SCIENTIFIC AMERICAN

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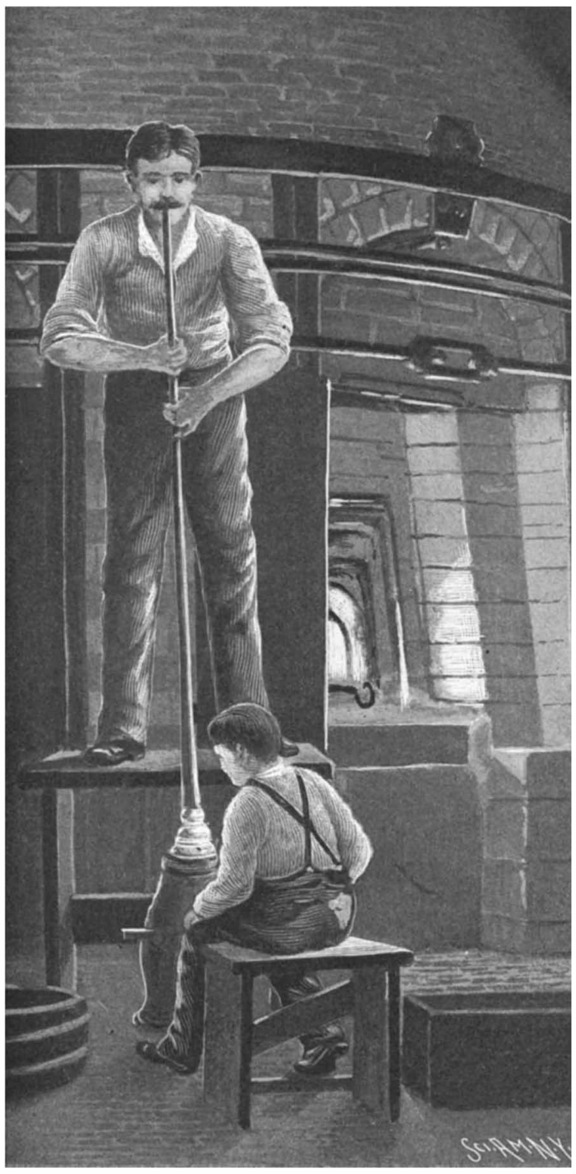

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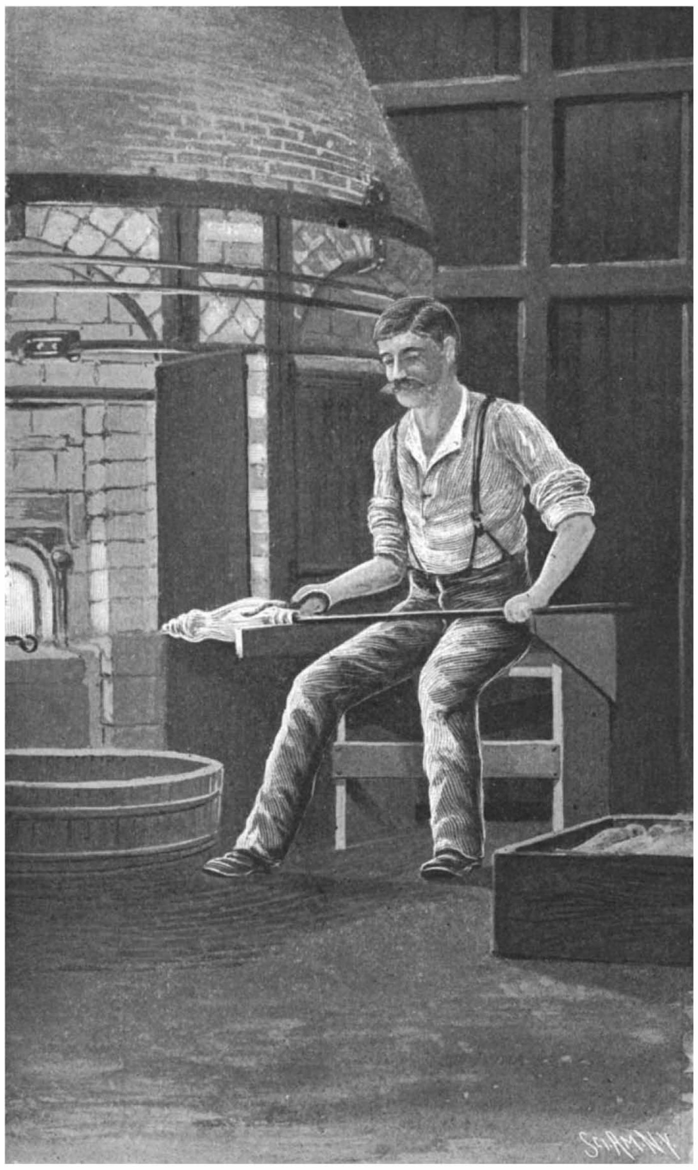

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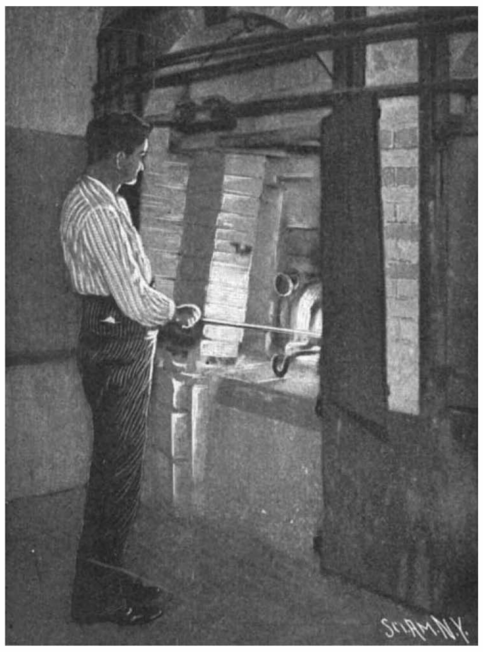
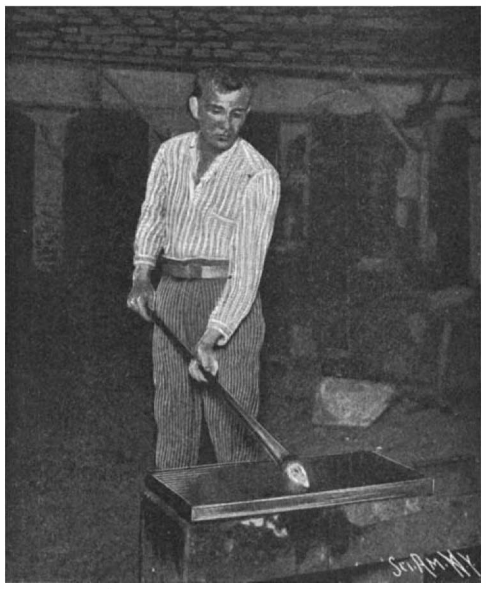
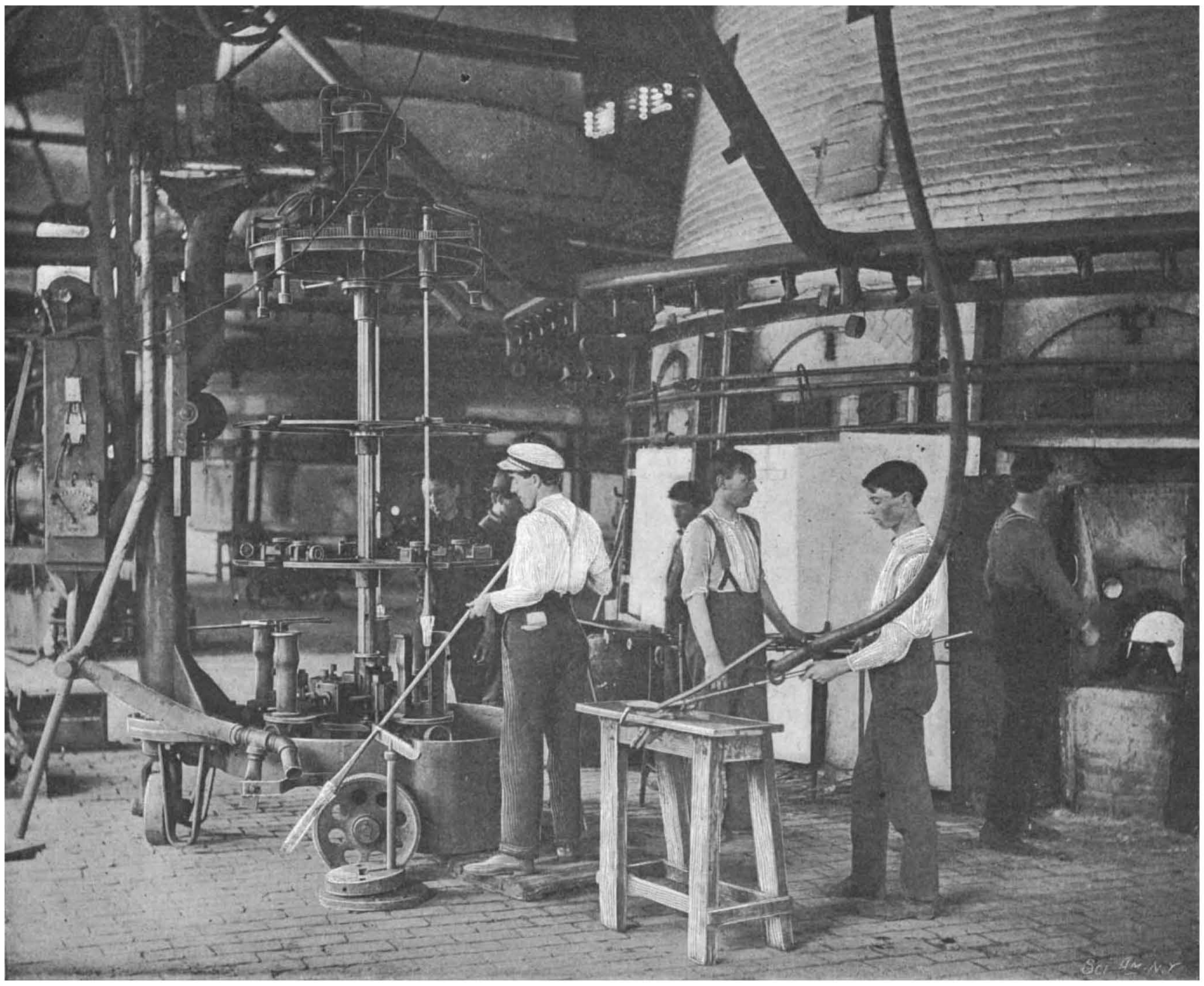


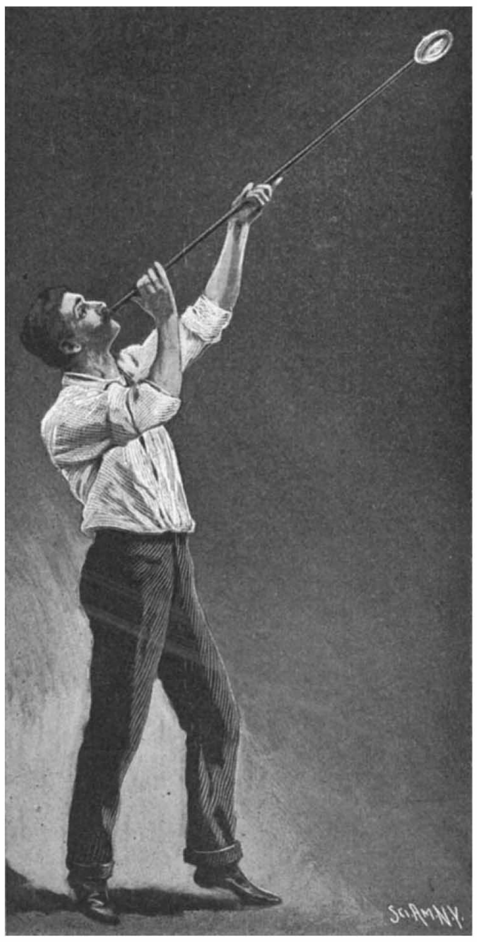
Gathering Molten Glass on the Blowpipe.



Rolling the Glass to Conical Form Before Blowing.



The Melting Furnace and Blowing Machine.



Blowing.

THE MANUFACTURE OF BLOWN GLASS—LAMP CHIMNEYS.—[See page 54.]

Scientific American.

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NEW YORK, SATURDAY, JULY 27, 1901.

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

THE RELOCATION OF OUR RAILROADS.

An observant traveler over the trunk lines of this country will be struck with the fact that many of them are undergoing a relocation and reconstruction which, in many cases, will cost two or three times as much per mile as the original line. One of the most notable instances of this is to be found on the main line of the Pennsylvania system between Pittsburg and Altoona, where the work of straightening out the line and lowering the grades involves an amount of excavation and embankment whose great cost is evident even to the casual traveler on the road. This work of reconstruction is not to be taken as in any sense a reflection upon the engineers who located the original lines. It simply means that the growth of traffic and the increase in wealth of the road are such as to justify the reconstruction of a road on a scale of excellence which, on account of its great cost, was unwarranted and indeed, impossible, when the lines were first projected.

When an engineer sets out to locate a line through a tract of country, his natural inclinations will lead him to make the line as nearly level and as nearly straight as the topographical conditions will allow, and it is only because he is handicapped by arbitrary conditions, chiefly of a financial nature, that his location shows the endless succession of curves and grades which characterize a preliminary survey. So true is this, that it may safely be said that the sharpness of the curvature and the severity of the grades will be in strict proportion to the resources of the company that sends him out. In the early days of railroads, when the present bewildering cobweb of lines was commencing to be spun out over the face of the continent, population was sparse, funds were limited, and the steam railroad as a means of transportation was yet something of an experiment. In marking his survey and submitting his preliminary estimate of the cost of a new road, the locating engineer was frequently tied down by rigid restrictions of economy in the shape of a limit of cost of so many thousands of dollars per mile, which he was informed the road was not to exceed. Working on this basis he was naturally careful to disturb the natural surface of the country as little as possible. In developing his line through hilly country he would swing round a bluff with a ten-degree curve, rather than involve the quadruple expense of cutting deeply into the bluff with a six or seven-degree curve. Similarly he would carry his line over the summit of a divide with a three or four per cent grade, rather than face the costly alternative of a lighter grade and a two or three-mile tunnel at the summit. The line was laid down with strict regard to economy in first cost, and with little or no regard to economy of operation. It was regarded as a temporary expedient, and the present costly relocations which are taking place are not the remedying of defects in the work of our earlier railroad builders, but are merely the completion of plans which they themselves had in mind from the beginning and would have followed had they been financially able. We note that our esteemed contemporary, The Railroad Gazette, has taken exception to the following statement made in the Report of the Master Mechanics' Committee on the "Maximum Monthly Mileage." "We cannot resist comment on the poor judgment, frequently displayed by our civil brothers in engineering, when, in selecting the cheapest line in the first instance, instead of one with a given maximum grade curve, they only prepare for work that must be done later at enormously increased cost." We think that the exception is certainly well grounded, and, indeed, we are of the opinion that of all the men who contributed to the construction of the pioneer railroads of this country, none are more deserving of credit for their general skill, good judgment, and foresight than the civil engineers who did their work subject to most harassing financial embarrassments. If blame is to be laid, it should be upon the financial and not the engineering aspects of these early roads. Just here, indeed, we would draw attention to the too-frequently-forgotten fact that the credit which is due for the conception and carrying out of engineering works is very intimately dependent upon the plenitude or scarceness of funds available for the engineer; and there is no doubt that as great resourcefulness and skill is frequently necessary in carrying out small works on a limited capital, as in directing the monumental structures of modern days where every facility in the way of men and material and unlimited capital, is available.

SOME RESULTS OF THE ALBANY FILTRATION PLANT.

The recently completed Albany filtration plant, of which we gave a fully illustrated description in the SCIENTIFIC AMERICAN of March 24, 1900, has afforded an excellent opportunity to obtain accurate data, both as to cost of operation and efficiency of results. Fortunately the responsible authorities have turned the opportunity to the best account, and the engineer of the works, Mr. George I. Bailey, has recently been able to present accurately compiled figures of the results already obtained. Although there were plenty of records of a kind on this subject, there were but few that gave comprehensive details. The method of treatment adopted at Albany is that of slow filtration through sand. The water is raised 18 feet by pumps into a large settling basin, from which it passes to eight filter beds, consisting of various superposed layers, ranging from gravel of about the size of a baseball at the bottom to fine sand at the top, the top layer of sand being about 4 feet in depth and the total depth of the sand and gravel being 5 feet 2 inches. The water is led in over this prepared bed to a depth of 4 feet, and is allowed to pass downward through the gravel and sand to a system of underdrains, at the rate of about 4½ inches an hour, the yield per acre of the filter-bed being about 3,000,000 gallons in every twenty-four hours. From the bottom of the filter-beds it is drawn off to a central pumping station, from which it is distributed throughout the city. The first purification takes place in the large settling basin, where the heaviest suspended impurities are deposited. In passing down through the filter-bed the silt and bacteria are deposited in the top layer of sand, and the greater part of it at the top of the bed. So perfect is this filtration, at the slow rate at which the water passes through, that the finest particles and most of the bacteria are strained out at the surface and not carried down into the bed of sand. Periodically, the top layer of sand containing the silt and bacteria is scraped off, cleansed in special washing machines, and redistributed over the bed.

It is justly claimed that the truest test of efficiency of a system of filtration is its effect upon the public health of the city which uses it, as shown in the lowering of the death rate due to certain well-known, water-distributed diseases. Now, comparing the average number of deaths per year in Albany for the year 1900 with that of previous years, it is shown in the report of the operation of the filtration plant that whereas the average for the previous decade had been 2,186 per year, the number of deaths for the year 1900, during which the plant was in operation, was only 1,742, a decrease of 444 deaths. Special significance is given to these figures by the fact that before this year, the number of deaths from all cases throughout the State of New York exceeded the mortality of the year 1899 by 6,647, and exceeded the average for the past five years by 8,000. Moreover, typhoid fever, a water-borne disease, was unusually prevalent throughout the State in the autumn, causing 1,948 deaths, or 350 above the average. In view of these facts, which are stated in the Monthly Bulletin for December, issued by the State Board of Health of New York, the reduction in the death rate of Albany from 2,186 to 1,742 must be considered as a decided tribute to the efficiency of sand filtration. Judged by the typhoid standard, the Albany plant has proved itself a great and decided success. The average yearly deaths from typhoid during ten years had been 84, whereas the number of deaths during 1900 was only 39, 14 of which were unmistakably alien or imported cases.

The efficiency of a filter is judged by counting the bacteria in the raw water and those remaining in the water after filtration, and thus obtaining the percentage of removal. In a table of results for the sixteen months from September, 1899, to December, 1900, showing, month by month, the work accomplished, the lowest percentage is 97.6 in September, 1899, and the highest 99.6 in April, 1900, the average percentage of removal for the whole sixteen months being over 99 per cent. The report shows that the cost of filtering at Albany per million gallons is $1.66, while the total cost of the whole plant, including the care of the filter beds, care of the grounds, pumping the water from the Hudson River and the laboratory expenses, was $4.52 per million gallons.

AN EPITOME OF AMERICAN RAILWAY METHODS.

On another page we publish an article on the extremely interesting ore-carrying railroad between Conneaut, on Lake Erie, and the city of Pittsburg. This road was originally built for the express purpose of carrying iron ore from the lakes to the steel works of Pittsburg, and it now promises to have an equal importance in the transportation of finished steel from Pittsburg to the lakes, for shipment to Europe. We commend this subject to the careful attention of our readers for the reason that the railroad exhibits the distinctive American principles of railroad operation in their most modern development. The principle of concentration, which has underlain the latest industrial developments of this country, has received its highest expression in the world of transportation, whether on sea or land, and in the moving of freight on railroads it has acted to produce by far the biggest engines and cars that are to be found anywhere in the world. The Pittsburg, Bessemer & Lake Erie Railroad set out to solve the problem of carrying over a given line the greatest possible amount of freight at the least possible cost in time, labor, fuel and repairs. The management, working with a free hand, and using 115 to 125-ton locomotives, 50-ton cars, 100-pound rails in the track, and easy gradients and curvature, have reduced the cost of operation below that of any other railroad in this country.

THE FUTURE POSSIBILITIES OF SIBERIA.

The world has now to deal with a new factor. Ten years ago the name Siberia called up only a picture of wastes of snow and ice, boundless steppes and coasts white with icebergs, but to-day the same Siberia is a land filled with thriving villages of peasant farms, producing grain and vegetables. The railway has succeeded in breaking down the bars between the world and Siberia. The vast country is now beginning to show its resources of gold, iron, copper, manganese, mercury, platinum and coal, the yearly output of which at present is but a favorable index of what it will be when the deposits are developed. In the past three years several American mining engineers have traversed various parts of Siberia and Central Asia, and they testify that the lack of exploitation of such evident mineral wealth as is found here is unparalleled in other parts of the civilized world.

Of this, gold is by far the most important, and, strange to say, it is the least developed product, being approximately $25,000,000 a year, thus placing Russia fifth among the gold-producing countries. It is almost entirely placer gold, and the quartz veins and original deposits of gold, though exposed to view in many places, both in the Ural Mountains and Siberia, have been hitherto unworked in any but the most inefficient manner. Furthermore, antiquated and expensive methods are in use by even the largest companies for working the placer deposits. These methods have undergone no improvements during the last fifty years. At numerous mines in Siberia 2,000 men and 500 horses are used on a single property to produce gold not exceeding $2,000,000 per annum; and in some of the platinum mines of the Urals the above-mentioned quota of men and horses is employed for an output not exceeding $800,000. The properties may be easily worked with the employment of dredges and mineral excavators, and even the auriferous gravel could be advantageously carried to the washing machines by wire rope gravity conveyers. The gold output of the Russian empire could be increased to three times its present amount by the use of modern mining machinery. Of the quartz deposits in Siberia it may be said they are entirely undeveloped. There are probably to-day not over a dozen stamp mills operating in the whole country, and it is doubtful if over 150 stamps are in use. Notwithstanding this fact the operations frequently pay large profits. Deep mining is unknown. It is doubtful if there is a single shaft in the limits of the Russian empire which has penetrated a precious metal deposit to a depth greater than 700 feet.

The difficulties of transporting machinery to the deposits is much less than is generally supposed. Of high mountains, such as the Rockies and Sierra Nevada, Siberia has practically none. The interior is penetrated by a network of vast waterways, rendering inland transportation easy and cheap. Heavy freight can be laid down in central Siberia at the majority of the mines, the freight not exceeding $40 a ton from New York, and if water transportation is made use of this price may be reduced nearly one-half. The freight loaded at Hull, England, is transported via the Arctic Ocean to the mouth of the Yenisei River, where, after being reloaded to steamers of lighter draught, it is shipped direct to the crossing point of the Trans-Siberian Railway. From San Francisco to east Siberia it is a matter of water transportation entirely. Regular steamer lines furnish excellent accommodations for passengers, and it is now possible to go from New York via Berlin, Moscow and Irkutsk to Vladivostock on the Pacific in twenty-five days. A railway which shall connect Asia and America at the Behring Strait will probably be built in the near future, and, notwithstanding the terrific cold of winter, it will not be so difficult to build as it was to construct the line of the White Pass and the Yukon Railway.

The prices paid for labor in Russia and Siberia are exceedingly low, varying from 15 cents to $1.50 per day, the laborers feeding themselves out of their earnings. This large range in the price of labor depends greatly upon the locality and whether food is plentiful or not. In central Siberia men can be contracted for by the year at $15 per month; the workmen are of the peasant class. It is not thought that laborers in Siberia will at once alter their methods, but this will probably come in time. The mining laws of Russia allow the taking up of mining claims by Russians or foreigners, but there are many severe restrictions. The claims consist of 200 acres of land, generally surveyed at the locator's option.

Cities of 10,000 to 50,000 inhabitants are now numerous in Siberia. Hotels with comfortable rooms, restaurants which may be said in many cases to be truly palatial, with electric lights and telephone connections, are not difficult to find, says Consul Thomas Smith, of Moscow. Anyone can traverse Siberia in great luxury in superb trains supplied with bath, piano, dining saloon, drawing room, easy chairs, observation cars, etc., the whole being lighted by electricity. The cost of the journey from Moscow to Irkutsk, 3,200 miles, including sleeping car, is only $44. Siberia is practically unknown to most Russians, and they have an idea that furs are always necessary on account of the intense cold. Actual experience in the city of Krasnoyarsk shows that the thermometer reaches 110 degrees for days together in the month of August, and any clothes but those made of silk and linen were absolutely unendurable. To those who wish an unhackneyed trip, Siberia offers an excellent opportunity.

THE HEAVENS IN AUGUST.

BY EDGAR L. LARKIN.

THE SUN.

The sun moves east 1 h. 53 m. in August—not 2 h.—because the earth's velocity is less than the average, moving 54′ 40″ daily instead of 59′ 8″, the mean. Part of this loss of speed is accounted for by its increased distance from the sun, having been at its most distant point on July 3. Therefore, not quite one-twelfth of the sky will be lifted up in the east or sunk in the west. The sun will be 9° 21′ 22″ nearer the equator on August 31 than on the 1st. At this writing (July 7) it is free from spots.

MERCURY.

This planet will reach its maximum elongation, west, on the 2d (19° 22′), and must, therefore, rise before the sun, because, being west, it sets before the sun does. Its right ascension—distance east from the first point of Aries—will be 7h. 31 m., but that of the sun will be 8 h. 48 m. The advancing horizon will overtake Mercury first because it is at a less distance from Aries, 1 h. 17 m. earlier, hence it will be morning star. Since it is 2° 29′ further north than the sun, it ought to be seen without optical aid from the entire Atlantic coast of the United States. Here in the marvelous air of the Sierra Madre Mountains it will glitter with brilliancy unknown in the Eastern States. Mercury will rise up through its node on the 9th; that is, it will come from the south to the north side of the plane of the earth's orbit. Thus:

(2) N.
————————
(1) S.

the line is cut out of the plane, and the circle, 1, is Mercury before passage and 2 after. The planet will be nearest the sun on the 13th, farthest north on the 23d, from which position it rapidly declines and retreats to the opposite side of the sun from the earth on the 27th, so that the centers of the earth, sun and Mercury will be nearly on the same straight line.

VENUS

is evening star and will be unimportant throughout the month, since it is farther away than the sun. Its eastern advance being only 20m.

THE EARTH.

Stand back to the sun at sunset on August 1, and look toward the opposite side of the universe; then the earth will be slightly west of θ Capricorni, and on the 31st a little west of λ Aquarii.

MARS

is so far away that, being in the solar glow, it will not appear of special interest, but a study of its motion is highly instructive. Its R. A. on the 1st is 12 h. 40 m., and on the 31st 13 h. 50 m.—gain 1 h. 10 m., while its declination south increases from 4° 16′ to 11° 44′. But this track carries it through the plane of the ecliptic from north to south, and it passes its descending node on the 5th at the 19th hour, when its R. A. will be 12 h. 51 m. and its declination south 5° 27′ 58″, which point is in the ecliptic plane, when for an instant the latitude of the center of Mars will be zero. This affords a fine opportunity for locating the earth's orbit among the stars. For Mars will slide along near and below the plane for several days, while Venus to the west will be advancing slightly above it, the equator, ecliptic and equinoctial colure, or 12th hour circle, all crossing between the two planets. August 5 will be of great interest, for Jupiter and the earth's orbit coincide, with Saturn only 1° above it. Remember where the sun disappeared on that day—make a note of where the center of the earth is, then in succession pass the eye from the sunset point to Regulus, Venus, Mars, Spica, Jupiter and Saturn, and an arc of the orbit traversed by the earth will be cut out. On the 18th Mars will pass the first magnitude star Spica 2° 7′ to the north, while on the 21st the distance between the star Regulus and the sun's center is only 15′, but since the radius of the sun on that day is 15′ 50″, Regulus will vanish behind the sun, or make an exceedingly close approach.

JUPITER.

The R. A. of Jupiter on the 1st is 18 h. 19 m. 35 s., and on the 31st 18 h. 14 m. 4 s., hence he loses 5 m. 31 s.; that is, retrogrades during the month. But on the 31st he stops, hesitates a moment and then begins a race with Saturn that will be one of the most impressive spectacles of modern times. Thus, at noon on the 29th the seconds, only, of R. A. are 4.35, 30th 4.06, 31st 4.59; thus 4.06 is the least—planet farthest west—and the next day it is east again. The entire world where the splendor of the approaching conjunction (November 27) is visible, cannot fail being lost in admiration.

SATURN.

Saturn also loses 5 m., and is in training for the race when he will strive to outrun Jupiter, but will fail. Both planets are in Sagittarius, and, in the splendid air of California, burn and blaze with a supernal light, unseen where the atmosphere is impure.

URANUS.

This distant world is in Ophiuchus and almost at a standstill, moving only 35 s. in the month.

NEPTUNE

sets before the sun and is invisible in the evening. Therefore in August, 1901, α Cancri and the cluster Præsepe, Regulus and both Lions, with the head of Hydræ, Sextans and the mast of Argo Navis will vanish in the west, and at this observatory, if not consumed in solar flames, will be cast into the ocean. In the east Cygnus, the Fox and Dolphin, with Capricornus, Aquarius, Equleus and the head of the steed Pegasus, will be new.

Mount Lowe Observatory, California, July, 1901.

TWO EMINENT CALIFORNIA SCIENTISTS.

By the death of Prof. Joseph Le Conte and Dr. Harvey Wilson Harkness, California has been deprived of two of its most eminent scientists. Both were men approaching four score years, and had been residents of the State from early manhood. Though as investigators each pursued a different branch of science, yet each rendered great service to the community and well deserved the high estimation with which they were universally regarded.

Probably no man has studied more industriously or arrived at conclusions that are more entitled to respect as to the complex geological system of California than Prof. Le Conte. From 1869, the year he became one of the faculty of the University of California, as teacher of natural sciences, all of his unoccupied moments were spent as a student. He was one of the first to scientifically explore the Yosemite Valley and the very first to describe and define the geological conditions and attractiveness of that wonder of nature. It was an appropriate spot for the old professor to give up his last breath. Prof. Le Conte was among the first who explored the region east of the Sierras in Inyo County, finding traces of the great lake that once covered that country to great depths, defining boundaries, and luminously detailing the remarkable geological problems there presented. Prof. Le Conte was the author of many scientific textbooks and a strong advocate of evolutionary doctrines.

The branch of science in which Dr. Harkness gained his great eminence was the obscure one relating to fungi, particularly as concerned the abundant plant and fruit life of California. The service he rendered to an important and expanding industry of the State in the definition and cure of this class of disease entitles him to grateful remembrance. For many years Dr. Harkness was president of the California Academy of Sciences and devoted his leisure to the development of that great institution. At the beginning of his administration the academy was ill housed and dependent upon contributions for an existence. Later James Lick left it over $1,000,000, and the building which it now occupies, filled with a priceless collection of natural objects, is worth three-quarters of a million and is of splendid usefulness.

Both of these eminent men lived lives simple and unostentatious. Their friendships were wide, and in the world of science they will be greatly missed.

SCIENCE NOTES

The Guttenberg Museum at Mayence was opened on June 23.

Wherever the Romans penetrated they were sure to erect great baths. Recent excavations on an estate in Scotland have revealed the foundations of an immense bath with concrete floors and walls, lead-pipe connection, hypocaust and stoke-hole with a flue extending from it, says The Architect. The foundations of the piers in the hypocaust are now displayed. The walls of the rooms are formed of stone and lime covered with strong concrete, with a polished surface and painted a brick-red color. The floors are all of concrete.

An attempt is to be made by the British authorities in Uganda to utilize the zebra for transport purposes in that country. It is contended that the characteristics of the animal render it specially suited to this district, since it is naturally immune against the ravages of the tsetse fly and horse sickness. The plan suggested is the domestication of the adult animal. The young zebra cannot be reared apart from its mother, and it is considered that if the animal were accustomed to the presence of man from its birth, in the course of a few years a large supply of zebras will be available for work.

The study of languages by those who are not able to obtain actual instruction from the professor has always been hampered by the fact that notwithstanding the grammar might be mastered there was always trouble with pronunciation. This phonetic difficulty has been overcome by the International Correspondence Schools of Scranton, Pa. The system employed is highly interesting, for each student in the language courses is furnished with a phonograph. The instruction proper is given by mail. The lessons are dictated by the professors at Scranton, and the phonograph cylinders are sent to the students. The cylinders are not copies, but are "master records," so that they are so clear that the students are easily taught the correct pronunciation. The courses in the foreign languages are under the direction of Prof. David Petri-Palmedo, who will give instruction in German; Prof. Edouard Lamaze, who will teach French, and by Prof. Antonio Llano, who will teach Spanish.

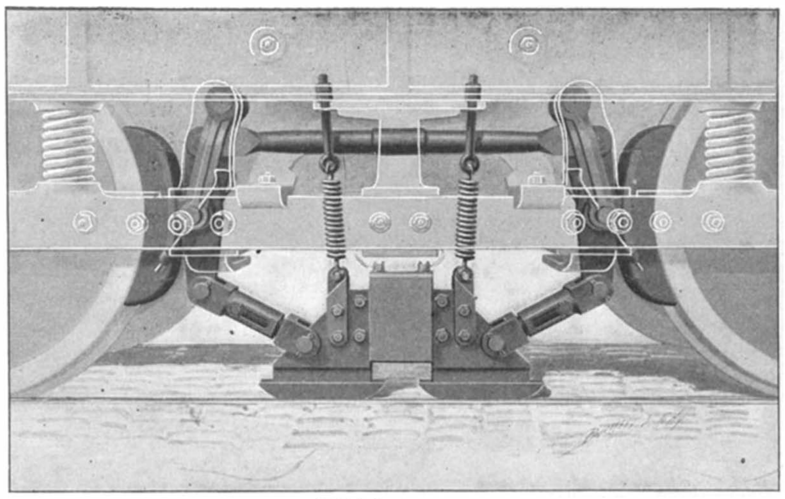
NEW WEAVING DEVICE.

A new contrivance, which it is anticipated will modify the process of weaving, has been invented by a young weaver named Bernard Crossley, of Burnley, Lancashire, England. By means of this little device, which can be attached to existing looms, one weaver can attend to eight looms, and as stoppages are avoided, each loom will produce 12½ per cent more cloth in the same time. The invention is a small device capable of attachment at a comparatively small cost to the present single box looms. There are at present some 850,000 power looms in England, and of this aggregate 600,000 can be fitted with the Crossley invention. Its mechanism is simple; it works at a tremendous speed, and effects the shuttle changes with remarkable rapidity. For example, if a loom is working at the good average rate of 250 picks per minute, this device, without any pause in its action, changes the shuttle in one four hundredth part of a minute—half a revolution of the first shaft. This change is accomplished without any of the faults in the general type of loom. The cloth is woven very evenly; that is to say, there are no thick and thin places in the cloth caused by the insertion of too much or insufficient weft. After the change of shuttle the loom resumes work without leaving any trace of the change having taken place, with the exception, perhaps, of a broken pick. It consequently produces a far superior cloth to that woven upon the present loom. In view of the remarkable merits and advantages of this loom the invention has been acquired by a wealthy syndicate, and it is stated that it will be attached to the looms in several of the leading cotton mills of Lancashire without delay.

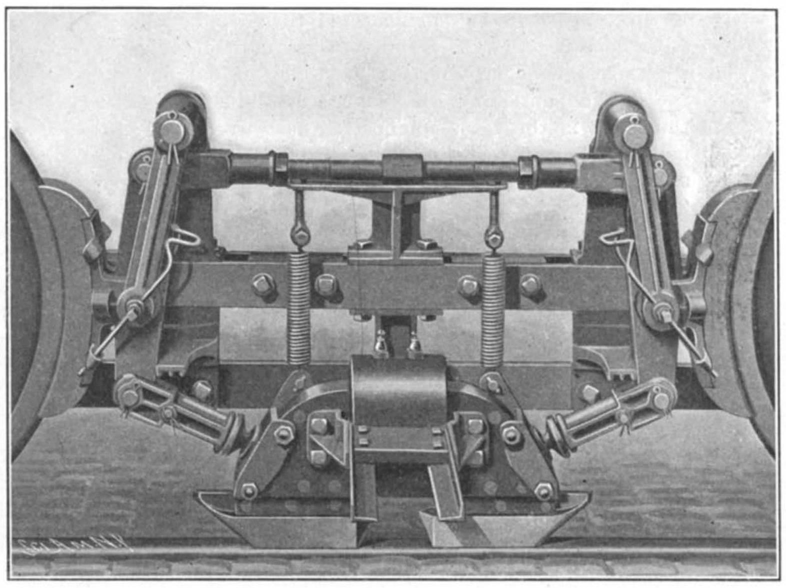
THE FASTEST TRIP OF THE "DEUTSCHLAND."

The Hamburg-American steamer "Deutschland," which sailed from the port of New York July 11, arrived at Plymouth July 17, making the trip in 5 days, 11 hours and 5 minutes. It is true that this was not the quickest trip which the "Deutschland" has made between Sandy Hook and Plymouth, but on this trip she ran on the long course. Her best time on a short course of 2,080 knots was 5 days, 7 hours and 31 minutes; but on the trip just completed she made an average run of 23.51 knots an hour, which beats her best previous record of 23.36 knots an hour. Her hourly average of 23.51 knots, if maintained over the short course, would enable her to cross in 5 days and 3 hours. Her greatest day's run on the recent trip was 557 knots, and on this day her average speed was about 24 knots per hour, allowing 23 hours and 10 minutes as the length of a nautical day going east.

THE WESTINGHOUSE ELECTRIC BRAKE AND HEATER.



MAGNETIC BRAKE SHOWING METHOD OF ATTACHING BRAKE TO CAR FRAME.



VIEW OF BRAKE FROM UNDER CAR.

The subject of power brakes for street cars is attracting considerable attention, and it is probable that in the course of time city and town ordinances will require their use. The Newell electric brake, which we illustrate, is made by the Westinghouse Company, of Pittsburg. The apparatus consists of two elements, one a brake and the other a heater. The brake may be installed upon the cars independently, but the heater is dependent upon the use of the brake. The brake proper, which is shown in our transparent view, consists of a double track shoe, combined with a powerful electro-magnet, which when energized by the power motors, acting as generators, is strongly attracted to the rail by magnetic force. Brake heads and brake shoes of the ordinary type act directly on the wheel and constitute a wheel brake of maximum power and efficiency. There are also sundry castings and forgings for simultaneously transmitting a downward pull and resultant drag of the magnetic track brake into lateral pressure upon the wheels. The brake can, of course, be applied to a single or a double truck car. In addition to the truck equipment, whether single or double, a complete brake includes brake-controller attachments to use when the motor controllers are not provided with braking points, and a diverter or improved form of rheostat for dissipating the heat generated by any excess of current over and above that required to operate the brake when the heaters are not in service. Our transparent engraving shows the method of attaching the brake-rigging to the truck, and of suspending the brake shoes and magnetic frames directly over the track. When the brake is not in operation the suspension springs carry the track magnets and shoes entirely clear of the rails, and by reason of their flexibility they permit the shoes to ride over or clear any obstruction which is not sufficient in itself to cause the car to stop. When the brake is operated through the saturation of the magnets by current supplied by the car motors, acting as generators, the track shoes are so strongly attracted to the rails that three distinct results are produced. First, a noticeable increase in the pressure of the wheels on the track takes place, because of the downward pull of the magnets; second, there is a pronounced retardation by reason of the friction generated between the track shoes and the rails; and third, there is a maximum braking effect on the wheels obtained through the transmission of the resultant drag of the track shoes to the brake shoes by means of the mechanism provided for that purpose. It is obvious that the net result of these three effects combined represents a much higher braking power than can be obtained by the use of any other brake without skidding wheels; moreover, the feature of the powerful track brake which, instead of decreasing the weight upon the rails at the wheels, increases it, is as unique as it is valuable.

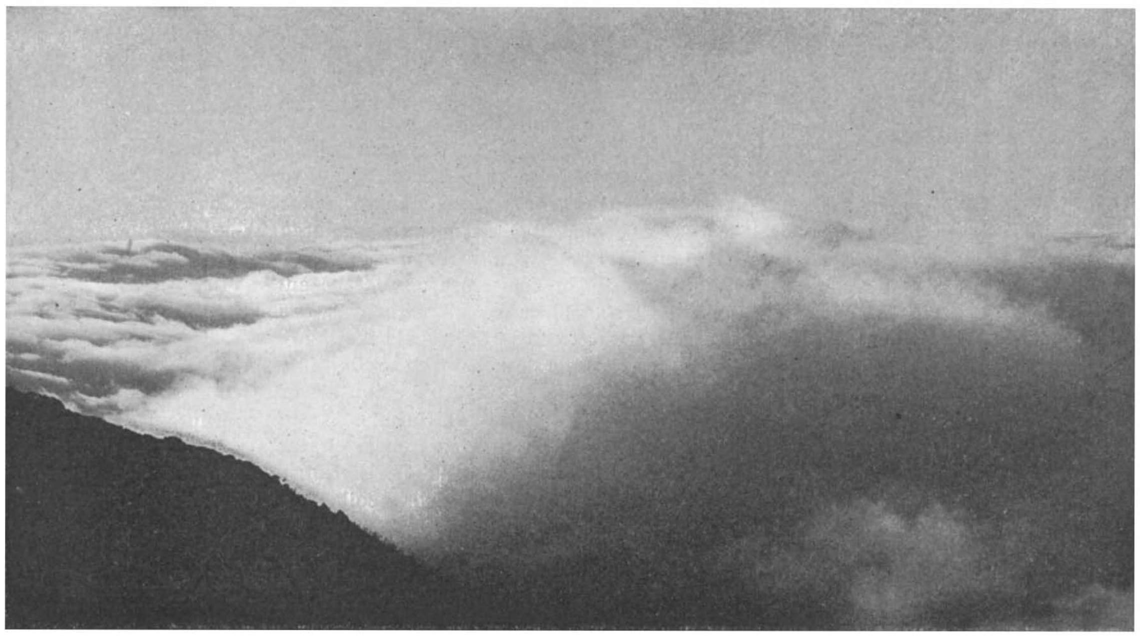
Our second engraving shows the brake from a point midway between the trucks, illustrating clearly the arrangement of the hangers, rods, etc., inside the truck-frames. The thrust against the wheel brake shoes, caused by the drag or frictional resistance between the track shoes and the rail, is similar in its effects to the thrust obtained from the expansive force of compressed air acting upon the brake cylinder piston in the well-known air brake, but the magnetic brake has the advantage that the brake shoe pressure is automatically regulated by the condition of the rail surface. This is a fortunate feature which results in securing the highest possible braking power at all times without danger of the wheel sliding. The track magnets are energized by current obtained from the car motors themselves acting as generators. This not only obviates any expense in that connection, but also effectually prevents the possibility of accident through sudden failure of the line current. The current necessary for the required magnetization is uniformly kept within safe limits by a proper adjustment of resistance always in circuit with the brakes, thus avoiding any injurious effect on the motors.

An additional advantage gained by the use of the magnetic brake is found by employing the improved form of rheostat, or diverter, previously mentioned, which has a constant resistance regardless of the heating produced by a continuous flow of current, in the automatic control of speed down long and steep grades. This result, owing to the fact that a certain resistance in the rheostat, insures a fixed current flow at a given speed; and this resistance can be readily adjusted so as to permit just enough current to pass through the track-shoe magnets to hold the car at the required speed, against the action of gravity, on any grade; any increase in speed increases the current and causes the brakes to act with greater force, while a decrease in speed instantly decreases the current and the brake action at the same time, so that the speed of a car may be automatically regulated within narrow limits regardless of changes in the gradient.

The brake can be readily applied to trailers by attaching the track magnets and accessories to them and connecting the magnetic coils to the wiring system of the motor cars.

The heating of the electric cars in the winter requires the expenditure of considerable power and it is quite evident that an electric car heater, occupying no valuable space, easily controlled and costing nothing to operate, will prove equally satisfactory both to street railway companies and their patrons. In the system which we are describing, the heaters are installed underneath and along the front of the seats. They are connected with the general system of wiring by means of a suitably arranged switch so constructed that the braking and starting currents, both of which are used for heating the car in cold weather, may be divided as desired and the whole or any portion thereof sent through the heaters, the remainder going through the proper portion of the diverter beneath the car. The ordinary car heaters with which the heat is generated by the line current have so much storage capacity that they are cooled to atmospheric temperature very quickly, when for any reason the current is interrupted. With the electric heater there is a great capacity to store and retain heat within its mass. In the event of blockades, or the failure of the line current from any cause, this heat-storage capacity is so great that the car is kept comfortable for an hour or more, even in severe weather. The operation of the heater is dependent upon the use of the brake and the heat produced is derived from energy which would otherwise be wasted. This brake and heater have been in practical use in Pittsburg and the results have been highly satisfactory.

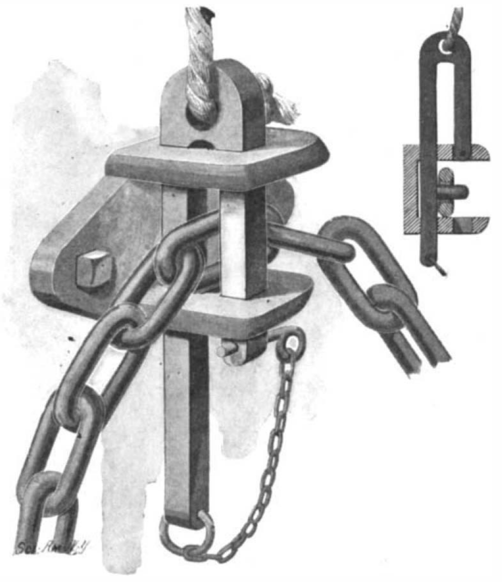
FOG STUDY FROM MOUNT TAMALPAIS, CALIFORNIA, FROM THE OBSERVATORY.



FOG STUDY FROM MOUNT TAMALPAIS, CALIFORNIA.

FOG STUDIES ON MOUNT TAMALPAIS, CALIFORNIA.

Some very interesting studies on fogs have been conducted on Mount Tamalpais by A. G. McAdie, forecast official of the United States Weather Bureau. On the coast of California there is a city, San Francisco, justly famed for the abnormalities of its climate. Overcoats and heavy wraps are worn in midsummer and lilies bloom in December. From May to September almost no rain falls, but during this period, with clock-like regularity, great banks of fog float in every afternoon and cover the bare brown hills. Day after day the inhabitants walk about under a sediment of water vapor, knowing that 1,500 feet above the air is clear and 20 to 30 degrees warmer. The Monthly Weather Review justly says that it is an ideal locality in which to study the formation of the cloud, the birth of the cloud, and to note the shifting strata at the bottom of the atmospheric sea. Like an immense blanket the fog is drawn through the Golden Gate. Below the blanket all is gray and dreary; above, all is sunshine and delightful weather. The topography of the district is remarkable because of the close juxtaposition of the ocean, bay, mountain and foothills. The valley, level as a table, is 450 miles long and 50 miles wide, having afternoon temperatures of a hundred degrees or over and is connected by a narrow water passage with the Pacific Ocean; the mean temperature of the water in this locality is 55 degrees. Thus within a distance of 50 miles in a horizontal direction there is frequently a difference of 50 degrees in temperature, where in a vertical direction there is often a difference of 30 degrees in an elevation of half a mile. Wherever the fog impinges on a condensing surface water trickles down, one side of the street is wet, the other dry. Under the trees, in the redwood canyons of the slopes of Tamalpais, the drifting fog after touching the leaves falls gently to the ground. A few hours earlier this water was in the Pacific; as vapor it traveled perhaps 1,000 feet upward. Then settling and chilled by the cold water surface it was carried inland as fog, and meeting in the leaf a modest but efficient rain-maker, turns to water and flows in part into the sea.



A SIMPLE CHAIN-STOPPER.

An attempt has been made at the Mount Tamalpais station to correlate the surface pressure conditions with fog. There are, however, many different types of fog. The conditions prevailing in winter, when tule fog formed in the great valleys drifts slowly seaward, are quite different from those prevailing in summer, when a sea fog is carried inland. A typical pressure distribution accompanying the sea fog has been recognized. In general a movement southward along the coast of an area of high pressure in summer means fresh northerly winds and high temperatures in the interior of the State, with brisk westerly winds laden with fog on the coast. The mountain, as might be supposed, is the driest station, the mean relative humidity being 59 per cent, while it is 83 per cent at San Francisco. Especially during the summer months is the difference noticeable, and doubtless it is this dryness which causes such an agreeable change of climate to visitors at this season. The average hourly wind velocity seems to increase with elevation, the values for the mountain station far exceeding those of the lower station. The maximum velocities recorded are respectively 9 and 47. We are indebted to Mr. McAdie for the remarkable pictures of fog which we illustrate.

Judging from published reports, the use of second-hand boilers by small manufacturers abroad is practically unrestricted, while the penalties in case of explosion are not severe. A boiler of the class mentioned recently burst in England; its age was unknown, as its history could not be traced, it having passed through several hands and used without any test as to its strength. Owing to defective construction and design it was said to have been safe when new for only 20 pounds per square inch, but was being used at 70 pounds when it blew up. The inspectors found that this latter event was due to carelessness, but fined the parties to blame for it only $10, possibly upon the ground that they didn't intend to do it.

A NOVEL CHAIN-STOPPER.

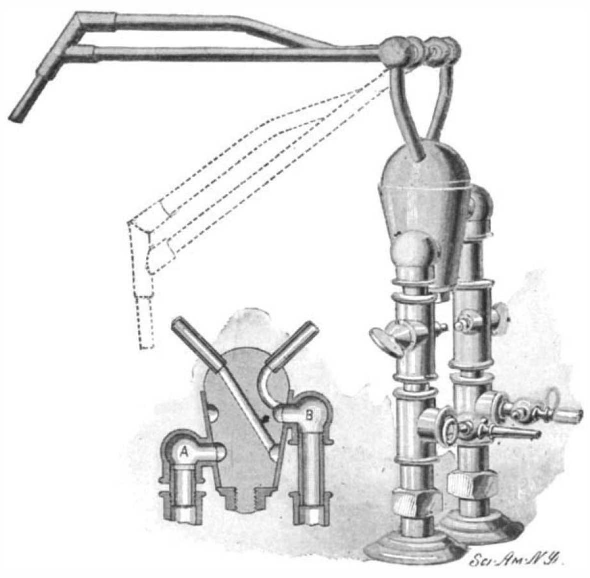
We present herewith an illustration of a simple chain-stopper invented by Mr. Michael A. Drees, of Peshtigo, Wis., by which a chain can be easily and effectively stopped, and which can be readily released, notwithstanding the strain to which the chain may be subjected.

The device comprises a body having oppositely arranged openings. The corresponding openings of the top and bottom lugs are in alignment with each other. These lugs are designed to receive the unequal legs of a stopper-bar. The two legs are connected by an eyepiece through which a rope is passed, whereby the stopper-bar can be withdrawn. The one leg of the stopper-bar is about twice as long as the other, so that when the stopper-bar is withdrawn to open position (see illustration) the shorter leg will be moved out of the space between the lugs. When the stopper-bar is moved to the locked position shown in the general perspective view, both of the legs will lie across the space between the lugs. One end of the chain is attached to the longer leg of this stopper-bar, the other end of the chain being provided with a key which can be inserted in an opening in the end of the shorter leg, so as to lock the stopper-bar in position. Thus locked, the two legs straddle the chain. When the stopper-bar is moved to open position, the chain is released.

AN IMPROVED BLOWPIPE.

The illustration herewith presented pictures a blowpipe invented by John McLoughlin, of 253 Tremont Street, Boston, Mass., and arranged so that it can be quickly and conveniently adjusted to bring the flame to the desired point.

The blowpipe is mounted on a base on which two vertical pipes, *A* and *B*, are secured, the one supplying air and the other gas. Valves in the pipes regulate the flow. The upper ends of the pipes, *A* and *B*, support a valve-casing in which a valve-plug is mounted to turn. The valve-plug, as shown in the smaller figure, is formed with two annular ports, one of which is constantly in register with the air-pipe and the other with the gas pipe. From these ports channels lead to feed-pipes secured to the outer end of the rotatable valve-plug. These pipes are swiveled to pipes opening into a blow-pipe nozzle. By reason of this construction the swivel connection and rotatable valve-plug form a universal joint, so that the blow-pipe nozzle can be brought into any desired position. The nozzle can be swung up and down, and can be turned with the valve-plug. The universal joint dispenses with the usual rubber-hose.



AN IMPROVED BLOWPIPE.

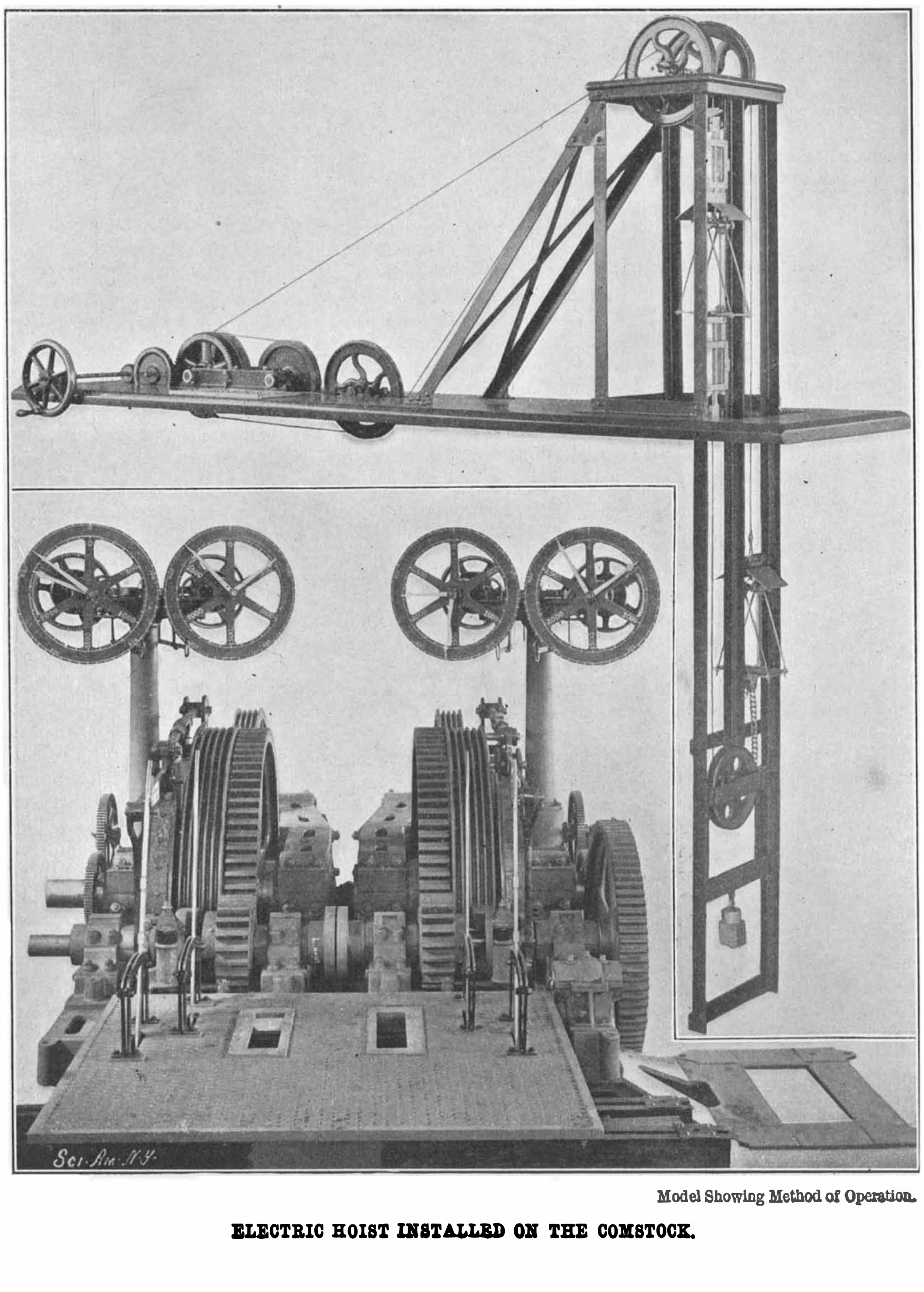
ELECTRIC HOISTS ON THE COMSTOCK.

BY LEON M. HALL.

With the advent of electricity on the Comstock it became necessary to take up the problem of hoisting from considerable depths by means of electrical energy, and after much research and a thorough investigation of the then existing electrical hoisting machinery, it was evident that in order to meet our conditions of service and power, we must procure something radically different from the usual run of such machinery. The writer then, after discussing the matter with the Risdon Iron Works, of San Francisco, decided on the system as described in this article, the ultimate result being the development, installation and successful operation of a continuous rope electric hoist, driven by means of a variable speed, three-phase induction motor.

The power for the Comstock is developed on the Truckee River, at a point near Floriston, thirty-three miles from the mines in Storey County, Nevada. The generating station is equipped with two 750 K. W., three-phase, 60-cycle, Westinghouse generators, and six 300 K. W. oil-cooled transformers. McCormic turbines are used to drive the generators and a close regulation is secured by means of Lombard governors. At the station the potential is raised from 400 volts to 24,000 volts, at which pressure it is transmitted over a double circuit of No. 4 hard-drawn copper wire. At the sub-station, in Virginia City, the potential is reduced to 2,300 volts, and in this form is distributed to the various mining companies. In the case of each hoist but one, namely, that at the C. & C. shaft, it is again reduced to about 450 volts.

The power is purchased of the Truckee River General Electric Company upon a continuous rate basis, the amount being fixed by a peak load of two minutes' duration. Under these conditions it has therefore been the endeavor of the mining companies to secure a hoist that will operate at the highest possible efficiency



Model Showing Method of Operation.

ELECTRIC HOIST INSTALLED ON THE COMSTOCK.

and at the same time affect the regulation of the general system to as slight a degree as is consistent with good service. To meet the condition of high efficiency, it is evident that the motor should operate continuously at or near its full load capacity and be designed especially for the work it has to perform. For a continuous full load condition, the work must of necessity be constant at all points in the lift, and the nearest possible approach to this was secured by the adoption of the continuous rope or balanced system, where the load is reduced to the weight of the rock alone. Then to secure the necessary variations in speed an induction motor with a non-induction resistance in both primary and secondary was developed. The resistance being varied by the introduction of a modified form of the ordinary street car controller. With an equipment of this kind the cages are started slowly and the dip in line voltage is comparatively slight, being about 7 per cent at starting. By running on the second notch of controller one-third of the maximum speed may be maintained for the full length of the shaft.

The hoist itself, as will be observed in the accompanying photographs, consists essentially of a main driving drum and an idler around which the rope is wrapped four times in order to secure the necessary friction for lifting. From the main driving drum, the rope is carried over the head sheave, down one compartment, under a movable tail sheave, back the second compartment over a second head sheave and on to the driving drum. One cage is inserted between the ends of the cable and the other fastened by means of heavy iron clamps, one above and one below the cage in the adjacent compartment. This simple arrangement allows of varying the relative position of the cages at pleasure and also permits us to use one cage in a single compartment without reference to the other.

The hoist is necessarily a geared machine, the motor speed being reduced by the introduction of cut gearing. To the main drum is attached a brake ring upon which is operated a heavy post brake. This brake is set automatically by means of a heavy weight and is released by hydraulic pressure. In the case of the Yellow Jacket and Belcher, there are two hoists side by side, both being operated by one motor. One of these is intended for the vertical shaft and the other for the incline, which leaves the vertical at the point where the vein intersects it. Double deck cages used in each compartment of the vertical shafts and a two-ton self-dumping giraffe in each compartment of the inclines.

The hoists have been erected in the most substantial manner upon concrete foundations and there is practically no vibration and very little noise.

The Yellow Jacket hoist was a success from the start and was operated for more than a month with a single cage in one compartment. This is the severest test to which the hoist can be subjected, and under these conditions the performance is as near perfection as any hoist I have ever seen. Tests were made during this time and the following are the results:

Weight of cage	1,200	pounds.
" " car	850	"
" " rock	1,600	"
Total weight lifted	3,650	"

Maximum rope speed, 600 feet per minute. Length of vertical lift, 1,175 feet. Time of hoisting, 2 minutes 10 seconds from the moment the load was started until cage was landed on chairs, at the surface. Time to accelerate load, 8 seconds. Power required as per watt meter readings was 88.40 horse power. Theoretical power required, 66.40 horse power. Efficiency of system is therefore about 75 per cent, and this includes motor deficiency and all friction losses from secondary of transformers. Secondary voltage was 525 volts before starting and the running voltage slightly over 500. The maximum current per phase at starting was 180 amperes, and 85 amperes when operating at full load. A reading was also taken while lifting the empty cage at 600 feet per minute and the wattmeter showed 48 horse power. It will therefore be seen that the results obtained are remarkably good, and no trouble should be experienced with a hoist of this character upon any well regulated plant. At a future date I will take pleasure in submitting data when these hoists are operated under balanced conditions. In conclusion, therefore, I will add that the successful operation of this hoist is a decided advance in mine hoisting; not alone in the high efficiency secured, but also in the large capacity as compared with the size of the motor in use. Of course, there are cases to which this system is not adapted, but wherever it is applicable, it is certainly worthy of serious consideration where economical operation is a feature of the development.

All four of the above hoists were built by the Risdon Iron Works, of San Francisco, and that firm publish a pamphlet with controller and torque diagram which will interest anyone interested in mine hoisting. The cut attached is from the experimental model submitted to the writer. All four hoists are built so that the speed can be doubled, using two motors instead of one.

THE MANUFACTURE OF BLOWN GLASS—LAMP CHIMNEYS.

In an article published in the SCIENTIFIC AMERICAN of May 18, 1901, we described the manufacture of plate glass as carried out at the Charleroi Works of the Pittsburg Plate Glass Company. The present article is devoted to the description of another great branch of the glass industry, known generically as blown glass. We saw that in the manufacture of plate glass, the mixture is first melted, then rolled into plate form on a table and finally ground down to the required thickness and polished. In the blown glass industry, the molten mass is formed into the required shape by an entirely different process, known as "blowing," a process which is nothing more or less than that by which a child forms its soap bubbles by blowing through a pipe upon the bowl of which is a film of soapsuds, the blown bubble in the case of the glass being molded, while hot, to the particular shapes required. Although the forms into which blown glass is worked up are endless, the general methods of manufacture are the same, and a description of any first-class works, such as that of the lamp chimney works of Macbeth-Evans Glass Company at Charleroi, which forms the subject of the present article, is illustrative of the blown glass industry in general.

Perhaps the most important feature in the manufacture of lamp chimneys or, indeed, of any form of glassware, is the mixing of the ingredients. As in the case of plate glass, the body of the mixture consists of a sand which is as nearly pure silica as can be obtained. The sand is quarried from silica rock, then thoroughly ground and sifted through a 40-mesh screen, the material being received at the works in the prepared condition. The second most important ingredient is litharge; while potash and soda are used as fluxes. When the above mixture is used for the best quality of lamp chimneys, about 50 per cent of the total is silica. The sand is melted in what is known as the "furnace," a large conical structure which is fired by gas from beneath and contains some 14 to 16 large melting pots, which are molded from a specially prepared and very carefully kneaded potclay. The melting pots are generally 44 inches in their largest diameter, and 50 inches in height. They are arranged in a circle within the furnace, each one opposite a door of the kind shown in our illustration. It takes twenty-four hours to melt the contents of a pot of the size just described. Ordinarily the contents are made up of part of the prepared mixture and part "cullett," i. e., glass left over from previous days of operations.

The blowing is done with a long iron tube, known as the blow-pipe, which has a mouth-piece at one end, and is swelled out and thickened into a bell-mouth form at the lower end. In the process of blowing, the operator dips the thickened end into the melting pot and twists it around until it has gathered up a ball of molten glass of the desired size. The blow-pipe is then withdrawn from the furnace and the ball of glass is rolled out to a conical shape on a plate and slightly inflated by blowing through the tube. The blow-pipe is then handed to the second operator, who completes the operation of blowing. The bubble, if we may so call it, of glass, is thicker and heavier at its lower end, and to secure the elongated form necessary in lamp chimneys the operator swings the blow-pipe to and fro, thus causing the bubble to stretch by its own weight. By thus alternately swinging and blowing he brings the bubble to the required length, and approximately to the required diameter, and then places it within a hinged mold, which is opened to receive it, either by himself or one of his assistants. He then twists the pipe and blows at the same time, thus pressing the glass against the inner walls of the mold. The tube with the molded chimney attached is then withdrawn from the mold, and handed to another operator, who, with a pair of spring tongs, forms the flaring top of the lamp chimney and marks a sharp depression just outside its base where it is to be broken away from the blow-pipe. Although a large amount of blowing is done by hand and mouth, increasing use is being made of what is known as the Owens Blowing Machine, which substitutes mechanical for hand power. This consists of a vertical stand, at the base of which is a circular table, carrying half a dozen of the hinged molds already referred to. After the first operator has blown and elongated the ball of glass to the desired shape, the blow-pipes are placed in the mold, with the upper end of the tubes secured in a clamp near the top of the stand. To each of the tubes is connected a rubber hose, which is supplied with air from a small air-pump located on and forming a part of the machine. The table with its blow-pipes is rotated and air pressure is applied through the hose, half a dozen chimneys being thus blown and molded at the same time.

The chimneys are next carried to the annealing furnace. This is constructed with a metallic belt conveyer, that passes through the furnace from end to end. The chimneys are piled up thickly upon this belt and carried through the furnace. The conveyer moves sufficiently slowly to subject each chimney to the heat of the furnace for from 12 to 24 hours. After annealing the chimney is cut down to length. This cutting is done by rotating the chimney horizontally above two fine transverse slits, through which a thin stream of hot air impinges on the glass at the point where it is to be cut through. The strain set up by this local heating is sufficient to enable the girl who attends the machine to break off the ends with a slight bending pressure. The chimney ends, after cutting, are sharp and rough, and it is necessary to give them the proper finish. The mouth of the chimney is smoothed by "glazing," which is done by exposing it to the blast of a small gas-fired furnace until fusion of the edge takes place, the result being the smooth, rounded edge which characterizes the lamp chimney. In the case of chimneys with crimped edges, the crimping is done in a special machine which slightly flares and crimps the edges at one operation. The base is squared and smoothed down by grinding it upon a circular, rotating, cast-iron table, whose surface is covered with sand and water. The lamp chimneys are stood on end in small pockets formed in smaller disks, answering to the "runners" of a plate-glass grinding machine, and are loaded with weights to give the proper pressure. After they have been ground they are taken to a stamping machine, where the maker's name is stamped on with a hydrofluoric acid preparation known as "white acid."

The chimneys are next taken to the labeling and packing room, where they are labeled, wrapped in paper, placed in separate cardboard boxes, and finally delivered to the packers. Such chimneys as are not shipped in boxes are packed loose with straw carefully worked around them. This packing is so successful that shipments of chimneys to such distant points as Africa and Australia reach their destination with practically no breakage.

Electrical Notes.

A line of electrically-operated canal boats running between Toledo and Cincinnati will probably be started in a short time.

A Berlin tramway company offers prizes of $750 and $375 respectively for the best speed indicators suitable for use on their cars. An additional royalty will be paid to the owner of the successful instrument. Those of our readers who desire further particulars are recommended to address Die Direktion der Grossen Berliner Strassenbahn, 218 Friedrichstrasse, Berlin, S. W., Germany.

The Cunard ocean liner "Lucania" has been fitted with the Marconi instruments, and messages have been successfully transmitted from the vessel to Holyhead, and communication was kept up until the vessel was 20 miles from shore. The New York Herald is installing a station at Nantucket lightship. It will then be possible to receive messages from an incoming vessel twelve hours before she is sighted off Sandy Hook.

The London County Council has at last decided upon the scope and approximate cost of its scheme for converting the existing horse tramways of the British metropolis to electric traction. It proposes to construct several new lines, and to carry out great extensions in addition to converting the tramways already in use. The cost of the enterprise is estimated at over $10,000,000. The scheme applies to the tramways throughout the whole county of London, and is to be partly shared by the local authorities of the various suburbs. Several street widenings and other improvements are embraced in this proposal, but the estimate does not include the cost of erecting the generating stations for the supply of the electricity. The conversion will be carried out simultaneously throughout the entire city, immediately Parliamentary sanction is obtained, so that before long London will be in possession of an up-to-date electric tramway system with all the latest improvements.

The conversion of the Underground Railway to electricity is to be proceeded with apace. Mr. Yerkes and his syndicate are to undertake the work. They propose to carry through the scheme without interrupting the traffic. When it is understood that there are twenty trains running in each direction every hour it will be recognized that Mr. Yerkes' task is by no means a light one. The syndicate proposes to erect a generating station to carry out the necessary alterations, and to supply new rolling stock at cost price. The contract is to be fulfilled within two years of Parliamentary sanction. The syndicate will get $2,500,000 worth of ordinary stock at the nominal price of 25 per cent and $830,000 worth of debenture stock, which carries 4 per cent at par, and 5 per cent on the outlay. The contract will not be placed in the hands of one electrical firm, but the various details will be purchased in the cheapest markets. Mr. Yerkes has also announced that everything will be purchased from English firms, and he will not come to this country for any material unless it is not obtainable in the home market.

A Novel Ore-Carrying Railroad.

BY WALDON FAWCETT.

The Pittsburg, Bessemer & Lake Erie Railroad, between Conneaut, on Lake Erie, and Pittsburg, is essentially a freight-carrying line, having been constructed primarily for the transportation of the iron ore which the immense cargo steamers bring down the Great Lakes from the Lake Superior district, and which is transferred along this road, which is owned by the United States Steel Company, to the steel-manufacturing plants of the company at Pittsburg. The port of Conneaut, Ohio, the terminus of the line, owes much to Andrew Carnegie, who, up to the time of his retirement from the active conduct of affairs in the steel world, took a deep personal interest in the development of this place, with its magnificent harbor, and gave free expression to the opinion that it would one day rank as the greatest ore-unloading port in the world.

The influence of the Pittsburg, Bessemer & Lake Erie road in the world of iron and steel can scarcely be overestimated. By taking the transportation of iron ore out of the hands of the independent carriers, it inaugurated a new era in one branch of operating costs, and of late it has proved an important factor in the growth of the American export trade in iron and steel, as it gives to the Pittsburg ironmakers an outlet to the Great Lakes, whence they may ship their finished products by vessels direct to European ports. Finally, the little road from the Carnegie furnaces to the inland seas constituted the cradle of the pressed-steel car, which is now rapidly coming into universal use in all parts of the world. The first steel cars of the present type were built for use on the Pittsburg, Bessemer & Lake Erie line, and the success of this class of freight-carrying vehicles dates from the day when a train of them was drawn into the furnace yards at Pittsburg loaded with iron ore.

Over this ore carrying railroad are hauled some of the heaviest trains in the world. The system operates, all told, barely 227 miles of track, and yet it transports within a year over 16,000,000 tons of raw material and finished product. This enormous aggregate is as great as the combined tonnage of the Northern Pacific, Union Pacific and Missouri Pacific railways, embracing as they do more than 13,000 miles of track whereon are operated 1,500 locomotives and 50,000 freight cars.

In other respects also this line from Conneaut to Pittsburg is the most remarkable in the United States. According to the statistics furnished to the Interstate Commerce Commission, it is accredited with the lowest rate per ton per mile, the highest average length of revenue haul in proportion to its freight train mileage, the greatest average paying load and the lowest "ton-mile cost" of any railroad on the American continent. Paying loads of about 1,600 net tons are recorded, and the average for an entire year was 777 tons. Officials of the road predict that ere long the average paying load will be in excess of ?00 tons, or more than four times as great as the average paying load of all the railroads of the country at large.

The entire line of the road is laid with 100-pound steel rails and 80 per cent of the line is straight track. In the direction of the ore haulage the permanent maximum grade is 31 feet to the mile. There are five of these grades, with an aggregate length equal to thirty per cent of the entire distance. The road is equipped, for the most part, with cars of the steel hopper type, each weighing 17 tons and capable of carrying 50 tons of ore, although there are also in use several hundred steel gondolas with a carrying capacity of 40 tons each.

Undoubtedly the most interesting part of the equipment of the road is found in the immense locomotives which have lately been installed. The problem of getting the ore-laden trains over the heavy grades long proved a perplexing one, and until a few months ago an assistant engine was stationed at each grade. To meet the exigencies of the case orders were placed for the new locomotives, which are among the heaviest and most powerful in the world. Each of the new engines is capable of hauling 1,400 net tons, exclusive of the weight of cars, on a grade of 52 feet per mile.

The total weight of the locomotive in working order is in excess of 125 tons and the weight of the tender is upward of 71 tons, so that the total weight of engine and tender is close to 196 tons. The wheel base of the engine is over 24 feet, and the wheel base of engine and tender together is almost 58 feet. The diameter of the driving wheels outside of the tires is 54 inches. The cab and running board are made of steel, and the tender has a capacity of 14 tons of coal and 7,500 gallons of water.

Iron ore is transferred from the boats to the cars at Conneaut in several different ways. At this port are the only automatic ore unloaders yet installed of the type which has attracted so much attention in the mechanical world, and which by means of a clamshell bucket suspended from a depending mast scoop up ten tons of ore at a time, dumping it directly into the cars. The ordinary type of hoisting and conveying machinery is also employed, and the ore is transferred from stock piles to cars by means of steam shovels, each equipped with a dipper scoop of 4 tons capacity. The ore is unloaded at Pittsburg by means of conveying apparatus of the same general type as that employed to some extent at Conneaut.

So extensive is the trackage at Conneaut that half a thousand cars may readily be handled daily, and 25,000 tons of ore have actually been dispatched from the terminal yards within twenty-four hours. In order that switching engines may be dispensed with to some extent, the Conneaut docks are equipped with a car-haulage system, the primary feature of which is found in endless steel cables, which are kept constantly in motion, and to any point on which a car may be quickly attached by means of clamps.

Automobile News.

A driver of a motor car returning from Biarritz to Paris recently found himself stranded near Etampes through his petrol supply giving out. As petrol was not to be obtained in the district he tried the only spirit that was procurable, and filled up his tank with absinthe. He declares that the motor never ran better than with this improvised fuel.

There is some talk of forming, under the auspices of the Automobile Club of Great Britain and Ireland, a union of chauffeurs, to be known as the "Motor Union," which is to be more easily accessible than the parent club, and, especially, to have lower membership fees, and thus to be within the reach of all. The Union will include the engineers and practical men, and will take charge of the technical department of the club as well as seek to obtain legislation in favor of the automobile interests. The Automobile Club will thus remain a club properly so-called, at the same time maintaining an intimate connection with the Union.

Alexander Winton has attempted to cross the continent with one of his automobile carriages, but after trying to guide it through the sand and snow of Nevada he was finally forced to abandon his trip. He left San Francisco May 20 and encountered his first obstacle in the shape of snow on the top of the mountain range. The automobile slid from side to side down the trail, frequently tumbling into ravines by the way, from which it was extricated with difficulty. It was found that the sand in the Nevada desert was particularly hard to travel on, and the automobilists were finally obliged to abandon their trip by reason of a huge sand drift.

The ascent of Mount Vesuvius in an automobile is a feat which has lately been accomplished for the first time, probably, by Count Carl Schönborn, Secretary of the Austrian Automobile Club. This performance, while not particularly dangerous, requires considerable skill and *sang froid* to carry out. It was upon his wedding trip that Count Schönborn had the idea of making the ascent with his young wife. The couple proceeded first to Rome, where the marriage took place, to Frascati, then to Naples, and a few days later, after having carefully determined their route in advance, they made the ascension to the upper crater, situated at 3,700 feet altitude. In spite of the complete absence of a practicable route, the pieces of stone scattered about, and the lava streams, the Count was able to reach the summit of the cone in only an hour and a half. The descent, which was relatively less difficult, required about two hours.

M. Mougeot, Secretary of the French Postal and Telegraph Department, has been carrying out a series of tests with electric automobiles for collecting the mail at Paris, and expresses himself in favor of the system. It is estimated that from ten to sixteen minutes (according to route) may be gained over the old vehicle, which is built on an ancient plan and has room for only 1,100 pounds of letters; a horse can carry 2,200 pounds, but to do so would require a four-wheeled vehicle, and this would be much slower. An interesting trial has been made by M. Mougeot in person with the new postal wagon equipped with Krieger motors. It weighs 2,200 pounds, including batteries. The tires are pneumatic in front and solid behind. The box has about 35 cubic feet capacity, with seat for two persons at the regulation height, 6 feet 11 inches above the ground. This vehicle made a trial trip in one of the districts of the city, accompanied by M. Mougeot and other officials in automobiles. In spite of the fact that the new mail wagon arrived before the time at the different post-offices, and was thus obliged to wait, it made the tour with a gain of ten minutes over the time allowed for the horse vehicle. The Department is highly pleased with its performance. This machine is one of a number which have been ordered; these include a Jenatzy, Krieger, a Bouquet, Garcin & Schivre and De Dion (new system) for the electric types, a Peugeot machine (petroleum motor), as well as a Serpollet machine (steam motor), which will transport 3,200 pounds of papers.

Engineering Notes.

Charleston, S. C., has a training school for firemen. A 70 foot scaling tower has been provided, as well as all necessary apparatus, and all the firemen in the city are required to take turns in drilling.

The N. Y. C. & H. R. R. R. Company has added to the staff of officials a landscape gardener, whose duty it is to oversee the decoration of station grounds and the improvement of the right-of-way between stations.

The pneumatic tube service for transporting mail in New York and other places was suspended June 30. The contractors will allow their machinery to remain in the hope that the service can be reinstated at the next session of Congress.

A refrigerating plant is to be installed at one of the furnaces of the Carnegie Steel Company, Pittsburg, Pa., in order to free the air from moisture before descending into the furnaces. The moisture will be collected on coils of tube through which brine will pass.

A cooling tower made of brush and twigs is in operation at the power house of the Los Angeles Pacific Railroad at Sherman, Cal. The cooler consists of a timber framework 60 feet long, 12 feet wide, and 13 feet high, filled up with brush and twigs, and it cools the condensing water for a 300 horse power compound Ball engine and a 460 horse power compound engine of the same make, working on a railway load.

Concerning the wear and tear of steam turbines on the steam end, the cost of repair therefor is very slight, indeed, as might be supposed from the fact that the piston, so called, floats, or does not touch the cylinder walls, but it would be thought that more or less loss by erosion of the blades or pins which answer for pistons would ensue, but this is not the case. turbine which has been in use for twelve years w. opened recently, and there was no erosion whatever discovered.

It is customary in sugar refineries to use steam for evaporating the sirup, and, as temperatures above the usual boiling point (212 degrees) are required, it has been the custom with some refiners to carry 100 pounds gage pressure on the coils. It is claimed by an investigator that this is a source of loss over the common pressure of 20 or 25 pounds; he says that there is more than three times the loss at the higher pressure than at the lower, and this exclusive of external leaks by pipe joints, radiation, etc.

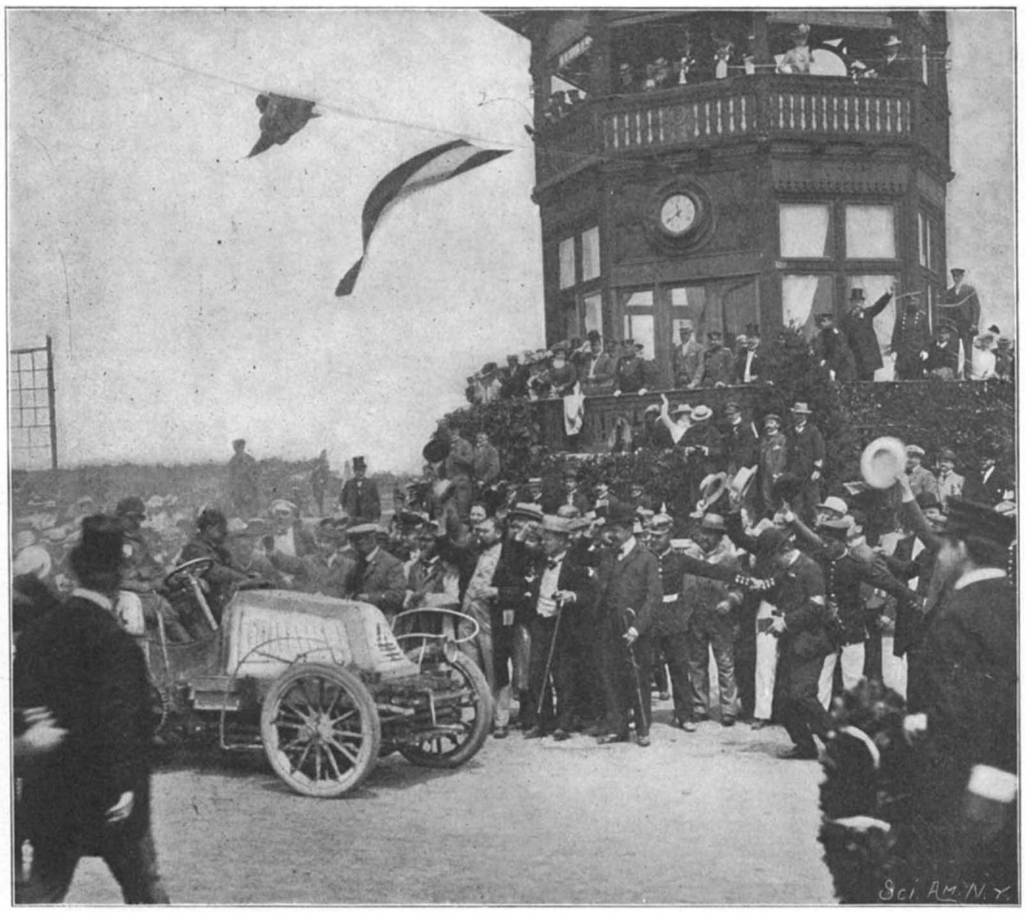
A large power station at Rheinfelden, which we have already illustrated, was recently shut down by a curious accident. Owing to sudden storms the water brought to the power station at Rheinfelden large quantities of branches, dead wood and leaves which were caught by the streams at the mouth of the forebays leading to the turbines. The branches collected so rapidly that the water rose to a height of over 6 feet. The turbines had to be stopped and the water gates lowered in order to clear the screens.

In the current issue of the SUPPLEMENT there is described an English motor driven fire engine. The ludicrous adventures of this engine on its way to a fire have been already detailed in this column in the issue of June 22, 1901. Some of the information given in connection with the present article is most interesting. It seems that in the smaller places in England horses have to be borrowed for the fire engines. Often thirty to fifty minutes are wasted in getting horses which, when an alarm of fire was given, were at work at their daily duty. A considerable amount of time is also lost in finding the proper harness for them. The horsing of steam fire engines in country districts is a very difficult problem. There is hardly a town of any size in the United States which does not have one or more fire engines, and they can be got under way with a delay of from thirty seconds to a minute and a half, while in the larger cities even thirty seconds would be considered slow work.

Rapid progress is being made upon the new subway beneath the River Thames, communicating Poplar on the one side with Greenwich upon the other. It is being constructed upon the same principle as the Blackwall Tunnel, the success of which prompted the boring of this subway, and the projection of several other similar tunnels at various points, to facilitate communication between the two banks of the river. Poplar and Greenwich are two busy working centers, and this new tunnel will prove a great boon to the working population. A shaft will lead to the subway at either end, the total length of which from shaft to shaft will be 1,217 feet. The shafts have been sunk to a depth of 63 feet and the subway will slope gradually from either end to a depth of 72 feet below the ground line in the center of the river. At no part will the crown of the tunnel be less than 13 feet below the river bed, so that it will be amply protected from the scouring effect of the water. One thousand six hundred tons of cast-iron tubing will be utilized in the construction of the tunnel, the total cost of which will amount to about $550,000.

THE PARIS-BERLIN MOTOR CARRIAGE RACE.

The Paris-Berlin motor carriage race was the most interesting ever held, although it cannot be said it was the most important for the industry, as the vehicles used in the race were not of a type which it is particularly desirable to advance. Both the French and German press have been anxious to prevent a repetition of races of this kind by legislative enactment. The precautions adopted to protect the lives of spectators were most elaborate. For weeks the course was placarded with notices of the coming race. Soldiers and mounted police were picketed at short intervals throughout the whole distance, and all the towns and many of the villages were "neutralized," every competitor being piloted by cyclist marshals at slow speed until the outer limit was reached. For a couple of weeks before the race, Paris was made almost unendurable from the odor of petroleum, and day and night were made hideous by the puffing of cars and the tooting of horns. The automobile has never been popular with many of the inhabitants of Paris, and the p asants detest it, for these wild races from one end of France to the other are almost sure to mean maiming or death to some one, and the Paris-Berlin race was no exception to the rule, a man and child having been killed and a number of spectators and automobile drivers hurt and seriously injured. The expense of organizing this race must have been enormous, and it is impossible to say whether the immediate results will be at all proportionate to the outlay. At first contests of this nature enabled manufacturers to discover the weak parts of their mechanisms, but now with their machines of the highest speed, it seems as though all parts were vulnerable and the number of extra pieces which must be carried is very large. The racing vehicle is built purely for speed, and is a distinctive type, but is dangerous, unreliable and expensive, and makers object supplying them, except to customers who are known to be expert chauffeurs.

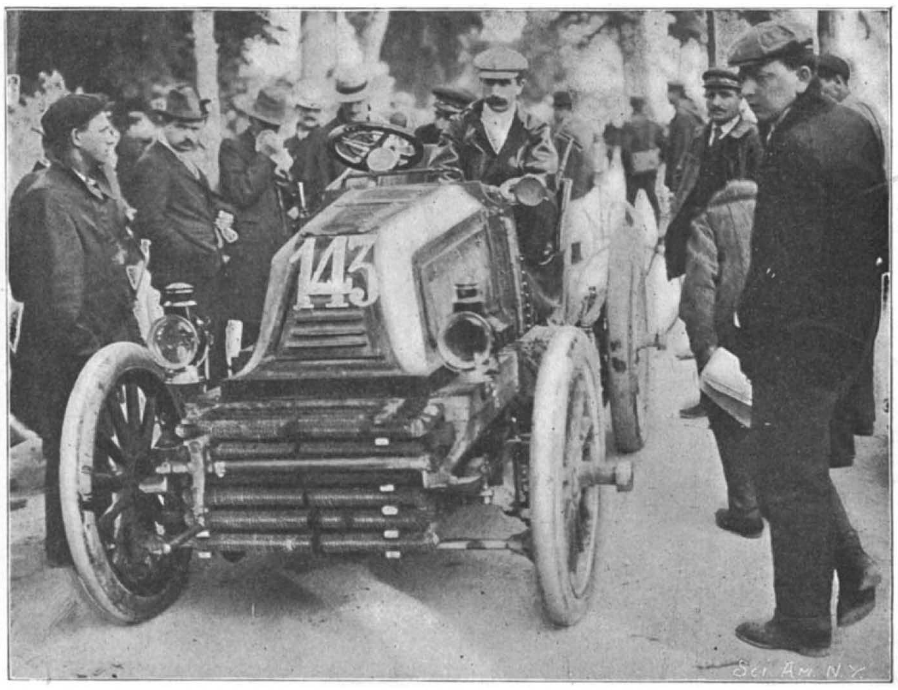


Welcoming Fournier, the Winner, as He Crosses the Line.

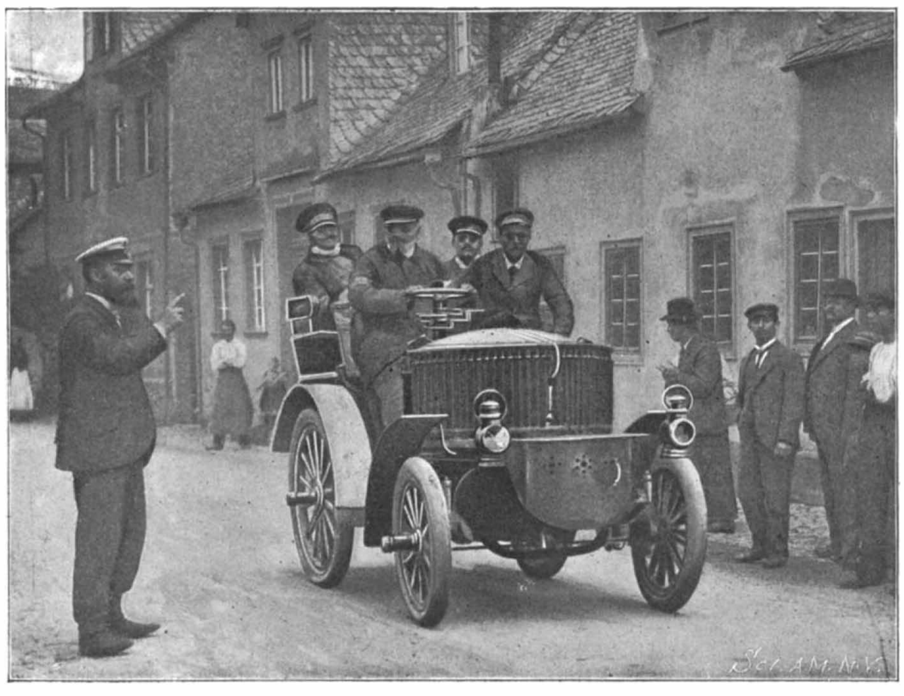
There were 170 vehicles entered for the race, and 110 made the start and 30 finished. Some of the carriages had motors of 50 and 60 horse power, and on the straight and level roads some of them made from 70 to 75 miles an hour; Fournier's the winner's net time from Paris to Berlin (744 miles) being 16 hours 6 minutes, or about 47 miles an hour. In the Paris-Bordeaux race Fournier covered the distance at an average speed of 53¼ miles, but the length of the present route, the condition of the roads and the number of towns to be passed through all served to decrease his speed.

The distance was divided into three sections, the first day's trip being from Paris to Aix-la-Chapelle, 282 miles; the second day from Aix-la-Chapelle to Hanover, 276 miles, and the third day from Hanover to Berlin, 184 miles. The start took place in the early morning of June 27, and an enormous throng gathered to witness the event. The carriages were dispatched two minutes apart until 7 o'clock in the morning, when the last of the horseless vehicles was started. The crowd was very enthusiastic over Mme. Du Gast, the only woman racer, whose portrait appears in one of the pho-

Mme. Du Gast, the Only Lady Entry and One of the Few to Finish.



Mr. Foxhall Keene, the Only American in the Race, Just Before the Star



Receiving Instruction About the Route.

Anthony, One of the Cracks, 100 Yards From the Start.

THE PARIS-BERLIN MOTOR CARRIAGE RACE.

tographs. M. Fournier arrived at Aix-la-Chapelle at two minutes past 12 o'clock, his time being 8 hours, 28 minutes and 3 seconds.

The day was marked by many accidents. On the way a child ran in front of one of the carriages and was instantly killed. The carriage of Foxhall Keene, the only American competitor, was overturned, but fortunately he was not injured. The next day the start was made from Hanover at 5 o'clock in the morning. Eighty carriages took part, starting in the same order that they arrived at Aix-la-Chapelle. M. Fournier arrived at Hanover at 2.13 P. M. in clouds of dust, having covered 276 miles in 9 hours, 7 minutes and 39 seconds. The correspondents who saw M. Fournier start from Hanover at 5.15 the next morning took a special train to Berlin, and when they arrived there they found the country roads lined with people. The enthusiasm at the West End race course, Berlin, at 11.46 A. M., when Fournier arrived, was almost beyond bounds. His friends broke through the line of troops, surrounded the car and cheered him loudly. The band played the "Marseillaise," and the Germans carried him on their shoulders to the judges' stand and thence to the prize platform, which, like the winning post, was decorated with both French and German flags. The other racers came in soon after, M. Girardot arriving second. Mme. du Gast came in at 4 o'clock. M. Fournier had eleven punctures in the tires of his vehicle, which prevented him from making a better record.

It may well be asked if the limit of speed in racing vehicles has been reached. It is not likely that it has, but the safe limit has been attained, and the higher the speed the more liable are the tires to destruction through excessive side strains in taking corners, in addition to the liability of puncture. Speed does not, therefore, depend entirely upon the motors; the tire is a factor of equal importance. It is almost impossible for even a trained chauffeur to carry on such sustained high speeds for days without physical collapse, the nervous strain being intense. Many of the French drivers in the recent race are still suffering from the results of the sport. The race, however, is intended to further the automobile movement all over the world by creating a great interest in it among the public, so that even though the technical lessons of the recent contest may not be very great, the net result must be gratifying.

THE CONQUEST OF THE AIR.

The navigation of the air has at last been achieved by a young Brazilian, M. Santos-Dumont, who has succeeded in driving his aerial ship a distance of ten miles in forty-one minutes, and performed evolutions which showed that he had the vessel under complete control during the trial, which was of course under favorable atmospheric conditions. His machine is by no means perfect, and there are some weak points to be strengthened, but within a month it is thought these defects will, to a great extent, be overcome. A number of inventors have been working along somewhat similar lines, so that M. Santos-Dumont has been very active, especially in view of the prize offered by M. Deutsch of 100,000 francs for a successful balloon trip from St. Cloud around the Eiffel Tower and return.

M. Santos-Dumont was born in Brazil in 1873 and early became interested in aeronautics. He soon abandoned spherical for cylindrical balloons, and the present is the fifth he has constructed. The balloon

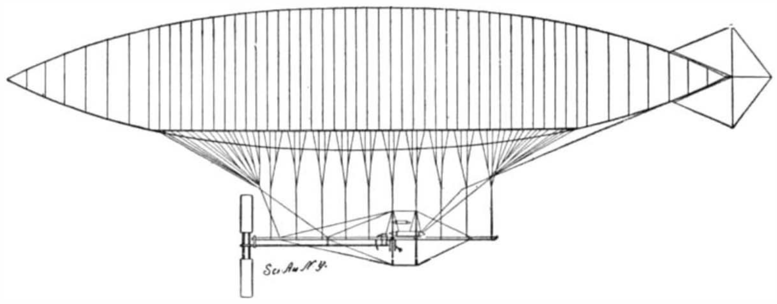
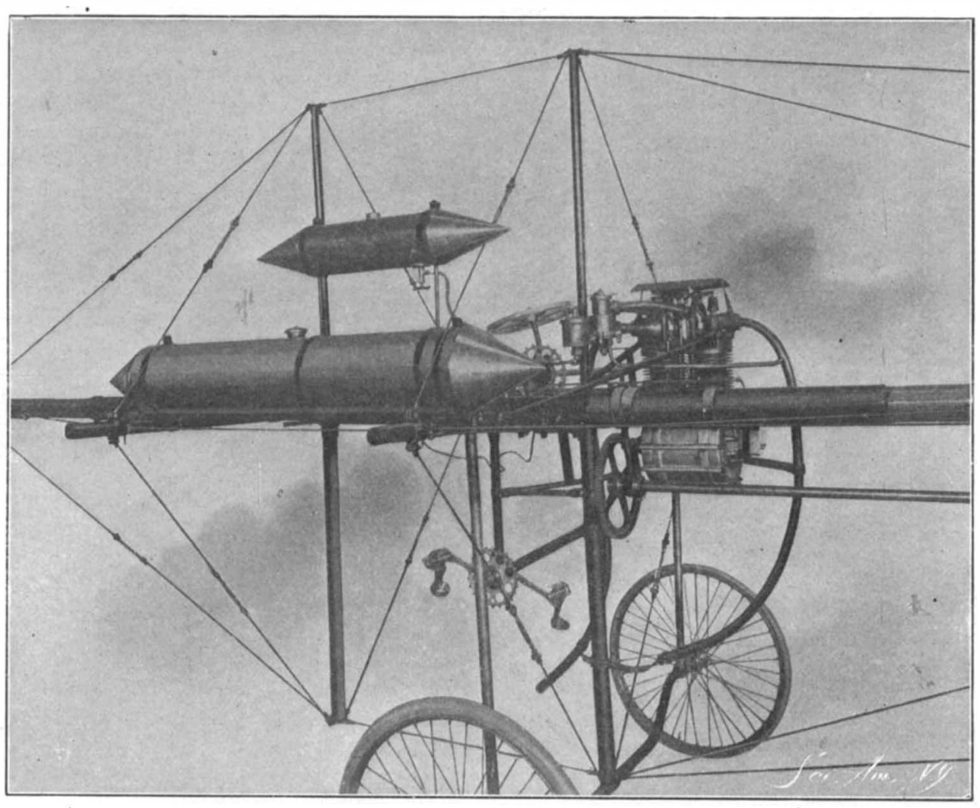


Diagram of the Santos-Dumont Air Ship.

proper is 111 feet long and 20 feet in diameter. Beneath the balloon, suspended by steel wires, is a cradle 59 feet long, composed of pine poles secured together at the ends. This cradle contains a four-cylinder motor of 16 horse power. Suspended from the center section is a triangular cradle, which carries the screw. The aeronaut sits in a small basket at the opposite end and controls the valves and rudder. Our engravings show the method of propulsion used in a previous

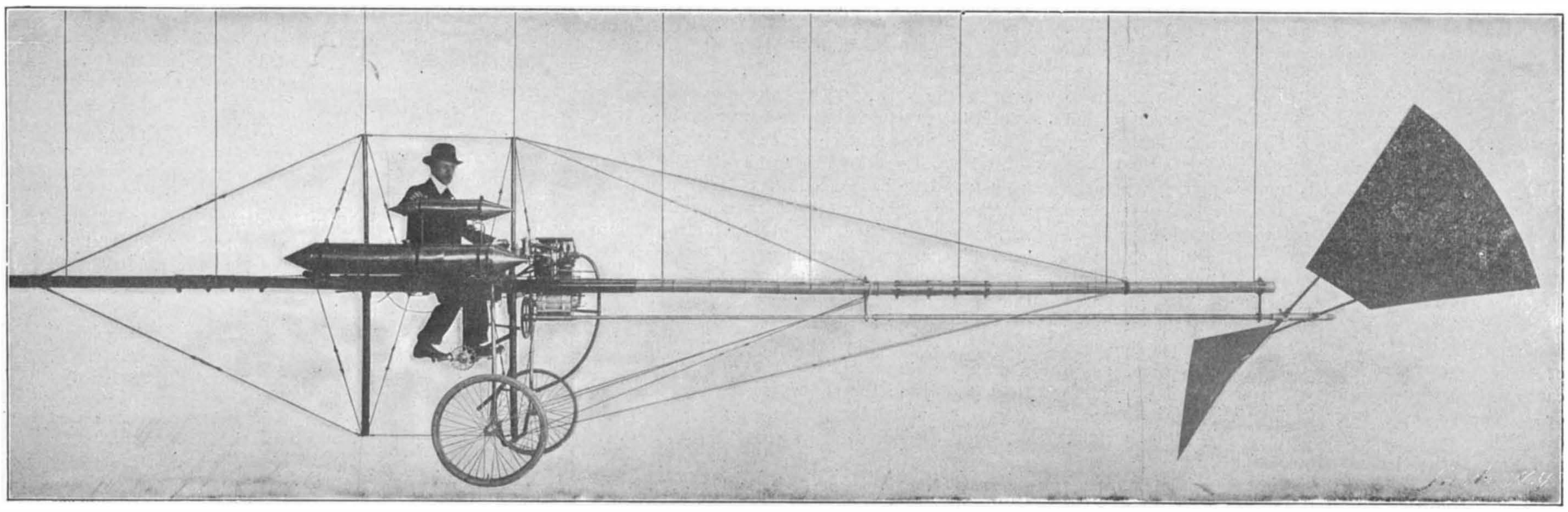


Detail View of Engines, Tanks and Controlling Gear.

experimental air ship. The start was made from the huge shed at St. Cloud, near Paris. At five o'clock in the morning the sliding doors were opened and the huge aerostat with its strange appendages was wheeled out and the motor was given a turn; the ropes were cast off and the balloon began to rise. M. Santos-Dumont threw out handful after handful of sand and the balloon slowly rose higher and higher. It swung around and made directly for the Eiffel Tower. It had no difficulty in rounding the Tower within three hundred feet and the return was then begun. It could not, however, make the balloon-house, the motors not working well, and the entrance to the Parc d'Aerostation being obstructed by some other balloon-sheds where M. Deutsch, the donor of the prize, is having a balloon built. The attempt would probably have been successful if it had not been for the fact that the supply of liquid fuel gave out so that the balloon was left at the mercy of the wind. A quick descent was arranged for and the machine became entangled in a tree. Fortunately it was not injured and M. Santos-Dumont escaped unharmed. In a short time he will make another ascent, and there is little question that he can make the trip in the time required to gain the much-coveted prize—the blue ribbon of aerial navigation.

Experiments Upon the Liquid of the Internal Ear.

In a paper recently read before the Académie des Sciences, M. Marage describes a series of experiments made upon the crystals which are found in the liquid of the internal ear. This liquid contains more or less voluminous crystals which have been called "otoliths." The different hypotheses which have been advanced to explain the acoustic action of these solid bodies seem to be scarcely probable, and in any case are not founded upon experience. The author has undertaken a series of experiments using the liquid obtained from the frog's ear and draws some conclusions as to the character and composition of these crystals. In the case of the frog, the contents of the internal ear have a milky appearance, and it is possible to secure as much as one or two hundredths of a grain. He finds the density to be 2.18, which is a very high figure. As to its composition, it is a solution of carbonate of lime and of magnesia in a liquid charged with carbonic acid. In contact with the air the carbonic acid gas disengages very rapidly, and it is easy to detect its presence. The liquid itself is very volatile; under the microscope it is seen as an oily substance which condenses in drops. It has been impossible to collect a sufficient quantity to determine its composition. The crystals which remain are formed of carbonate of lime and very small quantities of carbonate of magnesia. The most voluminous of these crystals are about the same size as a blood corpuscle (32 μ); the others, representing about 98 per cent, are much smaller and there are a great number which are scarcely visible with a magnifying power of 450 diameters. These otoliths are soluble in water charged with carbonic acid gas and can be made to reappear upon evaporation. The contents of the internal ear are thus seen to be formed of a solution of bicarbonate of lime and of magnesia with crystals in excess of insoluble carbonates. The great density of this mixture makes it an admirable conductor of sound. The existence of the crystals may also be made manifest in the living animal; the author has made radiographs of a frog under suitable conditions, and the presence of the otoliths has been revealed by a small round spot on each side of the head. To sum up, M. Marage comes



General View of the Suspended Truss, Showing the Aluminium Propeller.

THE EXPERIMENTAL MACHINE OF M. SANTOS-DUMONT, WHO APPEARS TO HAVE SOLVED THE PROBLEM OF AERIAL NAVIGATION.

to the conclusion that the liquid consists of a solution, in a liquid of undetermined nature, of bicarbonate of lime and traces of bicarbonate of magnesia with crystals of carbonates in excess, and that one of the functions of the otoliths is to maintain as nearly constant as possible the acoustic conductibility of the medium. He intends to continue his researches upon the ear of mammiferes and the human ear.

Liquid Expansion Motors.

Dr. O. Zimmermann, of Ludwigshafen, on the Rhine, proposes to construct motors on a principle which, if not novel, has at any rate not been applied with success so far, namely, on the dilatation of heated liquids, says Engineering. Between the temperature limits of its freezing and boiling points, water expands by 4.3 per cent. Considerably larger expansions result when we raise the temperature further, or when we apply other liquids like ether or sulphurous acid. The direct utilization of this expansion is, however, unprofitable on account of the high specific heat of water. Dr. Zimmermann overcomes this difficulty by arranging his caloric engine on the counter-current plan. Imagine two cylinders in tandem, the one heated, the other cooled; we call the cylinders *W* and *C*. They are connected on the sides, facing one another, by a system of pipes; their pistons *p w* and *p c* are perforated, and also connected by tubes, these latter passing through the first-mentioned tubes. If we call the space confined between the two pistons, the inner space, and that on their external surfaces the outer space, then, at a certain position of the two pistons, which are balanced and move in unison, the liquid in the inner space will be warm, and that in the outer space will be cold. If we shift the pistons, warm water will pass from *W* to *C*, and cold from *C* to *W*; the inner volume will be cooled, and the outer be heated. If we fit on *W* a kind of steam chest containing a piston *a* and communicating by ports with the inner and outer space of *W*, then the expansion of the outer volume and the contraction of the inner volume, consequent upon the heating and cooling respectively, must be equalized by a motion of the piston *a*. This piston can hence do work. In practice, the pistons *p c* and *p w* are whole and only connected by their common rod, the concentric tube system lying outside in a special cylinder which communicates by two ports with the outer and inner spaces. If we make the area of piston *p w* larger than that of *p c*, we can dispense with the special pressure cylinder, and can attach the continued piston-rods *p w c*, direct to the crank to be driven. In any case, it will be advisable to transform the rigid pressure of the liquid into an elastic pressure, and thus to combine the engine with one or more air chambers. When we heat *W* to the desired degree, and admit a certain quantity of air into the air chamber, the engine can work under any constant desired pressure. High pressures will be advantageous, because the higher the temperature, the greater the expansion coefficients, and for such motors the pistons will suitably be replaced by plungers. Dr. Zimmermann explains his views in a pamphlet which the firm of R. Oldenbourg, of Munich, has published; and he points out how hydraulic lifts, pumping engines, and even marine engines, might be constructed on this plan, for which he has secured a German patent. The heat-exchanger vessels—several may be wanted—with their two systems of tubes, would not require any awkward dimensions. But how a caloric motor of this novel type would really work between temperature limits of 20 deg. and 100 deg. or 200 deg. C., can only be ascertained by experiments, conducted on a large scale.

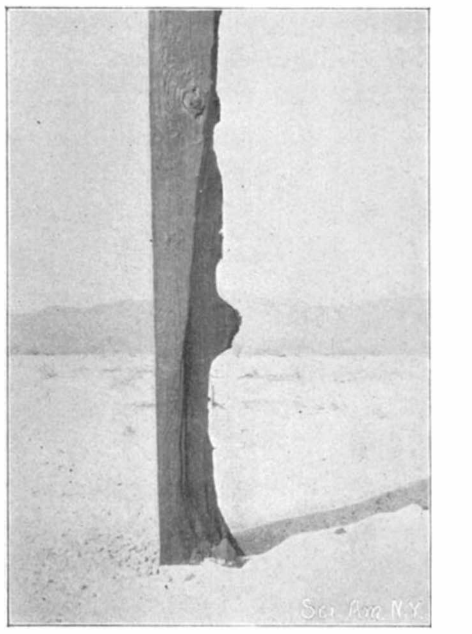
Big Rush for Automobile Patents.

By all odds the automobile section is the busiest of all the divisions of the Patent Office these days. Since all the fashionable world has taken to automobiling, and this sport is no longer a fad, the inventors of the country seem to have turned their attention to bringing out improvements in motors, carriages and other parts. The number of applications that are being received for patents on devices for automobiles is so great that it has been found necessary to have five special examiners on this work. Four separate divisions have been organized to which are referred patent papers, according to the specific kind of patent that is demanded. One division handles electric motors, another steam motors, another gas and acetylene motors and another looks out for the compressed-air motors. It is very seldom that the rush of business for a certain division is so great as to cause an increase in the number of special examiners or to bring about the establishment of additional divisions. One special examiner is ordinarily able to take care of all applications relating to one branch of work. The only record there is of a greater volume of work coming to one division than now falls to the lot of the automobile bureau, occurred some years ago at the time the bicycling craze was at its height. There was such a deluge of claims for patents on wheels, chains, bearings, handles and the other parts of a bicycle, that ten special examiners were detailed to help out the chief of the division. These cases have dwindled down since, until now only two men are required in the bicycle division. The electrical division is pushing the automobile section for first honors in the matter of work. There has been a marked increase in the development of the electrical science in the past five years, and this is shown in the Patent Office to a greater degree than anywhere else.—The American Automobile.

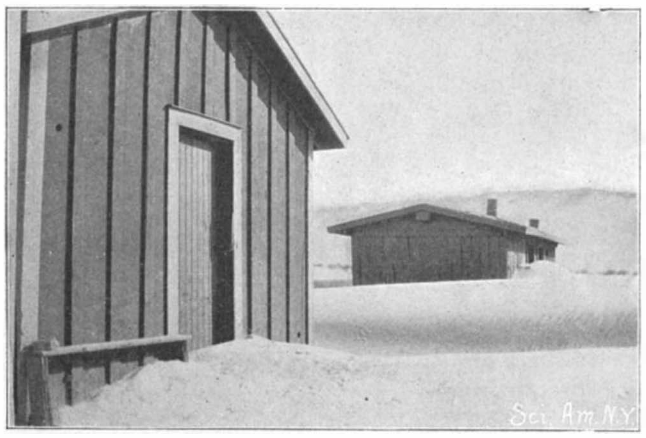
A NATURAL SAND BLAST.

BY JAMES M'ILHENNY.

The writer made a prospecting trip of two months on the Mojave and California deserts in southern California, and returned to Redlands from the latter desert by way of the San Gorgonia Pass. The small railroad town of Beaumont is at the summit of the pass at an elevation of 2,560 feet, from which in each direction the Southern Pacific Railroad descends heavy grades—on the west to Colton and southeasterly to Salton, the latter being 263 feet below sea level. North



ERODED TELEGRAPH POLE.



SAND DRIFTS AT RIMLON, CAL.

and south of Beaumont are the peaks of San Gorgonia and San Jacinto, averaging about 12,000 feet above sea level, and between these giant portals there blow at certain seasons of the year violent winds which pick up the sandy soil of the desert and use it as a sand blast to erode anything of a softer nature than itself.

The first illustration shows the lower six feet of a redwood telegraph pole, which has been cut half in two by the sand. The projection part way up is a knot which resisted the sand by reason of its tougher grain. Broken bottles or crockery which have been thrown from passing trains have the part which projects from the sand ground perfectly smooth. Where a bush or other object offers any resistance to the wind, there is piled behind it a drift of pure white sand in the same manner a drift of snow is formed behind a fence or haystack. The second cut shows the sand drifts behind the section house at Rimlon, near which the photograph of the telegraph pole was obtained. It was in the early part of June that these pictures were taken, and the maximum temperature for that day, in the shade, was 114 deg.

It is supposed that these winds are caused by the difference in radiation between the sand of the desert and the more fertile soil of the valleys that slope to the Pacific Ocean. The almost total lack of humidity in the desert air favors a free radiation each night of the heat that has been accumulated by the sand the previous day, and the same dryness causes a rapid rise of the thermometer as soon as the sun is up. The expansion of the air from contact with the hot sand causes it to rise and draw from the cooler valleys that lie to the west a supply to take its place. San Gorgonia and San Jacinto peaks being separated only by a narrow valley, form a funnel for concentrating the wind and make what might be called the largest sand blast in the world, as the dust and sand-filled air frequently covers a stretch of territory five miles wide by twenty long.

Caspian-Black Sea Canal.

Consul Hughes, of Coburg, informs the Department of State that a canal to unite the Caspian and Black seas is under consideration. The projected waterway will be 22 feet deep and about 150 feet broad; will begin at Astrakhan, on the Caspian, and end at the harbor of Taganrog, on the Sea of Azof. It is estimated that the cost will be about 40,000,000 rubles ($20,600,000). The center of Russian trade and manufacture, adds the consul, is gradually shifting southward, where the production of iron, coal, and petroleum is rapidly increasing. The metallurgical industries and the trade in cotton from middle Asia are also being largely developed. The railroads at times prove insufficient carriers, and the construction of other roads and the digging of this canal will be necessary in the near future to meet the growing demands of commerce.

The Fate of Von Zeppelin's Balloon.

On several occasions we have given an account of Count von Zeppelin's balloon and the experiments which he made with it. We regret to note that the machine has been badly injured. Violent storms which swept over central Europe in January nearly demolished the balloon house and ripped open the aerostat for about a third of its length. The inner framing, which was constructed of aluminium, was also badly twisted, and a large part of it was torn away. The cross pieces were so twisted and bent that some of them were actually broken. Count von Zeppelin intends to carry on his experiments and is repairing the balloon, and has ordered two more Daimler motors of a more powerful and lighter type than before.

Motor Trucks.

Motors for carrying merchandise to various parts of cities are attracting a good deal of attention at the hands of engineers. Recently extended trials of various types were held in Liverpool, and the conditions of competition were exacting. The vehicles were required to have a platform area for goods of from 45 to 75 square feet, according to class, and carry from 1½ to 5 tons load. The wagons varied from 18 to 22 feet in length, had wheel tires from 4 inches to 6 inches in width and made speeds of about five miles per hour loaded. They were driven by steam chiefly, though there were some oil motors. The boilers were mostly of the vertical type, both fire and water-tube systems, and carried 225 to 250 pounds per square inch gage pressure. The engines were beneath the truck platform, and of the horizontal type, having cylinders 3½ inches diameter by 6 inches stroke, compounded to 6¼ inches, and making about 350 to 420 revolutions per minute, geared to various ratios of wheel speed, direct and by chains. The total distance run was about 50 miles, and the several types came through with credit, accidents being very few.

The Current Supplement.

The current SUPPLEMENT, No. 1334, is one of the best numbers ever published. The first page engraving shows Fournier in his racing car during the Paris-Berlin motor carriage race. There are a number of other interesting illustrations showing scenes along the route of the race, and there is also a full list of the vehicles which covered the entire distance. "Abstract of the Statistics of the Railways of the United States for the Year Ending June 30, 1900," gives most valuable and interesting information. It is compiled by the Interstate Commerce Commission. "The Fire Hazard of the More Important Chemicals," by Ernest H. Cook, is continued. "Submarine Mines" is an illustrated article showing various types. In the Selected Formulæ column will be found a number of formulas for tooth-powders and pastes.

Contents.

(Illustrated articles are marked with an asterisk.)

RECENTLY PATENTED INVENTIONS.

Electrical Apparatus.

TELEPHONE-CIRCUIT.—WILLIAM E. PEMBLETON, Wittenberg, Wis. It is the purpose of this invention to arrange the circuit so as to enable telephone-subscribers to know whether the operator's instruments at the central station are cut in or cut out, while conversation between two subscribers is being carried on, and, further, to make it impossible for a third person to be connected by the operator with the two talking subscribers.

Mechanical Devices.

STAMP-MACHINE.—CHARLES H. KRAUSE, Southlake Linden, Mich. The invention relates to stamp-machines or mills for ores, and provides improvements on a similar machine patented twelve years ago by Mr. Krause. In the improved mill differential communicating cylinders are placed one above the other. In the smaller cylinder a piston operates which carries a stamping device. A pressure-actuated valve controls the exhaust from this lower cylinder. A valve-casing communicates with the cylinders. In the casing is an inlet-controlling valve actuated by the movement of the lower piston. In the casing is also an air-pressure actuating valve. The air-cushion between the two pistons permits the pestle to accommodate itself to the amount of material in the mortar.

PROPELLER-GOVERNOR.—FRANK S. CORMIER, Moncton, New Brunswick, Canada. This governor comprises a brake-shoe adapted to engage the shaft; a cylinder; a piston operating in the cylinder, and a valve which controls the steam supply to the cylinder. The piston is connected with the brake-shoe; and the movements of the valve are controlled by a float. If the stern of the vessel should be lifted the float moves downward, thereby opening the passage into the rear of the cylinder. The steam moves the piston so as to cause the brake-shoes to engage the shaft, thus preventing the racing of the propeller.

BEATING-ENGINE.—JAMES CONLEY, Administrator of the estate of Edward Conley, Manhattan, New York city. In the beating-engines which have been hitherto constructed it has been found that when the beating-drum runs at a higher speed than the bed-roll, the knives on the beating-drum are worn concave, while the knives on the revolving bed-roll appear convex, showing that the machine works unevenly. Mr. Conley devised an engine arranged to insure a uniform straight wear on the knives and to permit the beating-drum to yield upon the passage of lumpy matter between the drum and the bed-roll, thereby avoiding injury to the knives.

BED-ROLL.—JAMES CONLEY, Administrator of the Estate of Edward Conley, Manhattan, New York city. The invention relates to beating-engines used in paper manufacture, and its object is to provide a bed-roll arranged to hold the knives securely in position throughout their length on the central solid plug so as to prevent the knives from springing up in the middle even though the plug should warp or swell.

TRAP.—WILLIAM A. BRUNKER, Farmersburg, Ind. The trap is intended to snare burrowing animals, such as moles. The trap may be repeatedly set and will, as a rule, require no repairing. It is absolutely certain of its victim. The novel feature of the invention is a forked plug which must be dislodged for the animal to pass, and to dislodge the plug the animal must come within slings by which it is captured.

ROPE-GRIP.—HOWELL HANSEL, Manhattan, New York city. The device is intended to grip ropes or cables. Its construction is such that it may be conveniently carried in the pocket when not in use. It is particularly adapted for use by yachtsmen and sailors in raising and lowering sails and to prevent the cutting of the hands.

MACHINE FOR REMOVING SNOW AND ICE.—CHARLES POORE, Box 177, Aurora, Ill. The machine is intended for use on railroads, city streets and common roads. It is provided in front with rotary drums which cut and pick up the snow and ice and deliver them into a heated receptacle where they are melted. The water thus produced is conducted off at the side of the machine. The receptacle is heated by electric incandescent lamps; and the drums are rotated by electric power.

PROPELLING MECHANISM FOR VESSELS.—ALBERT J. TAPLIN, 420 Bernard Street, Vancouver, British Columbia, Canada. The propelling mechanism is located on both sides of a vessel's hull, slightly forward of the middle of her length. It is the object of this invention to increase the speed and steering capacity of a vessel and enable her to be turned in a very short distance.

COGGED-GEARING.—AMBROSE M. SEARLE, Geneseo, Ill. The gearing is intended to be be used in traction-engines. A brace-frame is pivotally connected with a hanging boxing and is rockable therewith and also independently. A tumbling-rod and a pinion on the tumbling-rod are held in place by the frame; and the frame is boxed to the pivot-lug and to the journal on the hanging boxing. A cog-wheel meshes with this pinion and runs on the journal of the hanging boxing. The pivot-lug and journal are at opposite points and upon a line drawn through their respective centers. A free lateral movement of the tumbling-rod is thus obtained, the pinion being constantly held upon the cog-wheel and transmitting the power from the cog-wheel by means of the guidance of the swinging frame. Thus the traction-engine is enabled to perform its work in any position relatively to the objective work to be done within an arc of 180 degrees described about the engine with the hanging boxing on the main shaft as a center.

GLASS-MOLD-OPERATING MACHINE. — FRANK A. SHUNK, 211 South Monroe Street, Streator, Ill. This invention is a labor-saving machine and is designed to open a mold in which a bottle or other article has been made; to remove the bottle therefrom; then to close one side of the mold, and place the bottle on a stand ready to receive it. After material for a fresh bottle has been placed in the mold, the other side, which has been left open before blowing another bottle, is closed. The invention is designed to provide means whereby most of these operations can be quickly performed in a practically automatic manner.

Miscellaneous.

BROILER.—JOHN FERRACIOLI, Manhattan, New York city. The invention is a broiler which enables one to prepare food rapidly and thoroughly, and which at the same time is convenient to handle and operate, the broiler being placed on top of an ordinary range, or upon a table or the like.

RADIATOR.—TIMOTHY S. MARTIN, Butte, Mont. This radiator is simple in construction. One of its main features is that it requires no air-cock. Provision is made for automatic collection and drainage of the condensation-water and for an adjustment of the distance between the two pipes, through which steam is admitted and returned respectively.

VARIABLE MEASURE. — THOMAS E. WHITE, Chicago, Ill. The invention provides a measure which can be quickly adjusted for different quantities of solids, making it particularly useful for hucksters or peddlers in measuring liquids.

EMERY-STEEL.—GEORGE F. LUCAS, Manhattan, New York city. The emery-steel is provided with cushions so arranged that should the steel drop the cushions will engage the surface on which the steel may fall. Thus the force of the fall is broken and the steel protected.

BUTTONHOLE AND RUFFLING GAGE FOR SHEARS.—EMMA L. N. STEEN, Manhattan, New York city. The invention provides an ingenious combined buttonhole and plaiting or ruffling gage for shears, and a buttonhole-gage adapted for attachment to any buttonhole-shears. When a strip of material is to be cut from a main web for plaiting or ruffling, the shears will cut the strip with an upper and a lower support and to a regular width either on the straight or on the bias. The buttonhole-gage can be applied to any construction of buttonhole-scissors.

SWIMMING-SHOE.—THOMAS J. A. FREEMAN, Jersey City, N. J. The shoe, or rather sandal, is arranged to aid the user in swimming or treading water, and likewise to permit convenient walking on land. The construction provides a foot-plate having a wing which acts as a propelling surface during swimming. The sandal is strapped to the foot.

LIFE-RAFT. — JOHN V. JANIN, Seattle, Wash. The life-raft is a pneumatic raft of simple construction, having means whereby it may be quickly inflated either when afloat or on shipboard. Pockets are arranged on the opposite sides of an inflatable body portion. In the pockets cork or similar material is placed. Inflating-pumps are mounted on opposite sides of the raft, the pumps being mounted to swing relatively to the raft. When the device is deflated and not in use it may be rolled compactly together for storage or transportation.

BROOM-HOLDER. — DANIEL H. MOWEN, Myersville, Md. Mr. Mowen has provided a novel construction for holding a broom, in which clamping-arms stand at angle to the carrier or base; in which the clamp includes a sliding member operated by the gravity of the broom handle and of the clamp; and in which the sliding, clamping member is made with a stop for limiting the dropping movement of clamping devices.

FUMIGATING APPARATUS.—GILBERT E. ALPHIN, Mount Olive, N. C. The apparatus is designed for fumigating fruits, vegetables, milk and other alimentary substances in order to prevent early decay. Sulfur or other prepared chemical capable of emitting fumes is employed. These fumes flow directly in contact with the articles to be treated and finally into contact with water by which they are wholly or partly condensed and absorbed. The water thus impregnated is subsequently used for preserving the article which has been treated.

Designs.

PIPE. — ARTHUR Q. WALSH, Manhattan, New York city. The pipe is a Pan-American Exposition pipe and is therefore made in the shape of a pan.

BELT.—LOUIS SANDERS, Brooklyn, New York city. The belt has a flat body with outwardly projected longitudinal series of crescent-shaped loops, and longitudinal strips passing through these loops.

STATIONARY PLATE FOR STATIC MACHINES.—JAMES M. G. BEARD, Fruita, Col. The plate has as its leading feature an approximately semi-circular curved edge, and an oppositely disposed straight edge.

HANDLE FOR SPOONS, FORKS OR SIMILAR ARTICLES.—CHARLES A. BENNETT, Taunton, Mass. The chief feature of the design is a particular arrangement of tiger lilies on the obverse of the spoon or fork handle. Minor features of the design are the finial or end ornament of the handle, and scrolls extending along the sides of the front panel. The obverse side of the handle is provided with scrolls or leaves joined with and forming part of some of the lilies on the front, and other leaves which are extended and curved to form the borders or sides of a panel.

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

NEW BOOKS, ETC.

DER SCHORNSTEINBAU. Von Gustav Lang, Professor an der Technischen Hochschule zu Hannover. Drittes Heft: Anordnung gemauerter Schornsteinshaefte. Illustrations 24 to 103a and two photolithographic plates. Hanover: Helwingsche Verlagsbuchhandlung. 1901. Large octavo. Pp. 332. Price, paper, $3.

Prof. Lang's third volume of his work on chimney construction deals with the arrangement of masonry chimney-shafts in a manner which is both scholarly and thoroughly practical. The author has thoroughly tested the old formulæ for simple chimney-shafts, with the result that he found many of them deficient. He has therefore drawn up new rules which fully consider the influence of height, clear distance, material, formation of stone, local wind pressure, and which enable the builder to construct his chimney with the least possible mathematical labor.

VON LOEBELL'S JAHRESBERICHTE UEBER DIE VERAENDERUNGEN UND FORTSCHRITTE IM MILITAERWESEN. XXVII. Jahrgang. Bericht fuer das Jahr 1900. Unter Mitwirkung zahlreicher Offiziere herausgegeben von v. Pelet-Narbonne, Generalleutnant z. D. Berlin; Ernst Siegfried Mittler & Sohn. 1901. Octavo. Pp. xiv, 651. Price, paper, $4.

The latest volume of the well-known Jahresberichte chronicles with characteristic German accuracy the progress which has been made in military science during the past year; the changes which have been made in the organization of the various continental armies; new weapons which have been adopted; new tactics which have been devised; and new experiments which have been made. Not the least interesting portion of the work will be found in the discussion of the stirring events which have taken place during the last year in South Africa, the Philippines and China.

THE LIMITS OF EVOLUTION. By G. H. Howison, LL.D., Mills Professor of Philosophy in the University of California. New York and London: Macmillan & Co. 1901. 16mo. Pp. xxxv, 396. Price, $1.60.

The volume is a series of essays and papers which, written and published at widely different times, have a connection with one another not apparent at first sight. The connecting-link, however, is to be found in the author's peculiar doctrine of "personal idealism"—a modified form of pluralism. In the preface of the volume will be found a very entertaining, though unfortunately brief, exposition of the tenets of this new philosophy.

HOW TO BUILD A MOTOR LAUNCH. By C. D. Mower, Designing Editor of the Rudder. New York and London: The Rudder Publishing Company. 1901. Price, cloth, $1.

This work has been written by a self-taught boatbuilder who is qualified to give the novice just that kind of advice that he particularly needs, and he succeeds, by clear description and easily-understood drawings, in putting into the hands of the amateur boatbuilder all the necessary instruction to enable him to put together a thoroughly servicable hull, suitable for any kind of motor. In the after part of the book are given designs of several launches, from 18 to 50 feet in length. The letterpress and drawings are up to the best work of the publishers.

YACHTS AND YACHT HANDLING. By Thomas Fleming Day. New York and London: The Rudder Publishing Company. 1901. Price, cloth, $1.

The author of this work, which is as charming as it is instructive and practical, has established such an excellent reputation in this particular class of literature that his mere name is a guarantee of the excellence of the book. In his preface the author makes an apology for writing the work in the first person; but all who read it will be agreed that it would be a distinct loss to the interest and value of the work had it been written in any other form. The first ten chapters—which include such subjects as seamanship, rigging, reefing, anchoring, stranding, etc.—are chiefly the outcome of personal experience. There are ten halftones, many of them of well-known vessels, and a host of clear line cuts showing the many different types of rig. An excellent book for the amateur yachtsman.

AMERICAN ENGINEERING COMPETITION. New York: Harper & Brothers. 1901. 12mo. Pp. 140. Price, $1.

The sixteen chapters of this little book are made up of a series of articles published in the columns of the London Times, and have been published in full in our SUPPLEMENT. They are the investigations by an English engineer of American methods in the great iron and steel industries of our country; and they lead to the broad conclusion that American competition in engineering industries is certain to prove a serious menace to English trade in the same line in neutral foreign markets hitherto almost exclusively British. The book is of value to Americans because of the insight it gives into the methods employed in these vast industries. Among those described are the iron and steel industries, including the manufacture of steel, locomotives, engines, machine tools, and the like. A clear exposition is also given of the methods of transporting the ores from mine to factory, via the Great Lakes.

MODEL BOILER MAKING. By E. H. Pierce. London: Dawbarn & Ward. 1900. 88 pp., 35 illustrations. Price, $1.25.

This is a practical little handbook on the designing, making and testing of small steam boilers. Stationary locomotive and launch boilers are described, and scale drawings given of the different types.

EMILE ZOLA. A Psycho-Physical Study with Appendix. By Arthur MacDonald. Fourth edition. Washington, D. C. 1901.

It is difficult to understand what Mr. MacDonald has accomplished in this so-called "study." A vast amount of information is catalogued; elaborate measurements are given; psychological examinations are made—all apparently to no purpose. Of this data gathered no use whatever is made. Nor is anything new told of the man Zola. With all due respect for the undeniable industry displayed in collecting material, we must confess that Mr. MacDonald's task is singularly unproductive of any valuable results.

PRACTICAL ELECTRICAL TESTING IN PHYSICS AND ELECTRICAL ENGINEERING. By G. D. Aspinwall Parr, Assoc. M.I.E.E. New York: Longmans, Green & Co. 1901. 392 pp., 231 illustrations. Price, $2.50.

This book is intended as a textbook and book of reference. The different methods of measuring magnetism, resistance, etc., are fully described, and their algebraical solutions are included in an appendix, as well as illustrated descriptions of the laboratory apparatus usually in use.

L'EVOLUTION DU PIGMENT. Par le Dr. G. Bohn. (Série Biologique "Scientia.") Paris: Georges Carré et C. Naud. 1901. 16mo. Pp. 96. Price, 75 cents.

The eleventh volume in the "Scientia" series is an admirable biological study of the coloring matter of organic tissues. Dr. Bohn has performed his work with a conscientiousness that will certainly be appreciated by students of cellular biology.

THE DESIGN AND CONSTRUCTION OF OIL ENGINES. By A. H. Goldingham, M. E. New York: Spon & Chamberlain. 1900. 16mo. Pp. 196. Price $2.

Full directions are given for erecting, testing, installing, running and repairing oil engines, including descriptions of American and English kerosene oil engines. The book is illustrated by a considerable number of diagrams and engravings.

EVOLUTION OF THE THERMOMETER, 1592-1743. By Henry Carrington Bolton. Easton, Pa.: The Chemical Publishing Co. 1900. 16mo. Pp. 98. Price $1.

Dr. Bolton has devoted himself to chemical literature and his bibliography of it is a masterpiece. He has also written considerably upon such curious subjects as alchemy. The little book before us is a most interesting treatise, and the list of authorities which he cites is quite remarkable.

SELECT METHODS IN FOOD ANALYSIS. By Henry Leffmann, A.M., M.D., and William Bean, A.M., M.D. Philadelphia: P. Blakiston's Son & Co. 1901. Pp. 380. 53 illustrations, together with 4 full-page plates and many tables. Price $2.50.

In this book will be found many of the valuable processes and data which have been published during the last decade in bulletins of the Department of Agriculture, Association of Official Agricultural Chemists, and the various State experiment stations. The book is intended to be a concise summary of analytic methods adapted to the needs of both practising analysts and advanced students in applied chemistry. Special attention has been given to the presentation of methods for detecting preservatives, artificial color, and poisonous metals.

BONE PRODUCTS AND MANURES. By Thomas Lambert. London: Scott, Greenwood & Co. 1901. 8vo. Pp. 162. Price $3.

An account of the most recent improvements in the manufacture of fat glue, animal charcoal, size, gelatine and manures. The literature of this subject is not very extensive, and the present work deals with the subject in both a practical and scientific way. It will interest all students of technology as well as manufacturers. The author has devoted a chapter to the methods used in making the many analyses of raw and finished products.

DICTIONARY OF CHEMICALS AND RAW PRODUCTS USED IN THE MANUFACTURE OF PAINTS, COLORS, VARNISHES AND ALLIED PREPARATIONS. By George H. Hurst, F.C.S. London: Scott, Greenwood & Co. 1901. 8vo. Pp. 382. Price $3 net.

The need of a dictionary of this kind is emphasized by the loose nomenclature of raw materials used in the paint and varnish business. Mr. Hurst's compilation is a most valuable one. It is thorough and accurate, and the matter is well presented. It is a valuable book.

A B C OF THE TELEPHONE. By James E. Homans, A. M. New York: Theodore Audel & Co. 1901. 12mo. Pp. 335. 268 figures. Price $1.

It is surprising what an excellent book can be produced at such a low price. Some of the illustrations are very poor, but many of them are excellent and the diagrams are exceedingly clear. The theory of the subject is described and the practical details are given. Many special types of instruments are shown. Typographically the book is a satisfactory one, and the binding, black and yellow with yellow type, is very effective.

THE INDUCTION MOTOR. A Short Treatise on Its Theory and Design. With Numerous Experimental Data and Diagrams. By R. A. Behrends. New York: American Electrician Company. 1901. 8vo. Pp. 105. Price $1.50.

The induction motor has received comparatively little attention from competent engineers. The few whose experience and knowledge would entitle them to speak with authority on this subject are deterred from publishing by commercial reasons. The author has made the induction motor the subject of early and special study. The subject is treated mathematically, and will certainly prove of value to electricians and those who are engaged in practical work.

EXPERIMENTAL CHEMISTRY. By Lyman C. Newell, Ph.D. Boston: D. C. Heath & Co. 1900. 12mo. Pp. 435. Price $1.10.

There seems to be no end in the making of textbooks, and the one before us is one of the best we ever remember to have seen. We are glad to note the omission of many illustrations which have been handed down from time immemorial. The way in which the matter is arranged and presented is excellent, and the glossary of chemical terms is an excellent one. The problems are also numerous. It is a thoroughly modern and valuable textbook. A teacher's supplement is also issued.

A SHORT MANUAL OF INORGANIC CHEMISTRY. By A. Dupré, Ph.D., and H. Wilson Hake, Ph.D. London: Charles Griffin & Co., Ltd. Philadelphia. J. B. Lippincott Co. 8vo. Pp. 391. Price $3.

The third edition of this excellent manual retains the main features of the preceding edition, but has nevertheless undergone some very material alterations. The introductory portion deals with general principles and is an excellent exposition of general chemistry. Then follows a description of the properties of the various elements and their compounds. The scheme of properties of any element or compound is an excellent feature.

ATOMS AND ENERGIES. By D. A. Murray, A.M. New York: A. S. Barnes & Co. 1901. 16mo. Pp. 202. Price $1.25.

This essay aims to give not a theory, but a discussion. In dealing with the movements of atoms the author has endeavored to not postulate any new force or factors of any kind, but simply to take the energies and laws which we now know, and to compute their effects in the atomic distances. The field entered is new and certainly large, and all students of chemistry and physics will be glad to read such a carefully considered discussion.

THE ELEMENTS OF ASTRONOMY. By Sir Robert Ball, LL.D., F.R.S. New York: The Macmillan Company. 1900. 16mo. Pp. 183. Price 80 cents.

What has long been needed is an elementary treatise on astronomy which would present the subject in an interesting manner. There is no one to-day more qualified to do this than Sir Robert Ball, and he has produced a most admirable little book which is well illustrated. The work, while it contains some mathematics, can be understood by those who have no special knowledge of mathematical science.

Whittaker's Revolving Planisphere, showing the principal stars visible for every hour in the year, consists of a circular disk on which the principal stars are seen and from our latitude are clearly indicated. By means of an exceedingly simple arrangement the disk may be made to revolve in such a way as to show only those stars visible in any given time. In addition to this may be shown the varying time of sunrise and sunset during the whole year. The price of the Planisphere by mail is 65 cents.

In "Six Months Abroad on Three Hundred Dollars," reviewed in our issue of July 13, the accommodations on the ocean voyages were second-class, and not steerage as stated.

Notes & Queries

HINTS TO CORRESPONDENTS.

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

(8278) F. A. G. asks: Can you recommend to me a satisfactory advanced textbook in electricity? Should like one containing an account of phenomena, both old and new, together with a clear mathematical exposition of the facts. Nipher's "Electricity and Magnetism" is sometimes used as a textbook, but its clearness is somewhat compromised by the author's frequent introduction of conversion factors, and he seems to have a fear of employing such generalities as Green's theorem, Poisson's equation, etc. Maxwell's work rather represents the opposite extreme, being too general for my purposes. An ideal book would be Thompson's "Elementary Lessons in Electricity and Magnetism for Advanced Students." A. The familiarity with the subject of electricity which your letter exhibits would indicate to us that you can hardly find what you require in any single textbook. You seem to have reached the stage where your reading of necessity would branch out into the special treatises and papers read before the learned societies. At any rate, we do not know any single, comprehensive treatise to recommend to the man who has passed beyond the use of Nipher and Maxwell. We would name certain works of a special character which may meet your need: Cummings' "Theory of Electricity," $2.25; Gerard's "Lessons in Electricity," $2.50; Gray's "Absolute Measurements," Vol. I., $3.25; Vol. II., in two parts, $6.25; Gray's "Treatise on Electricity," Vol. I., $4.50; Fleming's "Alternating Current Transformer in Theory and Practice," Vol. I., $5; Vol. II., $5; Jackson's Textbook on Electromagnetism," $2.25; Steinmetz's "Theory and Calculation of Alternating Current Phenomena," $2.25; Sir William Thomson's "Mathematical and Physical Papers," Vol. III., "Electricity and Magnetism," $5.50; Sir William Thomson's "Papers on Electrostatics and Magnetism," $5; Whetham's "Solution and Electrolysis," $1.90; Luptke's "Electro-Chemistry," $2.50. We could follow these with a long list of treatises upon the various sections of electrical engineering, but we do not understand that your wishes go out in that direction.

(8279) G. M. M. writes: I would like to have you explain Query 8252 to L. H. E. in your valuable paper. "To find the horse power of an electric motor, *measure* the amperes it is taking and the voltage of the current," etc. This may be very plain and simple to some, but to amateurs it is a problem difficult to understand. How are we to measure the amperes and volts, except perhaps by getting costly instruments? A short and simple rule for the measurements (if there is any) of electrical units would be of greater assistance to students than what to do with the product when obtained. A reply through Notes and Queries would help several of us and perhaps L. H. E. as well. A. If one wishes to measure the weight of a bar of iron, he will provide himself with standard weights and a balance; if he would obtain its length, he must have a standard rule. So it would seem apparent that if one would know the amperes and voltage of the current an electric motor is using, he must have the proper instruments for measuring these factors of the current. This was not involved in query 8252. The request there was simply for the rule for finding the horse power of an electric motor. That question was properly and plainly answered. The query above goes further and asks a rule for finding the volts and amperes of a current. There are a number of methods of measuring these which are used in the laboratory, but they would not be intelligible to those not already practised in measuring electrical quantities, and such have them in their laboratory manuals. The only practical way is to obtain the proper measuring instruments and measure them just as any other measurement is made. When the quantities are measured you may be able to see through the rule for their use.

(8280) C. O. P. asks: 1. Will you please tell me how many cells of sal ammoniac porous cup batteries it will take to excite the field of the alternating current dynamo described in SCIENTIFIC AMERICAN, September 11, 1897? A. The sal ammoniac battery is not adapted to use for the purpose you mention. It cannot furnish a steady current for any length of time. It is only fitted for such places and uses as call upon it for action a moment and then allow it to rest longer than it has worked. In this respect it is like some people. To understand this feature of batteries look up polarization of batteries in some textbook. Batteries which polarize easily are only adapted to use upon open-circuit work. The potassium bichromate cell may be used for exciting the fields, or the Edison-Lalande cell. A battery in which polarization is prevented is the sort to use upon a closed circuit, since it can give a constant current without diminution till its materials are used up. 2. Will you explain how I can rewind to make it direct current, and about how many volts and amperes will it develop, both as an alternating current and direct current? A. No change is required in the winding to adapt the machine to the direct current. A commutator must be put in place of the collector rings, and the windings of the armature must be connected to the segments of the commutator. We cannot give the volts and amperes which the machine will give. 3. Where can I procure data for making a fan motor that will run with batteries and using an 8 to 10-inch fan? A. You can find the full directions for making the motor and also a good form of battery with which to run it in Parkhurst's "Motor Building for Amateurs," price $1 by mail.

(8281) G. T. T. asks: I would like to know something about the action of zinc on iron. That is, we are told (could not say how true) that zinc in a water pail will keep same from rusting, and I believe that this is proved. Could you explain why this is so? A. We have heard the statement made many times that zinc will protect iron from rusting. We have not taken the trouble to verify it. If the fact is as stated, the result is not due to any action of the zinc upon the iron. Zinc has no direct chemical action upon iron. Whatever action there may be is due to an electric current set up in the water between the zinc and the iron. The result is a decomposition of the water. A small electric battery is thus formed in the water pail. The zinc is positive and the iron is negative. When the water is separated into its oxygen and hydrogen, the oxygen being electro-negative goes to the positive zinc, and the positive hydrogen goes in a similar way to the negative iron. In this way the oxygen which would rust the iron (since iron rust is iron oxide, a compound of iron and oxygen) is kept away from the iron and the iron does not rust. The zinc is oxidized and disappears.

(8282) E. N. F. asks: 1. Would not 17 cells, each of 2½ volts, 0.4 ampere, connected as per diagram, give the same results as though there were 12 of 2½ volts and 2½ amperes each and all connected in series? A. No. You show twelve coils in series connected to a multiple arrangement of four single cells on one side and to the line on the other side of the series. Now the E. M. F. of the twelve in series will be twelve times that of the single cells at their side. The line is in shunt with the single cells. The E. M. F. of the twelve cells will send a current which divides between the line and the multipled cells in the inverse ratio of the resistances of the two. The cells in series will therefore send current back through the cells in multiple, and most of the current will be lost in this way; since the resistance of the four cells in multiple is very small. 2. What reason is there why primary cells should not be overcharged? A. We presume you mean by "overcharge" the use of too strong a solution. If so, the answer is that the solution will act too fiercely upon the positive plate and much of the energy will be wasted as heat in the liquid of the cell. 3. Is it not possible for a motor taking 100 watts to develop more than 100-746 of a horse power? A. We do not see how a power can produce more effect than it has in itself. A horse power can do so much work and no more. 4. Could a 1-6 H. P. motor run a small automobile large enough to hold a 125-pound boy? If so, how many times should it be geared down, driven wheel being 2 feet diameter and driving pulley 2 inches? A. Yes; on a good road, at a moderate speed. The gearing must be made so as to rotate the wheels of the carriage as many times as are necessary to drive it at the number of miles per hour desired. 5. Will you please tell me how to make the luminous substance that is put on clock dials to make them visible at night? A. This question was answered in the Query column of SCIENTIFIC AMERICAN Vol. 85, No. 1, under Query No. 8249.

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DESIGNS.

TRADE MARKS.

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PRINTS.

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. In ordering please state the name and number of the patent desired, and remit to Munn & Co.. 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., 361 Broadway, New York.

SEALED PROPOSALS WILL BE RECEIVED AT the office of the Light-House Engineer, Tompkinsville, N. Y., until 12 o'clock M., of August 6, 1901, and then opened, for furnishing Miscellaneous Articles for the Light-House Establishment, for the fiscal year ending June 30, 1902, in accordance with specifications, copies of which, with blank proposals and other information, may be had upon application to Lieut-Colonel D. P. HEAP, Corps of Engineers, U. S. A., Engineer.

WANTED.—ELECTRICAL DRAFTSMEN. A COMpetitive examination of applicants will be held at the Navy Yard, Boston, Mass., August 7, 1901, for one first-class assistant electrical draftsman at $4.00 per diem, Bath, Me., and one first-class assistant electrical draftsman at $4.00 per diem, Quincy, Mass. For application and additional information, address "Commandant, Navy Yard, Boston, Mass."

JOHN D. LONG, Secretary of the Navy.

SHOE BLACKING.—FORMULAS FOR liquid and solid blacking are given in SUPPLEMENT Nos. 1213 and 1239. Price 10 cents each. For sale by Munn & Co. and all newsdealers.