judgment, and after another prolonged hearing and arguments by eminent advocates, the court has not only affirmed the fault and responsibility of the second party, but increased the damage interests to be paid the receiver to 2,438,000 francs ($470,534).

The use in this country of the trade-mark Chartreuse was decided by the two lower United States courts against the Chartreux monks and in favor of the new French company. An appeal is, however, pending.

According to the latest statistics, the total peat bogs of Sweden would be capable of producing 10,000 millions of tons of air-dried peat, suitable for fuel. This quantity, as compared with the present import of coal, would be sufficient for a period of 1,500 years. More exact examinations of the geological character of the peat bogs will soon be started by the Swedish Geological Society.



THE HAGENBECK RESTORATION OF DIPLODOCUS, IN WHICH THE AMERICAN MUSEUM OF NATURAL HISTORY'S MOUNTING IS FOLLOWED.

BIRDS OF PASSAGE.

BY B. S. BOWDISH.

It is a far cry from the day when Aristotle propounded the doctrine that birds hibernate like woodchucks, to the present time, yet much of the mystery which that early naturalist sought to dispel still lingers about the wonderful phenomena of migratory movement.

Only in birds (unless we except fishes) is true migration instinct found. Erratic, semi-migratory movements of insects take place; scarcity of food or some other strongly compelling cause induces, from time to time, a semblance of migration among some of the mammals, but only the winged and feathered inhabitants of the globe exhibit a seasonal rhythmic swing from south to north and *vice versa*.

Our modern knowledge embraces much data respecting the actual migratory movement, its date of commencement, duration, and termination; the termini of the journey, the route followed, and the manner in which the traveling is performed. We have accumulated a great mass of statistics concerning the time in spring and fall when certain feathered wanderers may be reasonably expected to appear at a given point along their route. We know that the method of performing these journeys varies much between species, as in length of flight that takes them from winter to summer homes and return, whether they fly almost continuously or by short, leisurely stages; whether flights are mostly by day or night or both; the route followed, and whether this is changed by varying weather or other conditions. We also know that certain species perform their flight to their northern summer homes along one route, and return to their southern winter homes by a widely different course. It is well established that some species flock and fly almost entirely by themselves, that others are found widely scattered among flocks of other species, that in still other cases two or three species may almost certainly be found flocked together, while in some instances the flight is performed more in an individual and straggling manner. It is a fact well known to many gunners that the course and manner of certain species of migrating birds has been changed materially within recent years, perhaps permanently, and that temporary changes of this character constantly occur, due to easily recognized causes. That class of birds whose life cycle is, perhaps, best known is naturally the one which includes those classed as game birds. Notably, as regards migration, these birds fall readily into three divisions: the water fowl, including ducks, geese, and swans; the Limicolæ or shore birds, principally the sandpipers and plovers; the gallinaceous birds such as the bob-white or quail and the ruffed grouse or partridge.

The southward fall migration of the first-mentioned division may, perhaps, be readily ascribed to search for wide and rich feeding areas, where open water is assured; the northern flight to a similar seeking of ample breeding grounds. While the southward flight is in some few instances continued as far as the West Indies and South America, in the main the movement is only sufficient and in general seems to conform to the cause assigned. In suitable localities on the New England coast and along Long Island we find an abundant representation of this division braving the rigors of winter, while in the wonderful breeding grounds along the coast of North Carolina, their numbers seem only to be limited by the persecution of the gunners. The northward journey of the members of this division, it is true, is for the most part, extended well into the Arctic or sub-Arctic regions, but this is largely a matter of necessity, to secure sufficient areas of suitable nature where they may breed in peace. Where birds of this division are not harrassed in late winter and spring by shooting, it has been found that they often remain in considerable numbers to breed, much further south than the usually ascribed southern limit of summer residence.

On the other hand, the migratory movement of the second division mentioned is one of the most extreme known. Such birds as the golden plover, black-bellied plover, buff-breasted sandpiper, and others of their kind are startling examples of the most wonderful migration flights. The golden plover, breeding within the Arctic Circle, often extends its quarters as far south as Patagonia. Of necessity the breeding season is short, but nearly six months is spent in winter homes. About four months of the year is spent in their spring and fall journeys, which are sometimes as much as 3,000 miles in length. In spring they travel northward *via* the Mississippi Valley, but in fall they go south by the way of Labrador and Nova Scotia, from the latter point launching out to sea, and in favorable weather often making a trip of 2,400 miles to South America without a known stop. There seems good reason to believe that this avoiding of our coast has increased in frequency since the shooting of the birds by the barrelful so reduced their numbers, and endangered a coastwise journey overmuch.

The black-bellied plover breeds equally far north and, on this hemisphere, winters in the West Indies, Brazil, and Colombia. The buff-breasted sandpiper summers as far north as the Arctic coast and winters south of Uruguay and Peru. Migratory movement in all such birds has been undoubtedly affected by changed coastal conditions and excessive shooting.

The third division represents birds that are practically unaffected by migratory instinct. The bob-white and ruffed grouse are permanent residents where found, till adverse circumstances force them to leave, or extermination removes them from a locality.

The most fundamental factor in migration, the cause, remains practically unknown so far as birds in general are concerned. The formerly attributed cause, and the one which still figures largely in the popular mind, and seeking of a comparatively equitable climate by birds in their journeyings north and south, has long been abandoned by the ornithologist. The question of food supply only offers partial solution. This is true of other tentative causes advanced. It seems probable that a number of causes in a great variety of combination contribute.

In the study of migration, one fact seems to be unmistakably established, namely, the existence of an extinct that enables birds in flocks or individually, to perform migratory flights of great length, and to return with great precision to the breeding spot of the previous year. Thus we find birds that breed gregariously, as gulls, terns, herons, and others, yearly returning to the same island, strip of beach, marsh, or swamp in a colony, and about the same time each year. In the same way our common birds that are more or less solitary in their nesting habits return in many instances to the same spot, year after year. The bridge girder, the beam in the cow-shed, or the molding on the porch pillar that has this year held a phœbe's nest, will, ten to one, hold such a nest next year. It is not exceptional to note on the limb of a village shade tree the occupied nest of the Baltimore oriole, the weathered last year's nest, and the battered remains of the nest of two years ago. A last year's nest of the vireo is often a good clue to the immediate whereabouts of an occupied nest. Robins' nests are not infrequently built on the remains of the domicile of the year before. A hawk's nest is often used for many years in succession, and this is particularly the case with the fish hawk or osprey, whose nests, thus added to year by year, often become very bulky, with the underpart or foundation a crumbling mass of age-decayed matter. Woodpeckers, who seldom use the same nest twice, often have two or more excavations in the same stub, the nesting cavities of successive years.

All this evidence of a return of individual birds to a given locality is, of course, not absolutely conclusive. It is seldom possible to adduce such conclusive evidence. The reasonable conclusion, however, must be that the weight of evidence is in favor of the theory

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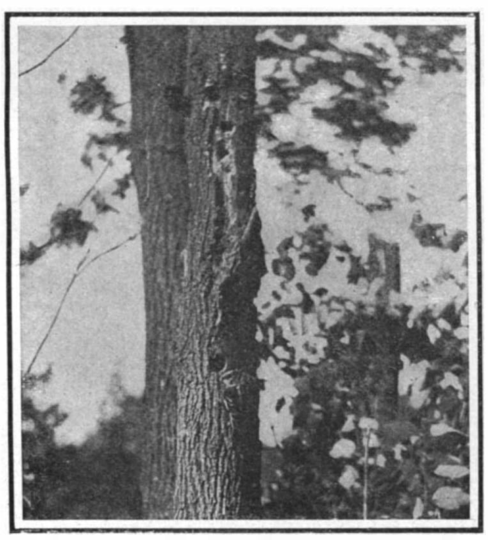
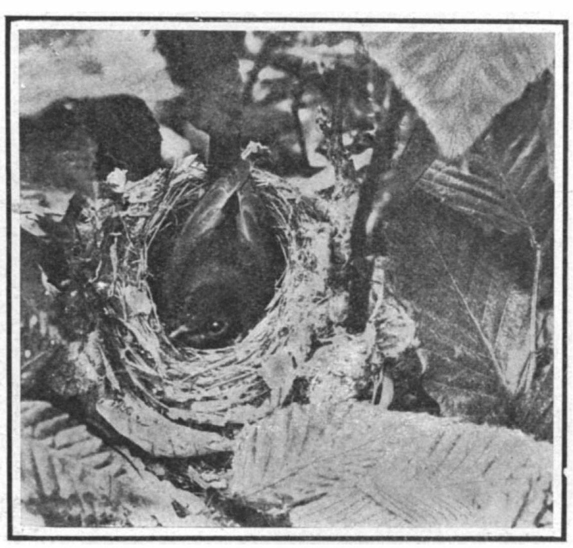
The osprey's nest to which the birds return year after year.

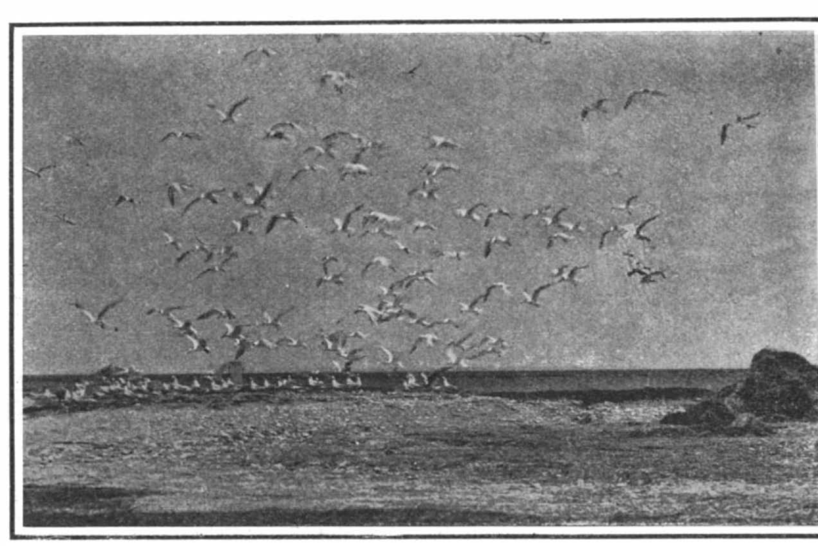


The downy woodpecker at home; a non-migratory bird.

The nest of the Florida gallinule built for years in the same site, even after the marsh has become the center of a hustling city section.



The hooded warbler and her home, close to last year's abode.



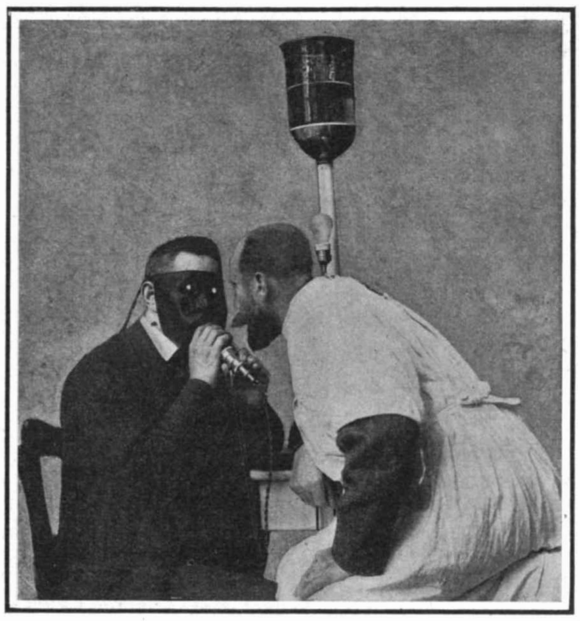
When the royal terns make their annual return to their island home.

BIRD MIGRATION.

THE OPHTHALMO-DIAPHANOSCOPE.

The ophthalmo-diaphanoscope is an instrument for examining the fundus, or back of the human eye. It is the invention of Dr. Carl Hertzell, of Berlin, who claims that the instrument and its accessories supersede anything that has previously been in use. Briefly, the instrument consists of an eighty candle-power electric lamp, which the patient holds in his mouth, as far back as possible. This highly illuminates the retina of the eye from the back, and the surgeon, looking at it from the front, is able to make a much more satisfactory examination than was possible by means of reflected light and eye-mirrors.

Of course, the examination takes place in a totally dark room, while the patient wears a black mask over his face, in order to concentrate the effect of the illumination, holes being cut in front of the eyes, through which the surgeon makes his observations.



THE OPHTHALMO-DIAPHANOSCOPE.

These are the essential points connected with the ophthalmo-diaphanoscope and its working. There are, however, a few other details connected with the invention which are of particular interest. The illumination, which is concentrated at one end of the tube, is ten times more powerful than that which is emitted by any other lamp previously employed in surgery for transmitted light. As we have seen, the normal candle-power is eighty; and a moment's reflection will convince the reader that it would be quite out of the question to make use of an ordinary lamp of this kind in the mouth, or, indeed, in close contact with any part of the body, because of the great heat which is generated. This difficulty has been surmounted by means of a continuous stream of cold water which circulates within the lamp. In the complete equipment, the water is stored in a glass reservoir supported upon a column, down the hollow of which the fluid passes to a flexible tube which carries the stream into the lamp, through which it circulates. A similar tube carries away the waste water, which is ultimately discharged into a vessel at the base of the apparatus.

A necessary and most ingenious addition to the ophthalmo-diaphanoscope is the contact signal lamp, which is fixed to the column beneath the reservoir, that is to say, about on a level with the eyes of the surgeon when he is making an examination of the patient.

This lamp lights automatically just before all the water is discharged from the reservoir, so that no matter how much absorbed the surgeon may become in his examination, he will be at once apprised that the reservoir is almost empty by a sudden illumination of the darkened chamber. He can then at once switch off the current from the lamp, which, now that the cooling stream has ceased to flow, would become heated and cause discomfort to his patient.

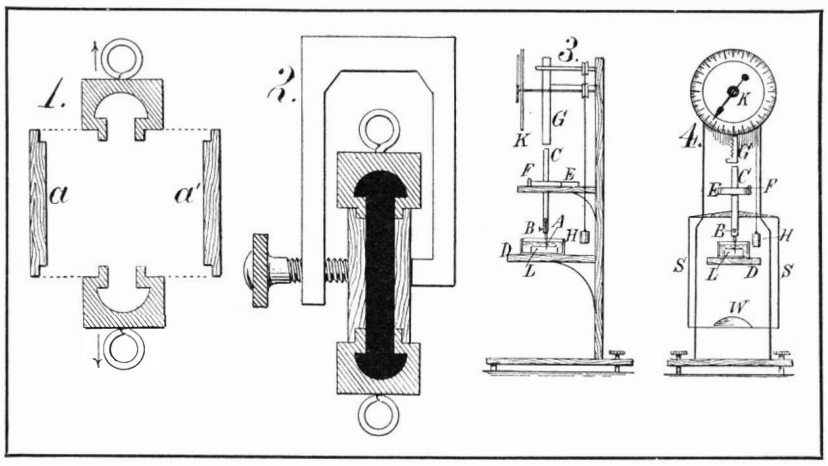
It should be added that the outer cover glass of the special lamp is readily removable, so that it may be sterilized after each use. Moreover, every part of the lamp may be had in duplicate; and as these are perfectly interchangeable, a broken or faulty part may be at once replaced. The whole apparatus has been devised with the utmost care; and it is claimed that even those who are unfamiliar with electrical appliances may quickly become accustomed to its use.

The ophthalmo-diaphanoscope was specially invented as an aid to diagnosing diseases of the eye; but it has proved of great service in examinations of the throat and nasal cavities, while it will probably prove of service to medical science in many other ways. Its chief advantage lies in the fact that an extremely powerful light may be obtained without heat radiation.

TESTING BITUMENS FOR PAVEMENTS.

In every direction, the industrial and scientific worlds are endeavoring to measure the properties of substances. An instance of this tendency was given in the article on "Testing for Hardness" in the SCIENTIFIC AMERICAN for August 29th, 1908. In the present article it is proposed to give some account of measurement efforts in a very different field of activity.

The sheet asphalt pavements so common in certain parts of the United States are composed of an admixture of some asphaltic cement and sand. It is quite important to have pretty exact information about this bituminous cement in advance of its use in paving mixtures. One reason for this is that the cements are by no means all alike. And second, the requirements for this use and that vary greatly. Thus it comes about that it is a matter of considerable importance to determine the characteristics of samples in course of manufacture or an advance of actual use. In fact, since the asphaltic cement is the controlling factor in the mixture used in sheet asphalt paving, it is very necessary to make this cement with just the properties suited to the particular case in hand. That is to say, asphaltic cement is a combination of refined asphalt and some tempering oil, as residuum petroleum. It will readily be seen, then, that the properties of the cement will vary with the relative quantities of the two ingredients, to say nothing of the characteristics of the particular asphalt and oil used. For practical purposes, then, it is found very desirable to know in advance whether the cement being made is going to be what is wanted.



Figs. 1 and 2 show mold for sample prism. Figs. 3 and 4 show side and front views of the Dow penetrometer.

There are two principal properties whose determination is sought. These are ductility and viscosity.

In order to measure the ductility, the following method, due to Mr. A. W. Dow, may be employed: A mold of four pieces is constructed, the plan view of these being shown in Fig. 1. These pieces are set up on a brass plate which forms the bottom. The side parts are held in position by a clamp, as shown in Fig. 2. The interior portion of the mold is in the form of a prism, 1 x 1 x 5 centimeters. The cement is now poured in, hot of course. When cool enough, the top is smoothed off. When the temperature has fallen to the point at which it is desired to make the test, the clamp is loosened, and the two side pieces *aa'* (Fig. 1) are removed. We now have a prism of cement held at the sides by clips—the end pieces of the mold. By inserting hooks in the eyes of the clips, it is easy to arrange matters so that these clips may be steadily drawn apart. This may be accomplished by hand. Mr. Dow mentions the rates of separation as 5 centimeters per minute for the temperature of 77 deg. F., and of 1 centimeter per minute for 20 deg. F. It is stated that "it is not safe for an asphalt having a consistency of 40 penetration at 77 deg. F. to pull less than 20 centimeters at this temperature." What is meant by "a consistency of 40 penetration" will become clear in the sequel.

In order to measure the viscosity (consistency) of a cement, recourse is had to a device for measuring the depth of penetration accomplished by a weighted needle in a given time. Prof. H. C. Bowen is said to have invented the pioneer machine about twenty years ago. Several devices have been developed since. The one which is probably most in use at the present time was devised by Mr. Dow. But this latter has now been improved upon by Messrs. Richardson and Forrest.

In the Dow machine, a broad upright rises at the rear of a base, as shown in vertical section in Fig. 3. The specimen of asphaltic cement is contained in a small tin box *L* immersed in water in a suitable receptacle. This last rests upon the shelf *D*. An aluminium rod *C* is held by a clamp *E*, controlled by a button *F*. A No. 2 cambric needle *A* is inserted in a brass rod, and this latter is held in position in the aluminium rod by the screw *B*. Attached to the aluminum rod *C* is the framework *SS*, Fig. 4, carrying a weight *W*. It will readily be seen now that by locking the clamp *E* open, by means of the button *F*, the needle, weighted by the parts *C*, *SS*, and *W*, may be brought into contact with the upper surface of the specimen, and allowed to begin penetration.

There are two remaining things for which mechanism must be arranged. There must be some means of measuring the time and the amount of penetration. The former of these is quite a simple matter. A pendulum beating half-seconds is arranged at some convenient point of attachment. The second requirement is accomplished as follows: In Figs. 3 and 4, *G* is a rack meshing with a pinion back of the dial *K*, and controlling the indicator. At the rear end of the spindle carrying the pinion is a drum. A rather thick thread is wound about this drum, and weighted at its lower end by the weight *H*. This last is of such amount as just to counterbalance the weight of the rack on the pinion. Consequently, if the lower end of the rack is brought into contact with the aluminium rod *C*, it will not contribute any influence to the penetration of the needle. At the beginning of the test, the lower part of the rack is brought into contact with *C*, and again at the conclusion. The difference in position of the rack will, therefore, give the amount which the needle has

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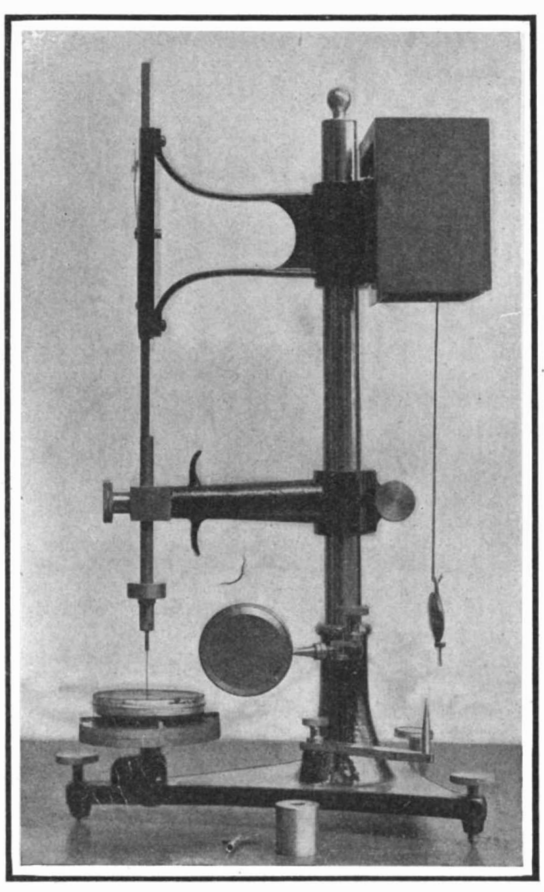
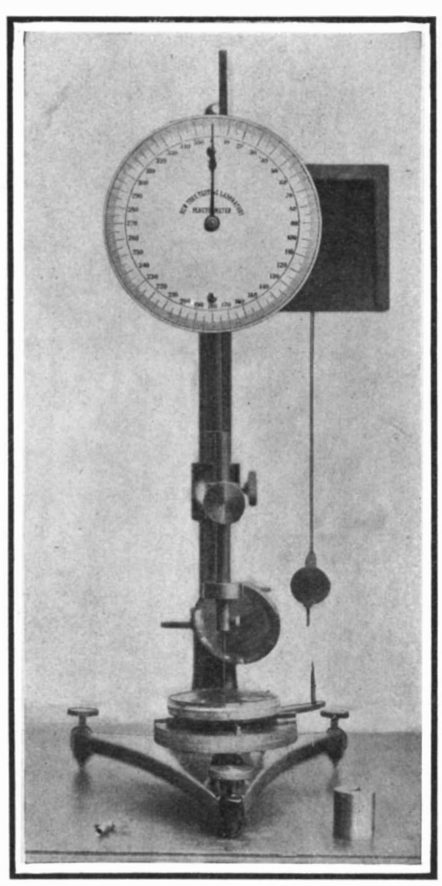


Side view of the improved penetrometer.



Pendulum and indicator dial.

TESTING BITUMENS FOR PAVEMENTS.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

SUPPORT FOR GARMENT-HANGERS.—FANNIE WOLF, New York, N. Y. This support is adapted to be secured beneath a shelf or within a wardrobe, showcase, or the like. The invention relates more particularly to a carrier in which a plurality of rods are used, one being longitudinally movable in respect to the overhead support, and another of the rods being carried by the first-mentioned one and also longitudinally movable in respect thereto, so that the support may be extended to its full length out from beneath the overhead support.

Electrical Devices.

TROLLEY-GUARD.—S. G. WILCOX, North Adams, Mass. The guard is in the form of a spring-pressed slidable plate, nominally extending across the top of the trolley wheel, to prevent it from leaving the trolley wire, the plate readily passing the trolley wire hanger, and the arrangement permitting withdrawing of the plate by the operator, at the same time pulling down the trolley pole.

IGNITION APPARATUS.—G. HANIQUET, Longbeach, Cal. It is sought in this invention to provide means for retaining a thin lubricating oil within a circuit closer. In addition the invention comprehends mechanism for reducing the electrical arcking as the contact shoe leaves the contact bar. It further contemplates slowing down the speed of the circuit closer shaft, as compared with the main shaft.

INSULATOR.—P. S. DUMBOLTON and F. FRANZ, Burke, Iowa. The invention is more particularly an improvement in insulators mounted on spiral wire coils which are suitably attached to a supporting screw pin. It is adapted for lateral oscillation, so that it may be used without danger of breaking, as is often the case with insulators so fixed on their supports as to be incapable of yielding to jar or vibration.

INDUCTOR-DYNAMO.—G. A. COLMAN, Seattle, Wash. The more particular purpose of the inventor is to produce a dynamo having a minimum of wearing parts and without brushes, collectors, or commutators. It relates to the construction of a high-speed rotor having generally the form of a smooth disk made entirely of solid metal, yet heterogeneous as to the magnetic properties.

Of Interest to Farmers.

CULTIVATOR ATTACHMENT.—D. B. BROWNING, Morrison, Okla. In operation the fender is supported by the hanger arm and the runner is adjusted a sufficient distance below the edge of the blade to prevent the soil thrown up by the plows from covering the plants, while permitting some soil to be thrown toward the plants at the roots. Engagement of the runner with the ground prevents the fender being moved out of place by the soil thrown up by the plow. The runner also permits the fender to fall in with the inequalities of the ground, so as to protect the plants, even when they occupy a lower level than the wheels.

Of General Interest.

TARGET-HOLDER.—C. P. WORRELL, Zanesville, Ohio. The object of this inventor is to provide in connection with the front of the box, clamping strips to bind the edges of the target and laterally adjustable to stretch the target out, and a member closing the rear of the box to check the shot or bullets, the member being preferably in the form of a separable metal plate.

ENVELOP.—L. C. VAN RIPER, New York, N. Y. The envelop has an ungummed flap which may be held within a pocket, or removed therefrom in order to allow the contents to be inspected by postal authorities. It is provided with the ordinary gummed flap, intended to be a sealed envelop, and yet allow the same to be sent through the mail at the postage rates required for unsealed matter.

FIRE-ESCAPE.—R. W. SCHWEIMLER, Louisville, Ky. Here the intention is to provide a device in which a person may be safely transported to the ground from an elevation quickly but without injury. It provides an inclined covered chute of zigzag construction. The user is conveyed to the ground while sliding in a sitting posture.

SCREEN.—F. J. REMBUSCH, Shelbyville, Ind. In this instance the invention pertains to screens, the more particular purpose being to provide a screen which offers a total obstruction to the passage of light through it, and in this manner improves the distinctness, clearness, and brilliancy of images thrown upon the screen.

SUBMARINE MINE.—A. P. BROOMELL, York, Pa. This invention relates to mines in which a mine is connected by a line with an anchor with means for paying out the line and for checking the paying out, so that when the mine and attached anchor are thrown overboard the mine will float as the anchor descends, and as it approaches the bottom it operates to draw the mine below the surface to an extent proportioned to the length of the gage line connected with the anchor.

EXTENSION-BOLT.—F. H. CRUMP, Los Angeles, Cal. This improvement provides an extensible formed bolt in which the solid bolt proper has a threaded engagement with a hollow internally threaded cylindrical member and an outer casing or sleeve surrounding the two, so that the bolt may be shortened or lengthened by turning the first two mentioned members relatively to each other. Further extension of the bolt within reasonable limits may be made by interposing additional threaded sections.

Hardware.

FAUCET.—W. F. ODEN, Ophir, Utah. The faucet is arranged to permit the operator to quickly change the position of the working parts for opening the faucet to the full extent for the removal of a mixture of solid and liquid material or for discharging a mixture of solid and liquid material through a desired sized spout or for completely closing the faucet.

LOCKING DEVICE FOR AWNING CORDS OR STRAPS.—S. ASCH, New York, N. Y. This invention is for use in preventing mischievous children having access to awning cords. Means are provided for inclosing and locking up the lower portion of the cord or strap at the point where it is attached. By means of a key access may be had to the interior so as to adjust the awning when desired.

Heating and Lighting.

FURNACE-GRATE.—W. J. THOMAS, Salt Lake City, Utah. The invention relates more particularly to a grate in which the grate bars are utilized as conduits for the delivery of air under pressure to the burning material. An object is to so construct the parts that any one of the bars may be removed independently of the other bars and without interrupting the delivery of air through the latter.

COMBINED MATCH-BOX AND CIGAR-CUTTER.—E. OLDENBUSCH, New York, N. Y. The box is adapted to receive a card or package of detachably connected friction matches. It is formed of two sections movable in respect to each other and one so formed as to frictionally retain the package or card of matches in engagement therewith, independently of the other section of the box which constitutes the cover.

Household Utilities.

COMBINATION CHAIR AND IRONING-BOARD.—ROSE HUFFT, care of C. C. HARRELL, Port Arthur, Texas. An object of this invention is to provide a device which in its normal form constitutes a chair, and which can easily be changed from the normal form into a stand, such as a table, ironing board, or the like. The invention effects economy of space in a household.

CUSPIDOR.—M. D. GREEN, Flora, Ill. This cuspidor may be hermetically sealed for sterilizing purposes. An object is to provide one having a removable receptacle therein and also means whereby a sterilizing or cleansing fluid may be applied thereto. A series of cuspidors may be cleansed and sterilized simultaneously.

WINDOW-SCREEN.—E. T. PETERS, Lincoln, Neb. The invention comprises a combination with a casement having sash grooves, and pockets in its head and sill, the pocket in the head being in alinement with the upper sash of the receiving groove and the one in the sill in alinement with the lower sash, both slidable in the groove of a screen resting on the upper sash, and movable into and out of the head pocket, a screen detachably connected with the lower sash, and movable into and out of the sill pocket, said pocket having a pan with slidable sections, the lower section being provided with an outlet.

TABLE-SLIDE.—L. A. WIEDEMAN, Louisville, Ky. In this slide the two side pieces are fastened to the respective halves of the table, while the central portion is fastened to the center leg; when the sides are pulled apart the side pieces will slide relatively to the center piece, the latter remaining practically in normal position. The table may be extended until the stop members of the slides engage the end top members on the central portion. Intervening leaves may then be inserted and will rest upon the upper parts of the slide.

Machines and Mechanical Devices.

ADDRESSING-MACHINE.—T. E. PLATER, Monett, Mo. This inventor seeks to provide the machine with cutting mechanism for severing the strip bearing the addresses, and also seeks the provision of means for moistening the strip immediately before it is cut, the strip being provided with a gummed surface to cause the portions severed to adhere to the articles to be addressed.

PORTABLE CONCRETE-MIXER.—C. W. OVERTURF, Dumont, Iowa. One object here is to provide a device in which the time during which the materials are subjected to the mixing process may be varied at will of the operator. This is done by means of a mixing cylinder through which the materials pass and which can be inclined to a greater or lesser degree, thereby increasing or decreasing the rate of travel of the charge therethrough.

CASH-REGISTER ATTACHMENT.—J. E. COSBY, Richmond, Va. The present invention includes a device operated on and by a key coupler which in turn operates upon the intermediate parts to effect a movement of the advertising mechanism, which may be operated step by step to expose successively the succeeding faces or inscriptions upon the cylinder.

GLASS-MOLDING MACHINE.—W. J. MILLER, Coffeyville, Kan. This invention relates to semi-automatic glass molding machines in which a table carries a series of molds and is given an intermittent rotary movement through a mechanism including cylinders, and the patentee provides an improved valve arrangement for controlling all the different mechanisms incidental to the several operations of the machine.

Prime Movers and Their Accessories.

REVERSING TURBINE.—H. T. WERBER, New York, N. Y. The turbine is capable of being rotated in either direction. The invention resides in the construction of the rotor, which enables it to be driven by steam admitted on either side. Admitting it on one side drives the rotor in one direction, and on the other side drives it in the opposite direction.

Railways and Their Accessories.

SIGNALING DEVICE.—W. P. SMITH, El Paso, Texas. In its present embodiment, the invention comprises a plurality of levers arranged to display signals or be housed within a casing, and mechanism whereby the levers may be locked in either position, and also means for locking the operating mechanism. Said locking mechanism may be controlled from the cab or other locality occupied by the operator.

GRAIN-CAR DOOR.—J. F. MCGLENN, Harvey, N. D. In operation blocks are engaged with their respective plates, after which the door is positioned, and hinged plates are turned into position against the edges of the door's inner face, and locked by pins. When the car is to be unloaded the blocks are removed, and the door's lower section swings outward. After enough of the load has passed outwardly to relieve the pressure on the upper section, the entire door is removed and suspended by hooks.

SWITCH-ROD.—E. W. BROWN, Grenada, Miss. This invention pertains to adjustable switch rods for railroad track switches. One intention is to provide a switch rod having shoulders against which the flanges of the switch points may be firmly held, thus preventing any lateral movement of the points.

RAILWAY-TIE.—E. BUTCHER, Chanute, Kan. The object in this instance is to provide a construction for ties which facilitates railway construction; provide a construction which may be in part or wholly renewed and re-used; provide a construction which lends itself to varying conditions of railroad construction, while being standard in form; and provide a construction which cushions the road-bed and allows for leveling the same.

FASTENING DEVICE FOR INCANDESCENT BODIES.—E. STEIL, 26 Winterfeld Street, Berlin, Germany. The invention pertains to means for fixing the incandescent body and its accessory, such as a projecting basket, on the burner head or to the frame of a gas lamp for the illumination of railway carriages, in connection with which the device is especially intended to be used.

Pertaining to Vehicles.

VEHICLE-CUSHION.—J. E. MOSEMAN, Donaldsonville, La. The object of this inventor is to provide a device wherein a pneumatic cushion is interposed between the body of the vehicle and the axle. The cushion may also be used with railway chairs, the legs of the chair resting upon the upper bar, and the lower bar being secured to the floor.

GRIP-THREAD FOR VEHICLE-WHEELS.—F. HOLAN, Niobrara, Neb. This invention refers to attachment for the rim of a vehicle wheel for the purpose of enabling it to grip the road-bed. An object is to provide a construction for the device which is simple and which can be readily attached when desired to the wheel.

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.

TEXT BOOK OF THE HISTORY OF ARCHITECTURE. By A. D. F. Hamlin, A.N., Professor of Architecture, Columbia University. Eighth edition. New York: Longmans, Green & Co., 1909. 12mo.; pp. 467; 235 illustrations. Price, $2.

In this work Prof. Hamlin has presented an admirably concise sketch of the various periods and styles of architecture, and has briefly criticised the more important works of each period or style. Despite the fact that extreme condensation in presenting the leading facts has been necessary, the work gives a very comprehensive view of the development of architecture. Not the least valuable feature of the work is the manner in which technical terms are defined and explained, together with a glossary at the end. Good judgment has been shown in the selection of the illustrations.

TIME AND TIDE. A Romance of the Moon. By Sir Robert S. Ball, LL.D., F.R.S. London: Society for Promoting Christian Knowledge, 1909. 16mo.; pp. 192. Price, $1.

This is a reprint of the second edition of "Time and Tide," which consisted originally of a series of lectures delivered before the London Institution. The book although popular presumes an acquaintance on the reader's part with such ordinary astronomical facts as may be contained in a work on so difficult a subject of comprehension as the tides. If we have any objection whatever to offer against this admirable work, it is simply that it is not what is now called up-to-date. In other words, we find the subject of solid tides on the earth, that is, the displacement of the earth's crust itself, not dealt with. It seems to us, in view of Dr. Hecker's recent experimental investigations of this subject and his convincing proof of Sir George Darwin's theoretical estimate of the "pull" on the solid earth, that it might have been wise to incorporate in this reprint these later investigations. As it is, however, the book covers the subject well and lucidly.

TWENTY-FIVE YEARS OF ROPE DRIVING. Mishawaka, Ind.: Dodge Manufacturing Company, 1909. Quarto.

It is not the usual practice of this journal to review in its columns trade publications or catalogues. In this particular instance an exception must be made because of the character of the work which lies before us. It is not only an example of admirable printing but a good piece of technical compilation. In the 103 pages of this book much solid engineering information is given as well as an occasional useful table. The material on Features of the American System of Rope Driving, Rope Drive Designs, American vs. English System, and Mechanical Power Transmission, is particularly good because it seems to state very fairly the main differences between two widely used methods of transmission.

ELEMENTS OF TRANSPORTATION. By Emery R. Johnson, Ph.D. New York and London: D. Appleton & Company, 1909. 12mo.; 360 pages. Price, $1.50.

This is a valuable discussion of steam railroad, electric railway, and ocean and inland water transportation. The author is Professor of Transportation and Commerce in the University of Pennsylvania. It has given us great pleasure to review in a short period two other books by Mr. Johnson, viz.: "American Railway Transportation" and "Ocean and Inland Water Transportation." The volume before this is fully as interesting, and these three books should be in the library of every person who wishes to keep fully apace with the times. The author's vast experience has enabled him to handle the subject in a masterly manner. The maps are particularly valuable, many of them being printed in both red and black, showing the increase in mileage at various periods, and also the maps showing the various so-called "routes."

DIE HAUS- UND HOTEL-TELEGRAPHIE UND TELEPHONIE. Von O. Canter. Dritte, gänzlich neubearbeitete Auflage. Von Paul Riemenschneider. 153 illustrations. Octavo. Vienna: A. Hartleben, 1909.

The book which lies before us has passed into its third edition. It is a text book for those electricians who are concerned with the installation of house telephone and telegraph systems. Since such electricians are not always technically trained men, the author begins the book with the usual popular discussion of the cause and effect of the galvanic current, electro-magnetism, and induction. Then follows a description of the apparatus employed, which description is as exhaustive as possible, and deals with the underlying theories of each part thoroughly. After a discussion of the simple and most common house telegraph apparatus, namely, alarms of various constructions, with their accompanying circuits, we find discussion of annunciator systems and telephone and microphone inventions. The subject of house telephony is described at length, as well as suitable protective devices against atmospheric electricity. Interesting is a discussion of tell-tale door contacts, clock contacts, fire alarms, etc. After describing the material necessary for the installation of a house telephone or telegraph system, the author passes to the manner of installing the systems described, and testing methods for the detection of injured portions. The estimates of cost given would hardly apply in this country, but serve the purpose at least of showing the relative value of different parts.

THE FORCE OF THE WIND. By Herbert Chatley. 80 pp.; 12mo.; ill. with diagrams. London: Charles Griffin & Co., 1909. Imported by Lippincott. Price, $1.25.

We find in this little book collected and correlated methods of calculation of wind stresses and wind power which we have often sought with difficulty from scattered formulæ in engineering pocket books and text books, and believe that it will fill a long felt want among engineers who have to deal with wind load on structures and similar problems. The formulæ, many of which are derived by the author, are as simple as moderate accuracy will permit, and calculus methods are introduced only where it is impossible to avoid them. The book is thoroughly up-to-date, including the latest results obtained by Lanchester and Eiffel, and is throughout clear and practical.

CO-ORDINATE GEOMETRY. By H. B. Fine and H. D. Thompson. 300 pp.; 12mo.; 9 plates. New York: The Macmillan Company, 1909. Price, $1.60.

In this book the several conic sections are treated early and in some detail, partly because of the value of a knowledge of their more important properties, partly because of the advantage, when presenting the analytic method to the student, of applying it in the first instance in the systematic study of a few interesting curves. In deference to usage, a chapter on the circle is introduced immediately after that on the straight line; but, if experience is to be trusted, it is better in a first course to proceed from the straight line directly to the parabola, so that, as early as possible, the student may get the impression which comes from seeing a method employed in the investigation of new material. The part of the book devoted to solid geometry is more extended than is customary in elementary textbooks; but it is desirable that the material here given should be easily accessible to students. Although intended as a college textbook, the present work follows the fortunate modern tendency toward the practical and forms as good a treatise upon the subject as possible for the non-collegiate student.

A Manual of Practical Assaying. By the late H. van F. Furman. Revised and enlarged by W. D. Pardoe. 497 pp.; 8vo. New York: John Wiley & Sons, 1909. Price, $3.

This standard work on assaying has, in the new (sixth) edition, been thoroughly revised and brought up-to-date. The chapters on zinc, water, and coal analyses have been rewritten, and minor changes have been made in certain parts due to the description of new methods. Because of their increasing importance commercially, chapters have been added on the assay of telluride ores, tungsten, molybdenum, and vanadium. On the latter important subjects the reputation of the work as one of the leading text-books on the subject has been completely maintained and the usefulness of the whole enhanced.

Structural Details. Elements of Design of Heavy Framing. By H. S. Jacoby. 368 pp.; 8vo.; 6 folding plates and 34 full-page ill. New York: John Wiley & Sons, 1909. Price, $2.25.

The title of this volume corresponds to a course of instruction conducted by the author in the College of Civil Engineering in Cornell University during the past nineteen years. In this course the students receive their first instruction in the application of the principles of mechanics to the design of the details of structures. Experience has shown that in many respects problems involving timber construction are better adapted for this purpose than if confined to structural steel. It may appear at first as if too much attention to details is given in the examples on the design of joints, beams, and trusses. The author believes, however, that the importance of careful study of every detail can only thus be properly emphasized. In practice it seems to be the exception rather than the rule to give the same attention to details of timber structures as to those of steel. In the interest of sound engineering practice it is essential that all connections and details have the same degree of security as the framed members. In several articles the order of design is given in full, with a view of economizing the time of the student, and of promoting systematic habits in making the computations required, these objects being regarded as important elements in efficient engineering education and practice. Whereas the book is intended for college use, much of it is so written as to be intelligible without the mathematics involved and valuable to the practical carpenter or builder desirous that his work shall be on sound principles or interested in the theory upon which are founded the rules of his practice.

The Internal Combustion Engine. By H. E. Wimperis. 320 pp.; 8vo.; fully ill. New York: D. Van Nostrand Company, 1909. Price, $3.

This is the first treatise on gas, oil, and gasoline engines we have seen which goes as thoroughly into the subject both theoretically and practically as do the best text-books on the steam engine. The author traces the energy that drives our engines all the way from solar heat and molecular action to the uses to which the modern internal combustion engine is applied, covering sufficiently the laws of thermodynamics, the chemistry of combustion and explosion, the best design in gas engines and producers, and oil and gasoline engines. The final chapter on gasoline engine efficiency and rating is the best we have seen on this much debated question, and is in so far practical and helpful to the amateur and the sportsman as to discuss the modification of accepted ratings which should be made in hill-climbing and other automobile competitions.

Henry Hudson. A Brief Statement of His Aims and Achievements. By Thomas A. Janvier. To which is added a newly discovered partial record, now first published, of the trial of the mutineers by whom he and others were abandoned to their death. New York and London: Harper & Bros. 148 pp.; 12 ill.; 16mo. Price, 75 cents.

The Hudson-Fulton Celebration has aroused keen interest in the life of one of the most romantic characters among the explorers and navigators of the sixteenth and seventeenth centuries. The book before us is divided into two parts, the first consisting of a brief sketch of the life of Henry Hudson, and the second dealing with newly-discovered documents. The latter have remained neglected for three centuries, and are here published for the first time. The discovery of these documents is due to Dr. R. G. Marston, M.A., as a result of a search in the Record Office in London. The story of the trial is of great interest, but of little satisfaction, inasmuch as we are ignorant of what punishment, if any, was inflicted upon the mutineers of the "Discovery." The importance of these documents is that they establish the fact (until now not established) that the mutineers were brought to trial, and that they embody a sworn testament, hitherto unproduced, of six members of Hudson's crew concerning the mutiny. The illustrations include no portrait of Hudson, since the author is satisfied that no authentic portrait of the man is in existence. Outside of the new documentary evidence above referred to, the narrative of Hudson's life is a condensation of the facts that have been recorded by Hudson's authoritative biographers, notably Purchas, Gerritz, Van Meteren, Asher, Murphy, Brodhead, and Read.

Machine Shop Drawings. Reading Drawings, Making Shop Sketches, and Laying Out Work. By Fred H. Colvin, A.S.M.E., F.I. New York: McGraw, Hill Book Company, 1909. 16mo.; 139 pp. Price, $1.

This little book is intended to be a help to those who do not thoroughly understand the reading of drawings, rather than an attempt to teach drawing in itself. It shows how seen and unseen portions are represented, the use of full and dotted lines, the way in which different views are drawn, and how to study them all so as to secure a correct idea of the shape of the piece represented. Many actual examples are given from the drawing-room practice of the leading shops in this country, and the meaning of each carefully explained. The book is an eminently practical one and is illustrated by well-executed engravings, the wax process, which is the only suitable one for the purpose, being used.

A Book of Fourth-Dimension Essays.

The subject of the fourth dimension seems to have aroused so much interest among the readers of the Scientific American that we have decided to publish in book form the prize essay, the three essays that received honorable mention, and about sixteen of the best essays which were submitted in the recent Fourth Dimension Contest. The entire collection will be edited by Prof. H. P. Manning, who will prepare an introduction of considerable length, in which the subject of the fourth dimension will be simply and lucidly discussed. The book will be ready about the latter part of December.

Legal Notices

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THE 10,000-TON SUCTION DREDGER FOR USE ON THE MERSEY.

(*Continued from page 332.*)

Each valve is of tapered cylindrical form extending the full depth of the hopper, with open-bottomed valve at the lower edge, and has a lift of four feet. These valves are worked by hydraulic cylinders controlled from fore-and-aft gangways and supported by a continuous fore-and-aft girder running the full length of, and above, the hoppers. Guide rings efficiently stayed to the hopper sides are fitted at the upper and lower parts of the valves for steadying the same.

A surface valve with lever for opening or closing it from the gangways is fitted on top of each hopper valve, to drain off the surface water. During dredging operations, the mixture of sand and water is delivered into the landers, and thence falls into the hoppers through the valves already described. The sand settles in the hoppers, while the surface water escapes aft along the waterway formed by the hopper coamings to the weir plates, which can be adjusted to suit the trim of the ship, and then flows overboard through large rectangular shoots, two of which are disposed on each side. When discharging spoil, the hopper valves are raised, and the sand rapidly falls through the openings in the bottom of the vessel.

There is an indicator fitted in the chart room which shows the draft of the ship, together with a complete system of repeating telegraphs and speaking tubes for transmitting orders to the pumping and propelling engine rooms, and to the different winchmen in their respective winch houses. Moreover, there are powerful electric alarm bells fitted to the pipemen's positions. Pushes are provided for each pipeman, and one on the navigating bridge, so as to give alarm in case of necessity.

The hydraulic installation carried out by the builders of the ship comprises a set of three-cylinder inverted high-pressure direct-acting engines having three cranks and three single-acting ram pumps, driven direct from the piston-rod crossheads. The hydraulic pressure is 800 pounds per square inch, and is used for working the four main sluice valves on the suction pipes at the sides of the vessel, as well as those on the delivery pipes at the ends of the landers, and for opening and closing the twelve hopper-discharge valves.

The propelling machinery is right aft, and consists of two sets of inverted, vertical, triple-expansion engines of the same type as the pumping engines, each having cylinders of 22½ inches, 37 inches, and 61 inches diameter, respectively, by a stroke of 45 inches. Steam is raised in four large single-ended marine boilers measuring 15½ feet by 12½ feet, placed between the propelling and pumping engine rooms and constructed for a working pressure of 180 pounds per square inch. Watertight doors controlled from the upper deck are fitted in the machinery space bulkheads to provide access from one room to another.

The side compartments adjacent to the hoppers, as well as the two forward holes, are buoyancy spaces rendered necessary for the vessel to support her weight of hull, plant, and load on the specified draft of water.

The engineers and officers are housed in the poop and the crew in the forecastle, the master's cabin being placed in a large teak house on the navigating bridge, with the chart and wheel house above.

The vessel is fitted throughout with a complete installation of electric light on the incandescent system. The engines and dynamo are placed in the propelling-engine room. The engine is of the inclosed type, compound direct double-acting, and coupled direct to the dynamo, which is of the direct-current compound-wound pattern. The powerful windlasses, each driven by separate vertical engines

(*Concluded on page 340.*)

and connected by compound positive clutches at both crank and main shafts, are fitted on the forecastle head for working the anchors.

The steam steering is of the Caldwell combined steam and hand type, with control shafting to the steering standard on the navigating bridge, and is placed in the engine-room casing. Hastie's hand-screw steering is fitted aft immediately over the rudder head, for use in case the steam gear breaks down. On the starboard side a motor launch is carried under Welin bow davits, ready for immediate use for taking soundings or making observations.

SOME CURIOSITIES OF INVENTION.

(*Concluded from page 332.*)

by cork bulwarks *b*. We wonder if the inventor really believes in the efficacy of the hand-operated screw propeller which he has provided.

The Society for the Prevention of Cruelty to Animals would undoubtedly interest itself in restraining the inventor who devised the arrangement here shown to enable a dog or cat to run a sewing machine. We once heard of a man who patented a contrivance for driving a coffee mill by means of a bicycle, so that by the simple contrivance of riding a bicycle it was possible to obtain not only a certain amount of exhilarating exercise, but also to provide enough ground coffee for breakfast. This patentee surely outdoes him. The dog is made to rotate a central shaft carrying a large gear wheel which meshes with a small bevel gear carried on the sewing machine driving wheel. It seems to us that after the dog had sewed one shirt he would be too dizzy to do much more; or perhaps when that occurs, the central shaft is to be driven in the opposite direction.

A grain of common sense is to be found in the trunk that becomes its own luggage trolley, for it must be confessed that the ordinary trunk when full is not the easiest thing in the world to handle. The inventor has provided a single wheel and a folding lever handle which serves the purpose of pushing the wheeled trunk along. He evidently was not concerned much with the problem of the amount of space consumed by the wheels and the handle when folded within the trunk.

The handle shown for carrying parcels used in carriages has been employed in European railways. The device consists simply of two straps and a rest board, with the whole easily detachable. Straps serve the purpose of binding the rest board and walking sticks and umbrellas together.

A boat driven by windmills is certainly a mechanical curiosity. Just why this complicated arrangement of bevel gears connecting the propeller shaft with the vertical windmill shaft should be better than canvas transcends our imagination.

There is a touch of the Yankee in the fishing device, the last of the inventions illustrated. Evidently the inventor was accustomed to fishing in streams where bites were few and far between, and where patience was ill rewarded. He has contrived a fishing pole with a swinging arm carrying a clapper which is made to ring a bell as soon as a fish bites and swings the arm down.

BIRDS OF PASSAGE.

(*Continued from page 335.*)

of the return of the same individuals. Some wonderful European records of the return of a species to a given nesting site are given by the late Prof. Alfred Newton. A common falcon, *Falco peregrinus*, a cosmopolitan bird commonly known as the duck hawk, in this country, had its eyrie at one point in Finland for 110 years; that is to say, there was at this same point an occupied nest of this species from 1736 to 1855. At Oxbridge, in one or the other of two earthen bottles placed for their use, a pair of blue titmice had their nest every year, with two

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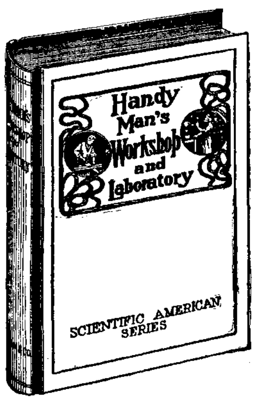

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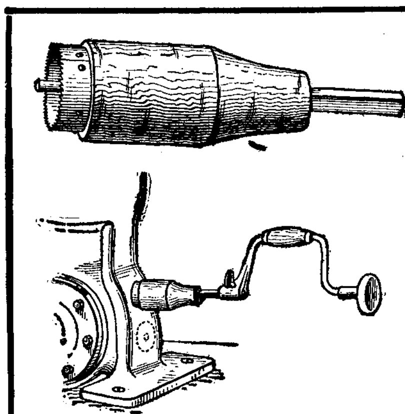
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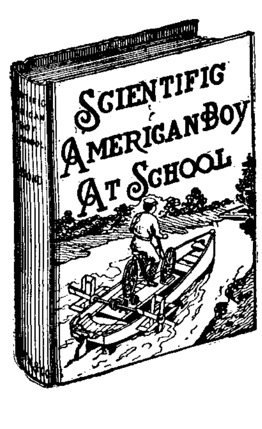

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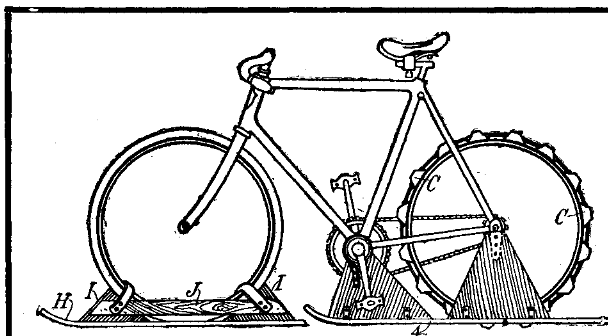
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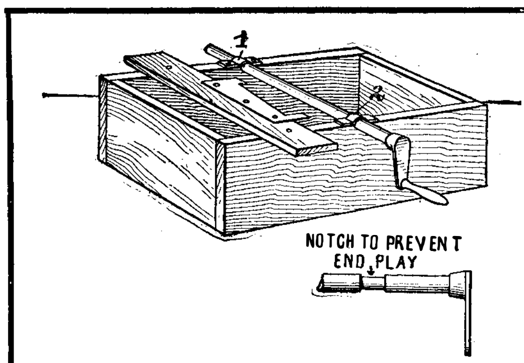

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AGENTS:—IF I KNEW YOUR NAME, I would send you our $2.19 sample outfit free this very minute. Let me start you in a profitable business. You do not need one cent of capital. Experience unnecessary. 50 per cent. profit. Credit given. Premiums. Freight paid. Chance to win $500 in gold extra. Write me for free outfit. Jay Black, Pres., 60 Beverly St., Boston, Mass.

Inquiry No. 8918.—For manufacturers of "Wydt's Electro-Catalytic Sparking Plug."

PATENTS FOR SALE.

FOR SALE on a royalty basis, a Bundle Tying Machine for mercantile use. A new field of enormous possibilities. Cheap in comparison with its need. Address J. W. Hall, Wrightstown, Pa.

Inquiry No. 8922.—Wanted the address of Worthington Boiler Co.

FOR SALE.—Patent No. 927,574. A new and useful Button Fastener for fastening buttons without sewing. Fills a long felt want. Will be a good money maker. Sell outright. Anton Mickish, Market Lake, Idaho.

Inquiry No. 8966.—Wanted the address of the Cohendet Motor Co.

FOR SALE—Patent No. 936,866. The most useful automobile appliance known. No auto stalled that has this appliance. Address H. S. Delamere, Room 1, South Berkeley Bank Building, Berkeley, Cal.

Inquiry No. 8987.—Wanted, the manufacturers of the Van Winkle Woods & Sons, and the Weber power meters.

FOR SALE.—Patent No. 936,141. Improvements on airships and aeroplanes. For further information write to A. E. G. Lubke, 852 Clayton Street, San Francisco, Cal.

Inquiry No. 8990.—For information regarding shoes not made of leather but similar to the same and are as durable.

OUTRIGHT SALE OR ON ROYALTY.—U. S. Patent No. 925,627, Canadian Patent No. 118,362. An apparatus for producing uniform fluid pressure for engines. A great saving in expense. For further information write Elmer Engebretson, Devils Lake, North Dakota.

Inquiry No. 8996.—Wanted addresses of manufacturers of machinery for working orange wood manicure sticks.

FOR SALE.

FOR SALE CHEAP.—One Potter trestle trench machine; one surface Potter trench machine; two Lambert 20 H. P. hoisting engines; one Buffalo concrete mixer; one centrifugal pump; one Edison band pump; one steam pump; a lot of screw jacks and braces; steel sheet piling 10 feet by 7 inches for 100 feet complete sewer and all tools necessary for sewer work. Address Rich Construction Co., 507 Missouri Trust Building, St. Louis, Mo.

Inquiry No. 9001.—For the address of progressive manufacturers of fruit jars.

FOR SALE.—Engine lathe, swings 9½ in., takes 25 in. between centers. Complete with full set change gears to cut all size threads, 3 to 40 in. Price only $43.50. Address L. F. Grammes & Sons, Allentown, Pa.

Inquiry No. 9010.—Wanted to buy a "Rector Help-a-Phone."

TYPEWRITERS.

REMINGTON $18.75—One machine only in new localities to secure desirable agent. Special agents' prices supplied on all makes of typewriters. 3 ribbons $1.00. Standard Typewriter Exchange, 23 Park Row, New York.

Inquiry No. 9012.—Wanted to buy papier mache boxes in the shape of water melons, colored to resemble melons, etc.

MISCELLANEOUS.

HAIR GROWS when our Vacuum Cap is used a few minutes daily. Sent on 60 days' free trial at our expense. No drugs or electricity. Stops falling hair. Cures dandruff. Postal brings illustrated booklet. Modern Vacuum Cap Co., 556 Barclay Block, Denver, Colo.

Inquiry No. 9014.—For manufacturers of machinery, supplies, etc., to equip a small plant for the manufacture of iridium-tipped gold nib making for fountain pens.

WANTED.—Apparatus and films for moving picture show; also phonographic attachment for moving pictures and illustrated songs. Address Frank H. Goulette, P. O. Box 225, Manila, P. I.

LISTS OF MANUFACTURERS.

COMPLETE LISTS of manufacturers in all lines supplied at short notice at moderate rates. Small and special lists compiled to order at various prices. Estimates should be obtained in advance. Address Munn & Co., Inc., List Department, Box 773, New York.

Inquiry No. 9016.—Wanted, machinery necessary for an installation of a plant for refining salt by a modification of the Bessemer process.

A LIST OF 1,500 mining and consulting engineers on cards. A very valuable list for circularizing, etc. Price $15.00. Address Munn & Co., Inc., List Department, Box 773, New York.

Inquiry No. 9018.—Wanted the address of parties manufacturing gold-plated pens for use in cheap fountain pens.

Inquiry No. 9022.—Wanted, to buy a light, small motor, not exceeding three pounds in weight, including everything in going order.

Inquiry No. 9023.—Wanted, to buy silk machines from re-reeling, twisting, doubling, to the final process of making it into clothes.

Inquiry No. 9025.—Wanted, address of rubber manufacturers in Germany.

Inquiry No. 9026.—Wanted, address of parties who make "invar" or other metals having a low coefficient of expansion.

Inquiry No. 9028.—Wanted, to buy a washing machine that is run by a coil spring motor.

Inquiry No. 9029.—Wanted, catalogues and all information on machinery for braiding straw in manufacturing straw hats.

Inquiry No. 9030.—Wanted, the address of firms manufacturing a wood fiber bottle and case made from same material.

Inquiry No. 9032.—Wanted, the address of parties who supply carriage and wagon makers with white gum wood blocks for making hubs for vehicle wheels.

Inquiry No. 9034.—For manufacturers of machinery that could reduce stumps to kindling wood.

Inquiry No. 9035.—Wanted, manufacturers to make a metallic case somewhat similar to the "Thermos" bottle.

Inquiry No. 9036.—Wanted, the address of the manufacturers of "Cycle Ball Bearing Suspenders."

Inquiry No. 9037.—Wanted, the address of the party who manufactures "Bakelite."

Inquiry No. 9038.—Wanted, the address of the Chipman Electric Purifying Co.

Inquiry No. 9039.—Wanted, machinery for the manufacture of salted peanuts.

Inquiry No. 9040.—Wanted, machinery necessary in the manufacture of tooth picks.

Inquiry No. 9041.—Wanted, parties to manufacture a small wooden arrow for use in connection with a toy.

(Concluded from page 340.)

exceptions, from 1779 or 1785 to 1873, or a total of 88 to 94 years. While it might be possible that by coincidence the individuality of this continuous tenantry would continually vary, yet it is hardly possible that it was other than a case of a family castle handed down to posterity.

A fact which is incidentally brought out by these observations on the return of birds to a given locality, is the apparently passionate fondness for a given nesting site, regardless of changing conditions in connection with it. In illustration of this the author just quoted cites the case of a stone-curlew, *Œdicnemus crepitans*, a bird frequenting open places almost exclusively. For many years a pair of these birds had a nest at a certain spot near Elwedon, Suffolk, England, and during this period the environment underwent a complete change, from a barren rabbit warren to a flourishing plantation, in the center of which the nest continued to be occupied. An even more remarkable example of fondness for a certain spot, regardless of change of conditions, was brought to the attention of the present writer several years ago. A portion of Long Island City, within the greater city of New York, was being built up on filled-in marsh. During the fall and winter a plot of ground was filled-in and a house built thereon. The following spring a Florida gallinule, *Gallinula galeata*, was repeatedly observed wandering disconsolately back and forth across the dooryard, seeking the site of last year's nest, though all about were patches of virgin marsh.

It seems quite possible that this fondness for a breeding home, once established, may be an important factor in the causes of migration.

Here, then are some of the facts that command attention, in the results of the data that has been accumulated regarding migration; the impulse to migrate, for which we have no adequate and demonstrable explanation; the stability to steer a course with such remarkable accuracy over areas where landmarks are wanting, and in the night and storm when they are obliterated, demonstrating a most highly developed sense of direction, which is but imperfectly present in the wildest races of mankind, and usually almost or entirely wanting in civilized man; the adoption of certain well-defined migration routes, both in the Western and Eastern hemispheres, which may be varied from spring to fall, or become changed by untoward conditions; the existence of this migratory instinct in varying intensity, which coupled with conditions of food supply and breeding sites induces in some species immensely extended journeys, from which there is every gradation to the species which are apparently immune to the promptings of this instinct. In connection with this last fact it should be borne in mind that the fact of a species being found in a given locality throughout the year does not necessarily imply that the individuals of that species are not migratory. The individuals found in a locality in winter may have summered further north, and coming to that locality in fall, overlapped the departing summer birds, so that at no time individuals of the species were wanting, though not at all times the same individuals.

TESTING BITUMENS.

(*Concluded from page 336.*)

penetrated into the specimen. As it is desired to ascertain this with considerable accuracy, it is necessary to magnify the displacement of the rack. This is the office of the pinion and indicator. The dimensions of these are so arranged that a fall of 0.1 millimeter (=0.0039 inch) will correspond to one division on the dial.

Penetration at most temperatures is permitted for just five seconds. At the beginning the reading of the dial is noted, and also at the close. The difference will show the amount of penetration in terms of tenths of a millimeter. But if the test is made at the freezing point of water, or at a lower temperature, the penetration is allowed to continue for a full minute. The weight carried by the needle is not always the same. For temperatures that do not rise above 32 deg. F., the weight is 200 grammes. At 77 deg. F. it is 100 grammes. For a temperature of 100 deg. F. or higher, the weight is reduced to 50 grammes. As the apparatus depending upon the needles weighs just 50 grammes, apart from the weight *W*, the requisite variations in load are readily made.

The question arises here, however, as to whether there is any point of view from which the amounts of penetration at the various temperatures may be regarded as comparable. Thus Mr. Dow gives the penetrations of three different asphaltic cements, A, B, and C, as follows:

PENETRATION NUMBERS.

Temperature.	A.	B.	C.
32 deg. F.	10	13	25
77 deg. F.	55	47	45
100 deg. F.	150	110	75
115 deg. F.	350	220	120

The amount of penetration of A at 32 deg. F. is 10; at 77 deg. F. it is 55. But are the cases comparable? Can we say with an justice that the viscosity in the one case is 5½ times that in the other? The penetration of 55 was accomplished with half the load and in one-twelfth the time. Offhand, it would seem that the number 55 should be 24 times as great.

There are, however, two other influences at work—one tending to make the number 10 too large, the other tending to reduce it. Falling bodies—and such a body the penetrating needle is—do not have a uniform velocity, but become accelerated. On the other hand, as pointed out by Mr. S. Whinery, the depth of penetration is not a measure of the work done, the needle being in fact of a conical form. The farther the penetration, the greater the amount of material displaced, and the greater the frictional resistance (due to adhesion) per unit of penetration. However, it is conceivable that the form and material of these counteracting factors might be so adjusted as to nullify each other.

With the disturbances arising from acceleration and from variation in resistance eliminated, there still remains the apparently faulty method of varying the weights and the time. It would seem better to maintain these factors precisely the same, or else correct the numbers so as to have them comparable, whatever the temperature. However, the Dow machine has, apparently, proved itself of great value in actual practice. An improved machine has recently been put on the market, in which the framework arrangement supplying weight for the needle is entirely discarded, being replaced by a tube containing the weight and holding the needle. This tube slides in a guide-arm supported by a substantial upright. The extra weight, as may be seen in the engraving, is placed low on the tube, and so will tend to deflect it but little, if at all. The table carrying the specimen is supported by a screw arrangement. This enables the specimen to be brought into contact with the needle at zero position. The mirror, seen at the bottom of the apparatus, enables the operator to determine when contact between needle and specimen has been secured. The counterbalancing arrangement used in the Dow apparatus is replaced by the pressure of a spring. The remaining features are essentially the same. The rejection of the framework device weighting the needle and the string counterbalance would seem to be steps in advance, especially if the replacements will yield as good results.

A practical word may be added as to the results shown in the table of penetrations. The cement A is regarded as showing as great a variation as is safe for pavement use. A greater variability in viscosity at the different temperatures would be difficult, if not impossible, in practical application. If soft enough for 32 deg. it would be too soft at high temperatures. C shows a steadiness which would be valuable if it were not for an accompanying bad quality. Its ductility (at 77 deg. F.) is but 20, while A is 300. B shows less variability in viscosity than A and more than C. Its ductility (at 77 deg. F.) is 75.

The susceptibility to change in hardness resulting from application of heat or to ageing may be ascertained by utilizing the penetrometer.

It will be seen from a consideration of the facts which have been recounted, that the tests for ductility and viscosity are of great practical utility.

Trigger mechanism, E. R. Williams........ 938,192
Trigger mechanism, single, P. H. Robinson. 937,864
Trolley, O. W. Brenizer.................. 937,761
Trolley pole, J. Harsen.................. 937,935
Trousers, F. H. Sprague..........937,883, 938,347
Trowel, P. Neerup........................ 938,070
Truck, S. Craig.......................... 938,301
Truck lateral motion roller bearing device, car, J. C. Barber........................ 937,752
Trunk tray support, C. F. Rom............ 937,866
Tube mill cement feeder, A. E. Sparrow.... 938,176
Tunnel, subaqueous, E. W. Moir........... 938,265
Turbine, elastic fluid, F. Hodgkinson...... 937,996
Turbine, elastic fluid, S. Z. de Ferranti.... 938,309
Turbine muffler and fly-wheel, combiner, J. A. Lawson............................ 938,253
Typewriter attachment, W. A. Tompkins... 938,354
Typewriter keyboard lock, W. P. Kidder.... 938,059
Typewriting machine, A. T. Brown......... 938,119
Typewriting machine, A. W. Steiger....... 938,178
Typewriting machine, Tanner & Jones...... 938,350
Typewriting machine, J. B. Secor.......... 938,439
Typewriting machine, L. D. Broughton..... 938,454
Ultramarines, manufacture of, F. Bellet.... 938,408
Umbrella, folding, J. T. Manning.......... 938,007
Valve, H. Gibbs........................... 937,931
Valve, F. Schreidt........................ 938,080
Valve, C. Wainwright..................... 93 ,292
Valve, air brake safety, O. Gibson......... 937,991
Valve, barrel, C. F. Terney............... 938,288
Valve, check, H. F. Cunning............... 937,773
Valve, engineer's, W. Ohlsen.............. 938,169
Valve gear, A. M. Wolf................... 938,360
Valve gear for explosive engines, A. A. Karcher.............................. 938,386
Valve, pressure regulating, H. F. Cunning.. 937,774
Valve, safety gas, F. D. Gregory.......... 937,791
Valve, vacuum air, C. A. Dunham.......... 938,226
Vapor burner, R. C. Bierbower............ 938,365
Vault, burial, H. Lanius.................. 938,250
Vault, burial, G. Hess.................... 938,379
Vehicle brake, R. R. Hart................ 938,322
Vehicle, dumping, C. Miller............... 938,012
Vehicle fender, C. W. M. Guhle............ 938,053
Vehicle, motor, H. Pieper................. 937,859
Vehicle motor fore carriage, Vignie & Forget 938,094
Vehicle reach, M. R. Hull................. 937,940
Vehicle ventilator, F. R. Harvey.......... 938,232
Vehicle wheel, E. Hartman................. 937,798
Vehicle wheel, E. Hopkinson............... 937,808
Vehicle wheel, L. M. Wolffsohn............ 937,910
Vehicle wheel, W. D. Trigalet............. 938,184
Vending machine, coin controlled, H. A. Ladue................................ 937,820
Vending machine coin controlled mechanism, J. Fritsche........................... 938,419
Vending machine, picture, T. R. McQuillan. 937,949
Vent, sanitary, W. S. Tuttle.............. 937,8 3
Ventilator. See Vehicle ventilator.
Ventilator, H. F. Maranville.............. 938,067
Vibrating, tension, and operating table, J. Lend................................. 937,825
Violin tuning peg, P. Rose................ 938,079
Voting booth, E. Hinton................... 937,806
Voting machine, J. H. Dean........938,126, 938,412
Wagon brake, E. A. Johnson............... 938,241
Wagon runner, F. Kindahl.................. 937,999
Wagon, school, Parry & Byers.............. 937,953
Wagon shock loading attachment, farm, F. X. La Londe............................ 938,152
Wall, retaining, M. M. Upson.............. 938,091
Warp carriage, H. D. Colman............... 938,124
Warp frame, W. L. Dorr................... 938,130
Washboard, J. E. Byrnes.................. 937,985
Washer, H. A. Davis...................... 938,302
Watchmaker's tool, C. H. Pratt............ 937,869
Water elevating apparatus, O. A. Roed..... 938,078
Water elevator, J. Montgomery............ 938,266
Water heater, electrically operated, J. A. Hunnewell............................. 938,237
Water heating apparatus, A. C. Dunham, 937,776, 937,777
Water purifying apparatus, H. Reisert..... 938,075
Water tube boiler, H. F. Ely.............. 937,782
Weather strip, W. C. F. Beale............. 938,107
Weight indicating mechanism, Heimann & Flatow............................... 938,054
Welding machine, chain, F. H. Howard..... 938,056
Wheel, E. Stewart........................ 937,969
Wheel, G. H. Treadgold................... 937,973
Whiffletree, quick releasing, E. A. Carkin.. 938,120
Window balcony, portable, T. Hull........ 938,382
Window ventilating device, C. V. Walker... 937,899
Wire stretcher, W. W. Snyder............. 937,881
Wire stretcher, J. R. Wade............... 938,029
Wood, bending, J. T. Breece.............. 938,366
Wood, preserving, Von Heidenstam & Friedemann............................. 937,802
Wrench, D. W. Shaffer.................... 937,966
Wrench, C. Sauer......................... 938,020
Wrench, E. D. Hamilton................... 938,319
Wristband, H. J. Collis................... 937,769
Yoke, neck, G. E. Wheeler................ 938,295

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., Inc., 361 Broadway, New York.

Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address Munn & Co., Inc., 361 Broadway, New York.