SCIENTIFIC AMERICAN

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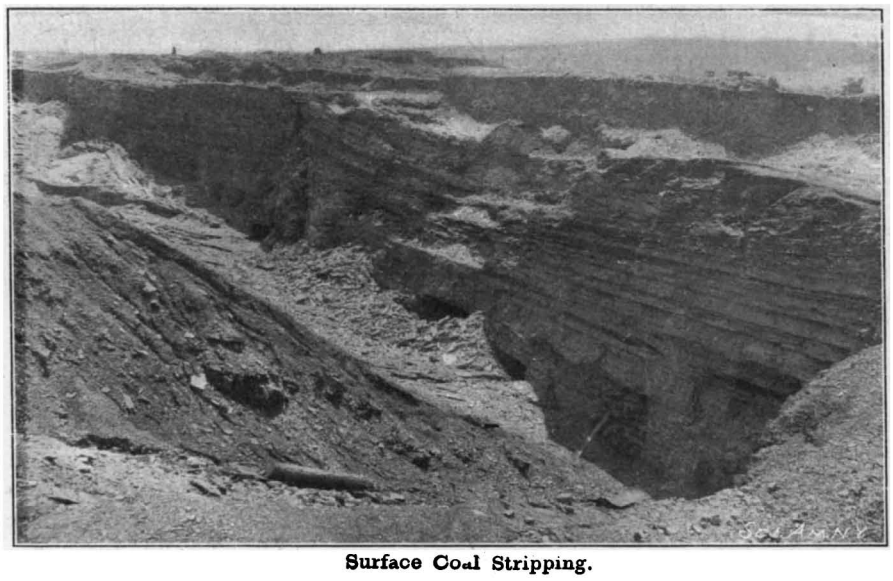
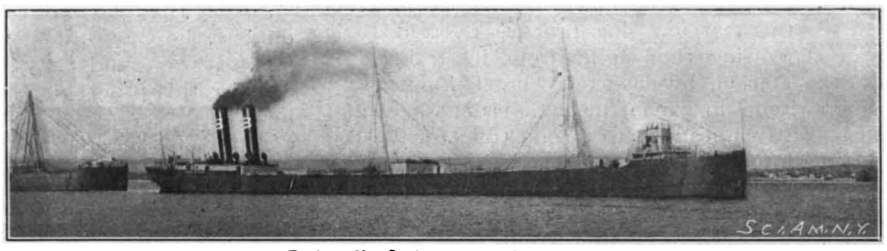
A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LXXXIII.—No. 22. ESTABLISHED 1845. | NEW YORK, DECEMBER 1, 1900. | [$3.00 A YEAR. 8 CENTS A COPY.

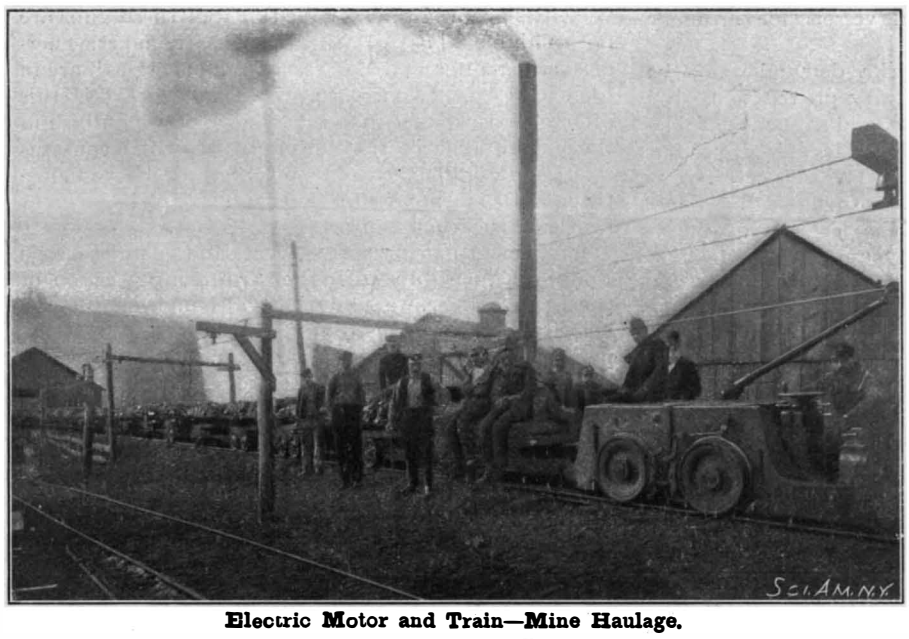
New Coal Car Dumper.



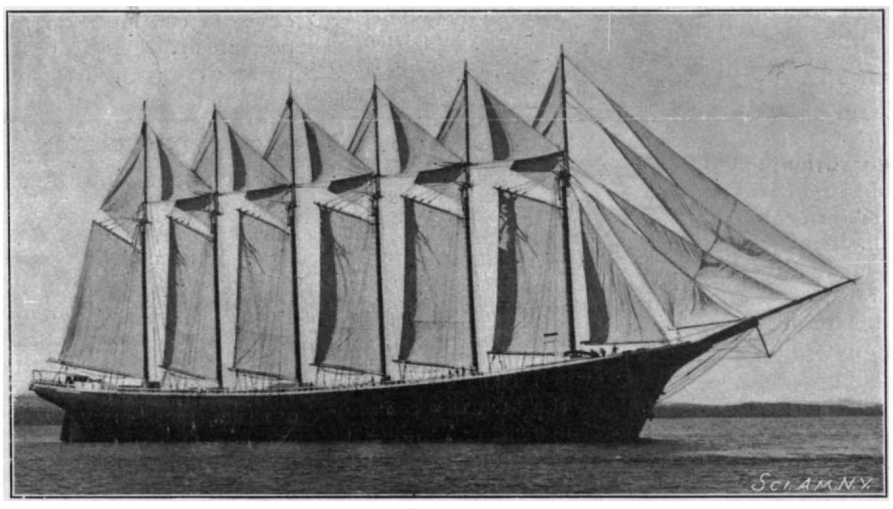
Surface Coal Stripping.



Lake Coal-Carrying Steamer.



Electric Motor and Train—Mine Haulage.



Six-Masted Coal-Carrying Schooner.

Four-Bridge, Coal Frameway for Unloading Anthracite.

HANDLING ANTHRACITE COAL.—[See page 341.]

Scientific American.

ESTABLISHED 1845

MUNN & CO., - - - EDITORS AND PROPRIETORS.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, - - NEW YORK.

TERMS TO SUBSCRIBERS

One copy, one year, for the United States, Canada, or Mexico $3.00
One copy, one year, to any foreign country, postage prepaid. £0 16s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845).....$3.00 a year.
Scientific American Supplement (Established 1876) ..... 5.00 "
Scientific American Building Edition (Established 1885). ..... 2.50 "
Scientific American Export Edition (Established 1878)..... 3.00 "

The combined subscription rates and rates to foreign countries will be furnished upon application.
Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, corner Franklin Street, New York.

NEW YORK, SATURDAY, DECEMBER 1, 1900.

CONGESTION OF TRAFFIC AT THE GRAND CENTRAL STATION AND ITS REMEDY.

It is a remarkable fact that although New York is the second largest city in the world, it has but one railroad terminal station within its boundaries. Except in the unlikely event of the construction of a gigantic bridge across the North River, it is probable that the Grand Central Station at Forty-second Street will continue to be the only great terminal in New York. The enormous volume of traffic which it has to accommodate has for many years proved too much for the capacity of the station yard; and only by resorting to a practice which all railroad men, including the officials at the Grand Central Station themselves, condemn has it been possible to receive, make up and dispatch the large number of local and express trains which use this station. The practice referred to is that of separating the engine from its train as it enters the station, by means of what is known as a "flying switch," in which the engine is cut loose and steams swiftly ahead on to a side track, while the train runs into the station. The element of danger lies in the possibility of the switch being thrown too late, or of the train, which is not under air-brake control, being switched on to the wrong track and colliding with stationary cars. It is to the credit of the station yard management that an admittedly risky practice has been followed for many years with so few accidents.

An attempt is now being made to improve and accelerate the handling of trains in the yard by installing a complete pneumatic switch system and abolishing the flying switch; but the experience of the first three days of operation was so disastrous that a return has been made to the old plan of separating the engine from its train. Almost from the hour in which the new system was inaugurated the yard service was thrown into such disorder that trains, both suburban and express, were detained from one to two hours, either in the station or in the tunnel approach.

The fact that the flying switch is again in force proves to a demonstration that the facilities are altogether inadequate to the ever-increasing number of trains that must be accommodated; and it is evident that some radical change must be made in this terminal or the traffic within the next few years will be thrown into a condition approaching a deadlock. The simplest solution of the difficulty would be to separate the express and local trains, reserving the present station for the former, and accommodating the local trains on a series of loops built on an elevated structure above the present yard. The two outer tracks of the tunnel should be reserved for local trains. Shortly after it leaves the tunnel the incoming track should be carried on an incline to a level at which it would clear the station yard. It should then connect with a series of concentric loops, which would extend around the yard in front of the present train shed, and unite on another incline by which the outgoing local trains would leave the station. Three or four loading and unloading platforms would be provided. As part of this plan, local trains would be made up at such points as New Haven, Stamford, and New Rochelle, and would run through the New York terminal and back to these towns without change of engines. A precedent for this arrangement exists in the great loops beneath the terminal station at South Boston—the main difference being that at Boston the tracks are depressed, whereas at New York they would be elevated.

By providing such an elevated station as this, the congestion would be completely relieved and its recurrence indefinitely removed. The overcrowding of the tracks involved in making up the local trains would be avoided, as these trains would be made up at such points as Stamford and New Rochelle, and would pass through the Grand Central Station intact. There would be no insuperable structural difficulties involved in the erection of the incline and loops suggested. Moreover, it is a change which could be made with the least cost to the companies and with absolutely no discomfort or delay to the traveling public; as the terminal could be run under the present system until the very hour at which the tracks were cut and connections made between the new elevated station and the existing incoming and outgoing local tracks.

PACIFIC COAST SHIP-BUILDING.

The ship-building industry on the Pacific coast for the past three years has enjoyed a period of extraordinary activity. From January, 1898, to September, 1900, thirty-two months, the number of new ships built aggregates seventy-four, with a total tonnage capacity of 37,910. Government vessels are not included in the list. Of the new craft, forty-five, with a tonnage of 14,229, were schooners, five were barkentines of 4,597 tons, one was a barge of 632 tons, and twenty-three were steamers having a tonnage of 18,452. The largest of the schooners rated 985 tons, and of the steamers, 4,597 tons.

Of the latter, three, aggregating 7,298 tons, were built of iron, the others of wood. San Francisco builders were the constructors of the larger number of both iron and wooden ships; but almost every port on the coast, from San Pedro to Puget Sound, wherever the necessary supplies of lumber were to be had, contributed to the total result. Creditable as the exhibit is, the outlook is even more flattering. There is not a shipbuilder along the 2,000 miles of coast who has not all the work contracted for that can possibly be handled, and who could not easily duplicate his present undertakings if the supply of labor warranted it.

The cause of this prosperity is easily explained. For many years prior to 1898 the industry languished, and the carrying trade, which had been stimulated by artificial "booms," was greatly depressed. Dividends on marine property were small. The earnings were swallowed by heavy expenses. Losses by sea were not made good, and the actual number of coast ships considerably decreased.

Just at the time that the maritime prospect seemed darkest, the extraordinary development of Alaska began. It was found that the number of vessels available for this profitable traffic was far below the demand. Every vessel that could be procured was chartered for the Alaska trade. High charters caused many to be withdrawn from the coast carrying trade, and a considerable scarcity of vessels for ordinary requirements began to be felt.

It was thought that the Alaska demand would be but temporary; but the contrary proved to be the case. It continued to increase, and is bound to be permanent. The Cape Nome traffic of the present year withdrew at least a hundred vessels of all sorts from available supplies; and with new discoveries along the Alaska coast, and the location of camps that indicate every sign of permanency, the demand for a greater number of craft than was required in 1900 is undoubted. The charters for 1901 for the carrying trade of the far North already assure this. The increased demand for vessels for the Hawaiian and Philippine trade has greatly depleted the coast fleet, until there is an actual insufficiency of vessels for the ordinary coastwise traffic. The dispersion of a great number of vessels to distant points occurs at a time when the conditions of Pacific ports are more prosperous than for many years, and when trade is remarkably active. Ocean freights have continued to advance until 50 shillings is asked on wheat charters to Liverpool, yet, even at this extraordinary figure, there are but few vessels available. The values of cereals in California, Oregon and Washington are uncommonly depressed, not because foodstuffs are not in demand, but for the reason that transportation cannot be engaged to deliver them.

Except in one instance, the single tonnage capacity of the new ships is not noticeably great; but the general average indicates a gradual increase in size. The steamer "Californian," referred to, an iron ship of 4,597 tons, built for the Hawaiian trade, and now in the Philippines, is the largest vessel of her class ever launched on the Western coast. If we except the steam schooner, a vessel which is said to be of a type peculiar to Pacific Coast waters, the coast vessels do not differ greatly in character from those constructed elsewhere in the United States. The largest schooner ever built was of 600 tons. These vessels are designed for the shallow harbors of the coast, and are, consequently, all of light draught and exceptional beam. Their carrying capacity is great and their seaworthiness uncommonly good. Most of them are fitted for passenger traffic, and have cabins on the upper deck aft, though in some instances the cabins are in the center. They are fitted with compound engines, and have an average speed of ten knots. Being schooner-rigged, they are largely independent of steam propulsion. The type is economical as regards the running expenses, both of crew and motive power.

THE COMPARATIVE EFFICIENCY OF THE KRUPP, ARMSTRONG, AND SCHNEIDER-CANET GUNS.

In determining the relative efficiency of modern guns there are many elements to be taken into consideration, particularly in the case of weapons which are intended for naval service, where velocities are usually much higher than those common in weapons for field service. A comparison of relative efficiency must take note of all ballistic features. As a matter of fact, the methods of designation used are apt to be misleading, for the reason that they make too much of certain elements of efficiency, and too little of others. Thus, we find that, popularly speaking, it has become the fashion to quote the muzzle velocity of a gun in preference to any other of its ballistic capabilities. If the public hears that a gun of a certain caliber is capable of a muzzle velocity of 3.000 feet per second, as against velocities of 2,600 or 2,800 feet per second in other guns of the same caliber, it is apt to consider that the high velocity weapon is incontestably the most effective. This superiority, however, by no means follows; for the mere statement of the muzzle velocity, unaccompanied by any statement of the weight of the shell to which such velocity is imparted, conveys no information as to the actual hitting power of the gun. Then again the relative efficiency may further be modified by a statement of the weight of the gun itself, for it is evident again that if two guns, one of which is considerably lighter than the other, show the same muzzle energy, the lighter gun is ton for ton a much more effective weapon. A further modification is introduced when the question of the "remaining velocity and energy" is introduced; for although a light projectile, issuing from the muzzle of a gun at an extremely high velocity, may have the same muzzle energy as a heavier projectile with a lower muzzle velocity, the lighter projectile will lose its velocity far more rapidly as the range is covered, and what is known as the "remaining velocity and energy" of the heavier shell will be relatively greater, the greater the distance that is covered. It is mainly for this reason that many of our naval officers regret to see the 13-inch guns displaced by the 12-inch, the hitting power of the 13-inch shell at long ranges being considerably greater than that of the lighter 12-inch shell.

In determining upon the armament of their navy, the Germans have evidently been governed by this consideration; for it is a fact that the Krupp guns, with which their ships are armed, fire projectiles which are considerably heavier for any given size of gun than those used in any other navy. Although the muzzle velocities given in the ballistic tables of these guns are not so high as those of other nations, the muzzle energies are greater and the "remaining energies" are in some cases enormously so. Just how great is this difference is shown in an article which we publish in the current issue of the SUPPLEMENT, which contains a series of graphical comparisons of the relative ballistic energies of the Krupp guns and those of the great firms of Armstrong and Schneider-Canet.

Thus, in comparing the velocities and energies of the Krupp 9½-inch gun with the Armstrong weapon of the same caliber, we find that, although the muzzle velocity of the Armstrong projectile is 762 meters per second, as against 729 meters per second for the Krupp gun, at 1,750 meters from the muzzle the velocities are equal, and at 5,000 meters the Krupp has a remaining velocity of 491 meters, as against a remaining velocity for the Armstrong shell of only 448 meters per second. The loss of velocity is due to the fact that the Armstrong projectile, weighing only 159·7 kilogrammes, as against 218 kilogrammes for the Krupp projectile, is more influenced by the resistance of the air, and therefore loses its velocity more quickly. Although the velocity of the Armstrong weapon is 33 meters greater than that of the Krupp gun, its muzzle energy is 1,098 meter-tons smaller, and at a range of 5,000 meters its energy is still 1,012 meter-tons less. Judging the two guns on the basis of the amount of energy developed per kilogramme of weight of gun, we find that at the muzzle it is for the Armstrong 176·8 meter-kilogrammes per kilogramme of weight of gun, and that in the Krupp weapon it is 214·4 meter-kilogrammes per kilogramme of the weight of the gun.

Comparing the guns on the basis of their armor-piercing ability, it is shown that while the Krupp 9½-inch rapid-fire gun can perforate 30 centimeters of Harveyized armor up to 3,100 meters range, an Armstrong gun of the same caliber, in spite of its greater velocity, can do this only up to 1,250 meters. Harveyized armor 25 centimeters thick is perforated by the Krupp gun up to 4,500 meters, by the Armstrong gun only up to 2,400 meters, while the Schneider-Canet 9½ inch gun cannot perforate that thickness at a range of over 2 000 meters.

Although a strong case is made out for the superiority of the Krupp guns along the lines referred to, there is one drawback to the use of the heavier projectiles which must not be lost sight of. We refer to the fact that the greater weight of the shell will reduce the total number of rounds that can be carried for each gun; a consideration which is of importance where every ton of the displacement of a ship is valuable when it comes to the question of distribution among the contending claims of armor, engines, stores, and ammunition. Furthermore, the increased weight must tell somewhat against the rapidity of handling; and if the ammunition is to be handled at the same speed, it becomes necessary to install heavier machinery for operating the hoists.

THE HEAVENS IN DECEMBER.

BY HENRY NORRIS RUSSELL, PH.D.

The close of the nineteenth century is marked by no celestial pageant. Indeed, the heavens are more than usually bare, for all the outer planets, except Neptune, are hidden behind the sun, and the inner ones are all three morning stars. So on the last evening of the century we shall see those silent and eternal stars alone which present the same aspect to us that they did to the sages of the East more than thirty centuries ago—Orion and the Pleiades, familiar to star-gazers when the Book of Job was yet unwritten, even as in present times, and seeming even more inconceivably far beyond our reach to us than to them.

To the fixed stars, therefore, must our attention be chiefly directed, when, as our custom is, we survey the evening skies. At 9 P. M. on December 15, the Milky Way extends in a broad span across the sky from east to west, passing a little north of the zenith. It is much brighter in the west than in the east, and also much more irregular in form and brilliancy.

Following its line from west to east, and noting the principal constellations, we come at first to Cygnus, a great cross of stars standing erect right along the center of the Galaxy, and close above the western horizon. Some distance higher up, and nearly overhead, is Cassiopeia, marked by a zigzag line of bright stars; and the next group to the east is Perseus. Midway between the last-named constellations is a bright spot in the Milky Way, which, with even the smallest telescope, is seen to be a magnificent cluster of telescopic stars.

Still following the Milky Way down toward the east, we next reach Auriga, whose brightest star, Capella, considerably surpasses any that we have so far passed. Below is Gemini, containing the conspicuous pair Castor and Pollux, both of which are almost of the first magnitude. Their line continued downward points out a little hazy spot of light which is the cluster Praesepe, in Cancer, the most characteristic feature of the constellation. The separate stars of this cluster cannot be separated by the naked eye, but are clearly seen with a fieldglass.

To the right of Cancer is Canis Minor, whose only conspicuous star is the brilliant Procyon. Further on in the same direction is Sirius, which, even at its present low altitude, is beyond comparison the brightest star in sight. The lower part of Canis Major—to which constellation it belongs—has not yet risen.

Above Sirius is Orion, which is too familiar to need description here, and high above him again is Taurus. Aldebaran, Sirius, and the two brightest in Orion, Rigel and Betelgeuse, form a remarkably perfect parallelogram.

Below and to the right of Orion is the little constellation Lepus, the Hare, which between the hunter Orion and his Great and Little Dogs must be pretty hard pressed. Just above Rigel is a moderately bright star, which is Beta Ericlani; and the classic river is represented by a long stream of faint stars extending thence to the westward, and then southward and eastward to the horizon, and filling up most of the southeastern sky.

The almost equally irregular and extensive shape of Cetus and Pisces similarly occupy the southwest. Above is Aries, a little south of the zenith, below which to the west is Andromeda, with the great square of Pegasus further down and standing on one corner.

In the northern heavens we may note that the Little Dipper hangs directly down from the Pole Star and that Draco lies below it. The Great Dipper is on the right, the last star of its handle out of sight near the horizon, and the head and paws of the Great Bear extend from it toward Gemini and Cancer.

THE PLANETS.

This month has more than the usual number of planetary conjunctions with the sun; but these are unfortunately not observable phenomena.

Mercury is morning star in Libra and Scorpio all the month. His greatest elongation occurs on the 7th, and throughout the first half of December he is well placed for observation, rising about two hours before the sun. On the morning of the 22d he passes close to Uranus, and on that of the 30th close to Jupiter, but in both cases the planets are too much involved in the dawn to be easily seen.

Venus is morning star in Virgo, Libra and Scorpio, rising nearly three hours before the sun on the 1st, and more than two hours on the 31st. She is receding from the earth and growing fainter, but remains as always the brightest of the planets.

Mars is rapidly approaching opposition and becoming more conspicuous. He is in Leo, moving slowly eastward and growing brighter. By the end of the month he will be a brilliant object, brighter than a first magnitude star, and rising about 10 P. M.

Jupiter, Saturn and Uranus are all in conjunction with the sun during this month; Uranus on the 4th, Jupiter on the 13th, and Saturn on the 28th, and all are invisible during the month, unless perhaps Saturn might be seen in very clear air just after sunset in its very first days.

Neptune is almost opposite to the three planets last named, and comes to opposition on the 19th. He is situated on the boundary of Taurus and Gemini, and is invisible to the naked eye, and, indeed, hardly worth looking at in any but large telescopes.

THE MOON.

Full moon occurs on the morning of the 6th; last quarter on the afternoon of the 13th; new moon on that of the 21st; and first quarter on the evening of the 28th. The moon is nearest the earth on the 3d, most remote on the 15th and nearest again on the 30th. She passes Neptune on the morning of the 7th, Mars on the evening of the 12th, Venus on the night of the 18th, Mercury on the morning of the 20th, Uranus at noon the same day, Jupiter on the morning of the 21st, and Saturn on that of the 22d.

At 1 A. M. on the morning of the 22d the sun enters the sign of Capricorn, and, according to the almanacs, "winter begins." And with the stroke of midnight on the 31st the nineteenth century closes.

Oyster Bay, N. Y., November 19, 1900.

COHERERS.*

BY AUG. RIGHI, PROFESSOR AT THE UNIVERSITY OF BOLOGNA.

The phenomena utilized in coherers has been discovered by successive stages. Varley, in working with a system of lightning arrester for telegraph circuits, found that a conducting powder unmixed with insulating powder could not be used, as after the discharge had traversed it the particles were arranged so as to form a conducting mass. But it was supposed that the heat of the discharge produced the phenomenon. A diminution of resistance produced by weak currents was not really discovered until 1884 by Prof. Calzecchi-Onesti. He used in his experiments metallic filings contained in an insulating tube with two electrodes and observed that when the tube was slightly turned about its axis the conductibility acquired by the filings disappeared. M. Branly observed later a similar phenomenon and found that the action might be obtained by allowing a spark to pass in the neighborhood of the tube and that the original resistance was restored by a shock. Prof. Lodge arrived at the same results in 1889 by studying a fact observed already by Prof. Hughes, but unknown to him, that a very small spark between two conductors which were almost touching established a communication which disappeared by a shock.

It is not yet known exactly in what manner the phenomena of the coherer are accomplished. According to M. Branly, it is due to a modification of the dielectric between the particles, and according to Mr. Lodge it is due to exceedingly small sparks between them which give place to the production of contacts. This explanation may be completed by admitting also the possibility of slight movements of the particles by the electric forces which would arrange them in conducting filaments. According to the first theory, the shocks would have the effect of renewing the portions of the dielectric between the particles, and according to the second the shocks break the adherence produced by the sparks. The late researches have given useful data without deciding the question of the cause of the phenomena. Thus the microscopic observation made by Messrs. Arons and Van Gulick, those of M. Vincentini and Di Ciommo and Campanile upon coherers with mercury drops and those of Melagoli by the photographic method seem to uphold Mr. Lodge's views, for they have permitted observing small movements of the particles and small sparks at the instant an electric wave was produced at some distance. M. Tommasina has obtained curious chains formed by adherent metallic particles, and M. Sundorph has succeeded in removing most of the iron filings forming a coherer without causing a disappearance of the conductibility produced by a wave. Besides, the adherence produced by a small spark between two conductors which touched slightly has been observed by Mr. Lodge and lately by Mr. Maclean (United States). But on the other hand, certain facts seem difficult to explain by the theory of Mr. Lodge. For instance, peroxide of lead acts in a contrary manner to metal filings, for its conductivity diminishes under the action of electric waves and it is the same for other substances, as, according to Mr. Rose, magnesium and potassium in kerosene. To these facts, contrary to Mr. Lodge's theory, it must be added that Mr. Branly made coherers in which the particles were fixed in a solid dielectric mass. In any case, it seems that the presence of a thin layer, of oxide, the most often, at the surface of the particles is necessary or at least useful for the working of coherers. It is true that they have been made with gold or platinum filings or carbon powder, but the influence of the surface layer has been well demonstrated by M. Blondel, who produced a film of sulphide of silver in increasing thickness at the surface of silver particles and found that a certain thickness of layer exists which gives the maximum effect.

Certain coherers lose their conductibility spontaneously, as Messrs. Branly, Ducretet, Popoff, Tommasina, and others have shown. Coherers of this kind would simplify experiments greatly, as a shock to the tube would not be necessary. In general, the automatic striker of M. Popoff is used, in which a relay is worked which operates a secondary circuit including the striking magnet. According to the carbon coherers recently described by Tommasina, this will not be necessary, and a simple telephone, which may contain the coherer in the interior, will reveal the waves. The form and constitution of coherers has been greatly varied by Bowlker, Maclean and others, and the arrangements of M. Tissot and Jervis Smith are especially remarkable. The frequent use of filing tubes in the last year has furnished us with data for some practical rules for the best construction. In general, it may be said that the sensitiveness is greater as the space filled by the filings is smaller and its particles smaller. But at the same time it is sensitive to outside influences, and its working is less sure. The choice of the metal is important, and it appears that nickel is the most advantageous. Again, it is well to completely inclose the glass tube and to make a vacuum in it, to be sure that the sensitiveness does not vary in time, on account of a surface alteration produced by contact with air. But few measurements have been made upon these phenomena up to the present, but it is known that the lowering of resistance produced by the discharge of a condenser through the filings is a function not only of the charge, but also of its potential, and that for a given capacity there is no effect when the potential is below a certain critical value.

*Lecture delivered at the Congress of Physics. Reported by special Paris correspondent of the SCIENTIFIC AMERICAN.

SCIENCE NOTES.

The Duke of Abruzzi has chartered the Gothenburg whaler "Capella" to proceed to Franz Josef Land in search of three missing Arctic exploration expeditions.

The supply of clams on the New England coast is diminishing. Extensive areas which four or five years ago produced great numbers of clams are now practically barren. The demand has increased at such a rate that too large a number of seed clams have been removed, and extinction quickly follows and the beds do not recover themselves.

Experiments in forestry are being carried on in California, the idea being to determine as near as possible the value of timber to a watershed. The rainfall in the lands which have been set apart for the experiments is accurately measured, and the relative amount of run-off is carefully estimated. The experiments are being conducted on a very extensive scale, so they will undoubtedly prove of great value.

The Department of Agriculture is preparing an order on the recommendation of the Department of War setting aside as forest reserves the island of Panay and the island of Pauitaui; the latter is one of the Jolo Islands. It is found that these are the richest islands in the world for rubber trees. It is the desire of the authorities in Washington to have the trees preserved, in view of the fact that our rubber supply may become exhausted.

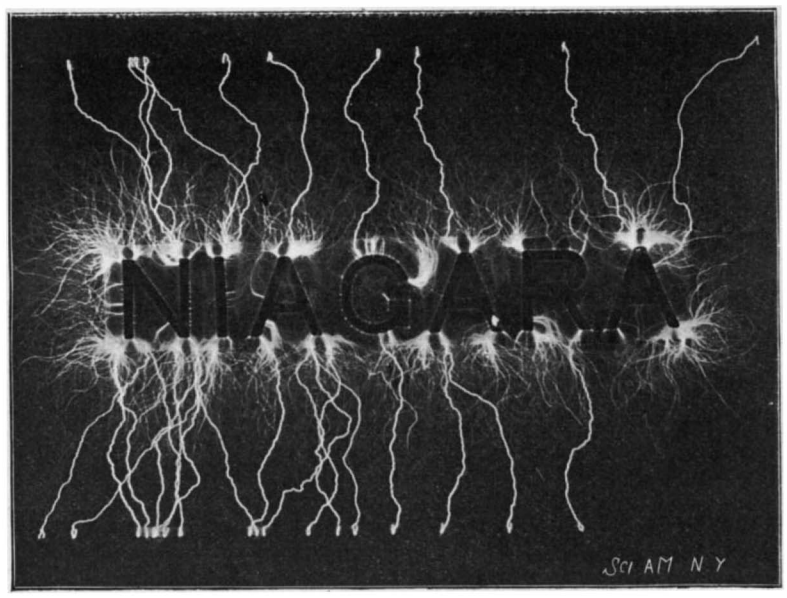
A Chinese banknote, issued during the Ming Dynasty, about A.D. 1390, has been placed in the British Museum, among the specimens of early printing from China. The surface of the note is black with age, though the characters upon the face of it are quite discernible. This is supposed to be the earliest specimen extant of a bank note issued from any country, and is about 300 years anterior to the issue of the first note in Europe, from Stockholm.

The London Lancet complains that the ordinary closed cab is a distinct menace to health. It says they are the undoubted source of infection; microbes infesting the cushions and the mats on the floor, and the air might easily contain pathogenic organisms left by a previous user. Hansom cabs are considered to be decidedly more sanitary, but they are considered as a kind of death trap in wet weather, when those riding in them are completely inclosed by windows and aprons, making it impossible to release themselves in an emergency.

The long looked for trial of the third-rail system on the New York elevated roads was recently carried out on the Second Avenue branch, when six trips were made between 54th Street and 92d Street. The trial train consisted of six cars, the two end cars being each equipped with four motors. The two motor cars were arranged so that the cabs were respectively at the front and rear ends of the train. The trip from 92d Street to 54th Street, a distance of thirty-eight blocks, was run in four minutes, at a speed of thirty miles an hour. The superiority of the motors over the old steam locomotives was shown in the rapid acceleration; and the substitution of the air-brake for the old vacuum brake was noticeable in the greater rapidity with which the stops were made. Judging from the results achieved on the trials, it is expected that the trains will run from the Battery to 155th Street on the Sixth Avenue line in forty minutes, instead of forty-nine minutes, which was the time taken under the old system. The new and the old cars are similar in appearance, the former being somewhat wider. In place of the old steam heating and oil lighting, they will, of course, be lighted and heated by electricity.

ARTIFICIAL LIGHTNING.

The electrically illuminated sign herewith shown is the work of Mr. P. M. Lincoln, chief engineer of the Niagara Falls Power Company, to whom we are indebted for our illustration and particulars. The sign may truthfully be called a miniature artificial thunder storm, the term "artificial" being used advisedly for the reason that the storm is strictly artificial and in no sense a mere imitation. The flashes of lightning and the thunder claps of a midsummer storm are repeated in the flashing illumination and the accompanying succession of sharp reports of this really magnificent electrical display. The sign consists of a large glass condenser charged with alternating currents of high potential. The partial and complete discharges of the condenser are the cause of the electrical display around the letters and over the surface of the glass. At low potentials each letter is surrounded by a beautiful violet fringe of brush discharge. As the potential is raised streamers begin to shoot out from the sharp corners of the letters and extend at first for a distance of about one inch over the plate. The length of these streamers increases with the rising voltage, until they form a brilliant and shifting halo, reaching out for a distance of 12 inches or more from the letters. Up to this point the electric discharges are only partial, but upon raising the voltage still higher, complete discharges occur, each being accompanied by a loud report. The white crooked lines of the illustration show some of the paths of these complete discharges. When the voltage is sufficiently high, each illumination is accompanied by one of these complete discharges, and when the frequency of 125 periods per second is reached, the discharge is extraordinarily brilliant, and the accompanying reports are strongly suggestive of a regiment of soldiers at rifle practice. Although the device is somewhat expensive, its effect when used as an advertising device is remarkably successful.



ARTIFICIAL LIGHTNING.

FIGHTING FIRE WITH WINE.

BY CHARLES FREDERICK HOLDER.

California has for four or five years been visited by a short rain supply, which has caused no little annoyance, trouble and expense to almost every industry in the southern part of the State, though certain regions have had their normal rainfall. In some localities water has almost entirely given out, and small ranchers have deserted their places and driven their stock to more favored sections. One of the most serious results of the lack of rain has been the forest fires, which in the past few years have raged with unprecedented violence and devastated hundreds of square miles of forest, which will not reproduce themselves in a century.

In many parts of California these fires have occurred owing to the dry conditions which have prevailed. Perhaps the most remarkable fire occurred near the town of Wrights, in the Santa Cruz Mountains, south of San Francisco. Here the fire was started, as in many other instances, by an irresponsible rancher who was burning brush. The wind sprang up suddenly, swept the flames into the forest, and in a very short time a fierce wall of flame was rushing up the west slopes of the Coast Range, carrying destruction before it. The mountains here were covered with a fine growth of old oaks, mazanits and madrones—landmarks in the country—which fell like straw before the destroyer. The wall of flame swept to the summit and descended into the cañons, following these rivers of verdure in and out, rushing on in an ever-increasing volume.

In the pathway of the fire was the ranch and Mare Vista winery of E. E. Meyer, one of the largest wine-making establishments and vineyards in Santa Clara County. To protect it and the homes in the vicinity, the people of the surrounding country assembled en masse, organized themselves into an efficient body of fire fighters and began a campaign in which striking acts of valor were performed. It was impossible to stay the flames, and as they went rushing down the cañon toward the winery, destruction of the valuable property seemed inevitable, and the result demonstrated the necessity of having in this and other States men who will make a study of fighting fire as a science. Trees in advance were cut down; ditches of earth dug, and every expedient known to fire fighting of today was tried; but so fierce were the flames that they seemed to leap hundreds of feet into the air, bounding in lurid sheets over the breaks, and in an incredible short time swept down to the winery, as shown in the accompanying illustration, and surrounded it. Under ordinary circumstances it would have seemed impossible to save the building, but the band of workers rallied under the intelligent lead of the Meyers, and men were posted on the roof who poured streams of water upon every portion. Young Mr. Meyer was held by ropes from a window while he used the hose upon the flames which were licking up the timbers at the base of the building, the heat being so intense that a stream had to be played upon his body.

LARGE WINE VATS WHICH WERE USED TO SUPPLY THE FIRE PUMP.

A FIRE EXTINGUISHED BY THE USE OF WINE.

It was believed that the winery could be saved, when, without warning, the water gave out. Some large trees, which were dropping in every direction, had fallen upon the supply pipes, crushing them in and clogging the reservoir. This was an unexpected catastrophe, but the resources of the fire fighters were by no means exhausted, though a desperate expedient was resorted to. The owner of the winery gave the order to attach the hose to the great vats of Zinfandel wine which were stored in the cellar (see illustration), and man the wine pumps. This was promptly done, and an exact picture of the situation at this time is here shown. Wine had been used in this way before, but the owner was not aware, in all probability, of the precedent. In a few moments valuable wine was being pumped upon the flames with remarkable effect. In the words of a witness, "it acted like some chemical prepared for the purpose." Wherever it struck, the flame was smothered at once, peculiar clouds of smoke rising, telling that the chemical combination was a success; so successful, indeed, so apparent, that the exhausted men, who had been working for hours, and whose clothing and hair were charred, raised a cheer and began the fight with renewed vigor. In a letter to the writer, Mr. Meyer says: "My cellar is surrounded by large pine trees, and these were burning furiously, throwing the flames toward the building which caught fire in several places. The wine I found to be a far better extinguisher than water. The wine I used was young, hardly through fermentation. It contained about one per cent of sugar, and was still quite warm. I had two pumps going, each throwing a one-inch stream."

Four thousand gallons of this wine was thrown upon the flames in this way before the building was safe, probably one of the most remarkable and successful methods of fighting fire known. The method was somewhat expensive, as the wine retailed at 50 cents per quart when bottled, and $8,000 in wine was used, yet it saved buildings and machinery worth many thousand dollars and demonstrated that a winery has a protective against fire in its vats if the owner has the courage and temerity to use it.

Photographic Telegraph Receivers.

Messrs. Siemens & Co., of London, have patented an invention regarding telegraph receivers of the photographic description. In this invention the photographic impression is produced by the deflection of the cathode rays relatively to the recording surface through the agency of the electromagnetic effect of the signaling current. The cathode rays act directly through the medium of a fluorescent screen, which has a portion of its light transmitted through a lens to the recording sensitized surface. It is stated that this process is specially applicable for the purpose of recording Morse signals. The inventors have somewhat modified the original method by using a different current strength to signal each sign, and by the special arrangement of the cathode ray apparatus the variations of the current strength causes differences in the deflection of the rays in relation to a fluorescent screen. These variations in the light are transmitted to the recording surface by a lens and mirror, or a lens, diaphragm and mirror, which are so shaped that an image of the signal is recorded upon the sensitized strip. If necessary, the straight line deflections by currents of widely varying strengths may be substituted by a rotary deflection by means of a series of magnets variously energized through a corresponding number of conductors.

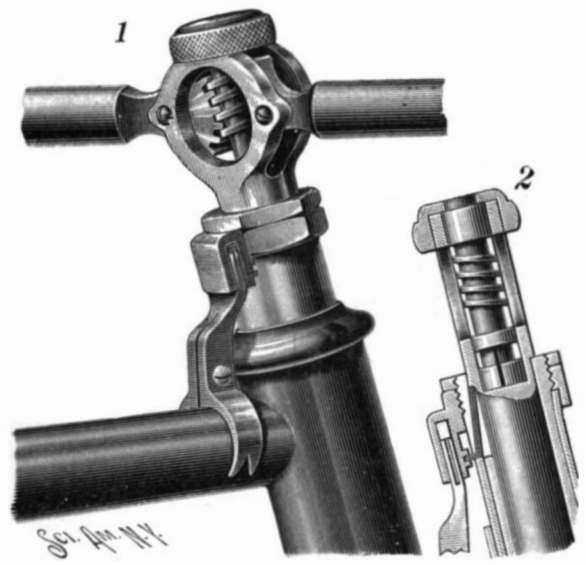
THE first sleeping cars built in Japan have just been completed.

A NEW BICYCLE HANDLE-BAR.

A novel manner of mounting bicycle handle-bars has been devised by Mr. Tacitus W. Gaillard, 346 South Fifth Street, Brooklyn, New York city, the special objects of the invention being to facilitate easy adjustment and to render the mountings of the bars secure. To the upper end of the fork-stem a tubular plug socket is fastened, upon the enlarged upper end of which a nut is screwed. The nut serves to clamp the fork-stem and the enlarged portion of the socket rigidly together. From the rear portion of the nut two parallel spring-fingers project downwardly, which are designed to receive a spring portion formed on the bifurcated upward extension of a clamp embracing the upper horizontal bar of the bicycle-frame. When the spring-fingers hold the extension of the clamp, the fork-stem is held steadily and prevented from moving except upon the application of positive pressure.

In the socket of the fork-stem is a plug which carries the handle-bars. The plug is provided with a spring-catch extending through a slot in the socket and through a corresponding slot in the fork-stem so as to engage a stud on the inner spring-finger. Thus the plug is removably held in place. By withdrawing the plug the removal of the handle-bars is facilitated.

The upper end of the plug has two ring-like extensions, between which are mounted the inner ends of the handle-bars, which ends are in the form of toothed segments. Meshing with these segments is a worm, the lower end of which is split, and the parts sprung out to form spring-fingers, which are held friction-tight in a cavity in the plug. The worm at its upper end is provided with a cap, which, when turned, rotates the worm and adjusts the handle-bars. No tool is required. The bars may be adjusted even when the rider is on the wheel.



THE GAILLARD HANDLE-BAR.

HANDLING ANTHRACITE COAL.

BY WALDON FAWCETT.

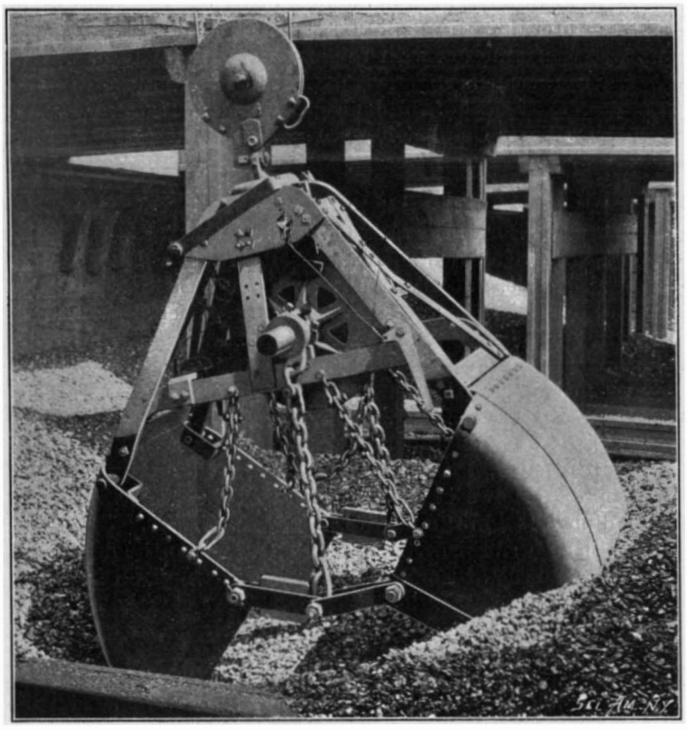
The story of the development of the anthracite coal field of Pennsylvania has always been full of attraction for students of commercial and industrial progress, both here and abroad, and its interest has been deepened as time has gone on and the apparent inexhaustibility of certain of the deposits has been demonstrated. There has been slight recognition, however, of how really an important a part in the evolution of the anthracite coal trade has been played by the improvement of facilities for the handling and movement of the fuel at every stage of its transit from mine to consumer. Nevertheless, in few industries has the value of the market been so entirely dependent upon an ability to place the commodity within reach of consumers. Finally, the many unique features of the system followed, notably the extent to which the railroads have controlled the mines and the operations of the pool which apportions the quantity of coal to be carried by each road, make the transportation of anthracite the most distinctive phase of the trade.

At the present time there is not a link in the entire transportation chain which connects the mine and the consumer wherein the most advanced and economical methods are not in force. The use of electricity about mines for lighting and other purposes has resulted in the development of electric locomotives for haulage purposes, and the coal is now drawn to the surface by electric engines of from two to fifteen tons weight. These locomotives have from one to three motors, ranging from ten to thirty-five horse power, and each is capable of pulling quite a train of the small cars in use in mines, at a speed ranging from six to ten miles per hour. Even the mine cars have undergone wonderful improvement during the past few years. Steel is largely employed in their construction and improved devices for quick dumping are fitted.

The coal is transported from the mines in the new type of pressed steel car, which is of about 50 tons capacity, and from 20 to 25 of these cars make up a train. In service on the coal-carrying roads are some of the largest and most powerful locomotives ever constructed. Some of these engines weigh close to 125 tons without the tender, and have a wheel base in excess of 24 feet. Locomotives of the type mentioned have a tank capacity of more than 7,000 gallons of water and a coal capacity of some 14 tons.

The railroads which enter the anthracite region are all operated under an agreement as to the basis on which the shipments of coal are to be divided between the various lines. The Philadelphia & Reading Railroad, for instance, which controls nearly a third of all the mining territory, is privileged to carry one-fifth of the aggregate output of the anthracite field. Another road is apportioned fifteen per cent of the total; several lines are entitled to one-tenth of the aggregate, and so on down to the lesser carrying lines, four or five of which only receive three or four per cent each of the whole yield.

The great bulk of the anthracite mined in the Pennsylvania district is shipped either to New York or Philadelphia, or else northwestward to Buffalo. These three cities are centers of the chief areas of consumption, and consequently serve as distributing points. A considerable portion of the coal consigned to Philadelphia or New York is reshipped, either by rail or coasting vessels, to Boston and other points in New England. Some coal goes south by the same means of transit, but it is a comparatively small proportion of the whole. The port of Buffalo, at the lower end of the Great Lakes, is the gateway through which passes the principal portion of the coal destined for western consumption. From Buffalo heavy shipments are made by lake vessels to Chicago, Milwaukee, Duluth, and other points, and there is also a very considerable traffic by rail.



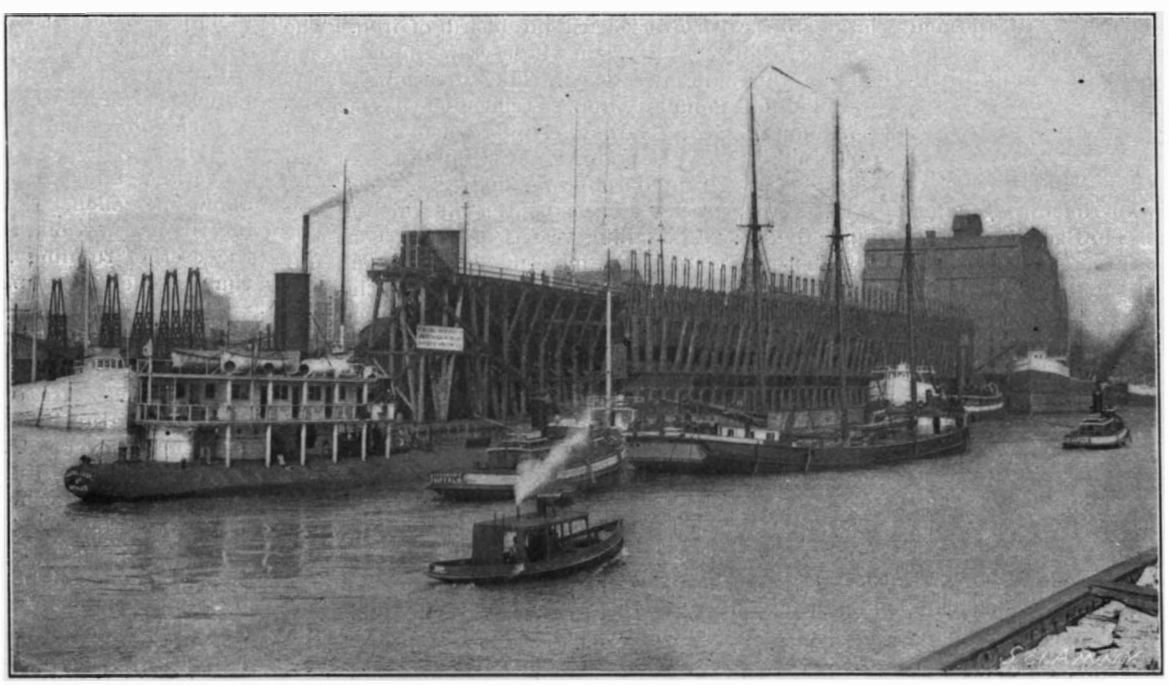
CLAM-SHELL DREDGE UNLOADING COAL FROM BARGE.

The receipts of anthracite coal at Boston are somewhat in excess of those of bituminous, and both fuels reach the New England metropolis almost exclusively by water. As an illustration of the preference manifested by the coal shippers for the water route, it may be stated that every year during the past decade in the neighborhood of 2,000,000 tons of anthracite have been received at Boston by water, whereas in no year of which there is a record have the rail shipments exceeded 32,000 tons. The coastwise coal-carrying trade is carried on principally in wooden barges of from 800 to 1,500 tons burden. The construction of craft especially designed for this service has been carried on most actively during the past few years, and last year upward of half a hundred coal-carrying barges were turned out at the shipyards on the Maine and Massachusetts coasts. These barges, most of which are from 200 to 250 feet in length, are towed by powerful towing steamers. One of the best fleets of tugs in this service consists of six vessels, each 140 feet in length and fitted with triple-expansion engines, capable of driving the boat at a speed of 14 miles per hour. There are also numerous four and five-masted wooden schooners in the coastwise coal trade, and within the past few months a six-master had gone into commission. These vessels, all exceeding 300 feet in length, cost in the neighborhood of $100,000 each, spread 10,000 feet of canvas, and will carry 4,000 or 5,000 tons of coal on a draught of 23 feet.

Keeping pace with the other lines of development in the handling of anthracite is the improvement of the pier from which the coal is transferred to ocean vessels. As representative of modern facilities in this line there might be cited the largest of the coal piers of the Reading Railroad at Port Richmond, near Philadelphia. This structure which is probably the largest coal pier of the kind in the world, is 770 feet in length, 61 feet wide and 44 feet high above mean mud tide. The docks on either side have been dredged to a depth of 26 feet at mean low water, so that any craft may be accommodated. The pier is provided with four tracks and has four berths, two of which are provided with six chutes, each thus enabling four 1,500-ton barges or other craft to be loaded simultaneously. The approach to the piers, an earth-fill, is 1,150 feet in length, and the railroad cars, after being emptied, are run by gravity from the pier to the tracks on which the empty cars are stored. This pier, when taken in conjunction with the other facilities at the port, enables the Reading Company to ship fully 21,000 tons of anthracite coal in 24 hours.

In the loading and unloading of coal to and from vessels, and the rehandling of the fuel under various conditions, there are employed some of the most ingenious types of machinery known to the mechanical world. The primary form of apparatus for transferring the coal either to or from a vessel is what is known as the bridge tramway plant, consisting of long bridges with girders of steel or iron, mounted side by side on suitable rails so that they can be readily moved from place to place. Each machine operates over one hatch of a vessel, and is provided at its front end with a hinged apron of suitable length for extending the trolley tracks of the machine over the vessel.

The hoisting and conveying apparatus, known as the "trolley," runs along a track suspended from the bridge from the end over the vessel to the opposite end over the railroad cars or stock pile. For handling the anthracite there is used a self-filling and automatic dumping grab-bucket which will handle three-fourths of a ship's cargo without hand-shoveling. For shoveling the coal from stock piles to cars or boats there is employed an automatic shovel-bucket which requires no hand-shoveling whatever. One of these novel coal-carrying buckets will usually make a round trip from the hold of a vessel to the extreme end of



TYPICAL DOCK FOR LOADING COAL VESSELS.

the bridge and back again in a minute, a distance of six hundred feet in addition to the height of hoist. In actual work a rate of forty-five seconds per trip has been averaged for several hours. The cost of handling the coal by this method varies from seven-tenths of a cent to two cents per gross ton.

The same general form of bridge tramways are also the fundamental feature of the storage and rehandling plants. Balanced cantilever cranes are also, however, used to some extent in the rehandling of coal. At the works of the Bethlehem Steel Company, at South Bethlehem, Pa., for instance, a crane driven by steam, and having a reach of 365 feet, travels between two piles of coal 58 feet high. The coal is brought to the works in cars and dumped into great hoppers, from which it is drawn into tubs, hoisted, conveyed and dumped on the storage piles. The different sizes of coal may thus be kept separate.

At Cheektowaga, New York, and several other places in the United States, there are in service what are known as shed tramway plants especially designed for handling coal from vessels and stocking it under the same roof. The overhead runways on which the trolleys travel from the rear end of the building to vessel at dock front are movable from side to side, inasmuch as the upper supports of these runways are hung from wheels which move on tracks suspended on roof-trusses, thus enabling every portion of the storage space to be reached, and enabling the overhead tramways to move to any position along the front of the dock or in the sheds, to suit the hatch of the vessel or the stock-pile. By this plan the coal is never dumped more than two or three feet. A plant of this kind ordinarily has a storage capacity of a quarter of a million tons and will handle three thousand tons of anthracite per day.

Some coal is loaded into vessels from great bins built directly on the water front and some little distance above the deck of the vessel, so that the coal will slide readily through the adjustable chute through which it gains access to the hold. Finally, there are the various types of car-dumping machines, giant mechanical marvels, which in the space of a minute pick up a loaded coal car, overturn it, emptying its contents in the hold of a vessel and return the empty car to the railroad track. By the employment of one of these machines not only is rapid loading possible, but an entire cargo may be put aboard without its being necessary to move the vessel. With the addition of extra overhead cranes one of these car-dumpers has a capacity of ten thousand tons per day.

A Railway in Ashantee.

Kumasi, the capital of Ashantee, is to be brought into closer communication with England by the construction of a railway to the coast. The work is to be undertaken by a Liverpool firm, and already a party of twenty-seven engineers are on their way to the Gold Coast for the purpose of surveying the country. The line is to be 180 miles in length and of 3 feet 6 inches gage. The route to be followed is a very difficult one, extending through dense bush forest and over broken country. The engineers are to be assisted in the survey work by 1,700 carriers and laborers, to be dispatched and maintained from England. As the survey party proceeds, the work of construction will be carried out, operations being commenced at several places simultaneously. The great difficulty with which the contractors have to contend is the scarcity of labor and food, but it is anticipated that native labor will be forthcoming to the extent of about 10,000 men. The principal object of the railway is to develop the gold mining industry of the country. The land is very auriferous, and when the question of transport between Kumasi and the coast has been facilitated by the completion of this railway, the industry will be rapidly and extensively developed. Many of the West African gold mining companies are interested in the scheme, since it will then be able to reach the Ashantee capital within fourteen days from England.

Peculiarities of Siamese Music.

Profs. Stumpf and Neesen, of the Berlin University, have concluded some interesting experiments regarding the peculiarities of Siamese music. The Siamese musical octave differs from our own in the fact that it comprises seven equal intervals. The sounds, though perfectly harmonious, are somewhat curious. While the Siamese Court Troupe were at the Zoological Gardens in Berlin, these two professors decided to record these musical tones in their natural sound to such exactitude that the faintest variations might be clearly defined. In the earlier experiments the ordinary phonograph was employed, but was proved to be unsatisfactory, owing to the unpleasant constant rasping which always accompanies phonographic reproductions and which in this case destroyed the distinctness of the sounds. A telephonograph was then employed, and the results were all that could be desired. By means of this apparatus the sounds are so clear, and the graduations so faithfully recorded, that it is a difficult matter to distinguish between the actual recital by the troupe and its telephonographic reproduction.

Correspondence.

A Kerosene-fired Automobile.

To the Editor of the SCIENTIFIC AMERICAN:

In a copy of the SCIENTIFIC AMERICAN of November 17, I find you state that our boiler is fired with gasoline. The particular advantage possessed by this company over other makers of steam carriages is that we *do not* use gasoline as fuel, but in its place use kerosene. You will immediately recognize the importance of this difference, otherwise than which the item is correct, and we thank you for the same.

B. SHERWOOD DUNN, Sec'y and Treas.,
New York Motor Vehicle Company.

November 20, 1900.

A Popular Error.

To the Editor of the SCIENTIFIC AMERICAN:

It is generally entertained that the discharge of ordnance over or near the location of an animal body lying on the bottom or bed of a pond or river will, by the vibratory movement of the water, due to the impact of the discharge, cause the body to rise to the surface; and as a result of this opinion, the discharge of ordnance or of an explosive over a drowned body is usually resorted to, without any reference to the period of its immersion, the temperature of the water, or if the body is mutilated and to what degree; for if it has been but a brief period immersed, is much mutilated and the water is cold, such discharge or explosion over it is wholly and absurdly useless, as the specific gravity of the body is too superior to that of the water for it to rise.

The condition in which an immersed animal body may be raised to the surface by the discharge of ordnance or an explosive over it is this:

If the stomach of the body is intact, and the body not much mutilated, the temperature of the water and the period of its immersion is such as to evolve the gases of decomposition, the body increases in volume; and when its specific gravity is lessened to a degree that it is detained on the bottom only by molecular attraction, the disturbance of the water over it, whether by the action of the wheels or propeller of a steamboat in shoal water, or by the vibration of the water due to any impact on its surface, will disturb this adhesion with the bottom, and the body will rise to the surface. CHARLES H. HASWELL,

Board of Public Improvements, New York.

New York, October 18, 1900.

Iron Sailing Ships.

To the Editor of the SCIENTIFIC AMERICAN:

I have read with much interest Mr. Waldon Fawcett's article, published in your issue of September 22, on the subject of "American Sailing Vessels." We do not quite understand the author's statement relating to construction of metal ships, as follows: "Early in 1883 there was launched at the shipyard of John Roach, at Chester, Pa., the 'Tillie E. Starbuck,' a full-rigged iron ship, the first metal sailing ship built in the United States, and one of the first turned out anywhere in the world. The 'Starbuck' was also the first sailing vessel in the world to carry iron masts."

I witnessed the arrival at Liverpool about the month of May, 1870, of the American-built bark "Iron Age," which, as her name indicates, was built of iron. The vessel attracted great attention at the time among Liverpool shipping men, as she was said to be the first iron ship to be built on this side of the Atlantic. English-built iron ships were common enough at that date. In fact, the construction of a wooden ship in England was the exception, not the rule. Furthermore, I then saw vessels with not only iron masts, but large ships with every yard on board of iron. The American ship "Amity," of whose crew I formed one, had an iron main lower mast. The three lower masts were painted to imitate iron. I remember the exclamation of a St. George's Channel pilot when he boarded our ship: "Why, Captain, I never saw an American ship before with three iron lower masts."

The author makes another statement which I very much doubt: "The sailing vessels of recent construction, both wood and steel, have made some wonderful speed records, and have easily discounted the performances of that one-time pride of the shipbuilders, the 'Red Jacket,' . . . or of the 'Sovereign of the Seas.'" While the ships of to-day may be fine vessels, I do not believe that they can discount easily passages made by such clippers as the "Sovereign of the Seas," "Red Jacket," and "Flying Cloud," which vessels were built with view to speed, and whose fine models have never been surpassed. Except the fliers of recent date, very few steamers have equaled a famous run of the "Sovereign of the Seas," from noon to noon, on one of her passages to San Francisco.

I am greatly interested in American shipping, and would like very much to hear what passages are made by the big ships and monster schooners of to-day. Also would like to know number of crew carried by the five-masters referred to in article by Mr. Fawcett, and by that 5,500-ton (cargo capacity) six-master, which, I believe, has since been launched.

WILLIAM OWEN.

Panzos, Alta Verapez, Guatemala, October 20, 1900.

Automobile News.

Many accidents have occurred on account of the tires becoming detached from the steering wheels of automobiles, and too much attention cannot be paid to this matter.

The race from Berlin to Aix-la-Chapelle began August 30 and ended September 2. It rained heavily on the third day of the race, but fifteen machines succeeded in finishing. The net time of the winner was 14 hours 26 minutes and 22 seconds. This time was made with a motor tricycle.

The Touring Club of France is doing a great deal to help along the motor carriage cause by compiling lists of charging stations; and they are using their best endeavors to ascertain, where the plants are owned by private parties, whether they are willing to sell their current for recharging electric accumulators or not, and during what hours they are willing to do so, and a series of questions have been sent to all such parties.

A great improvement in motor tricycles is being introduced by the De Dion firm. The essential difference between the new and the old motor tricycle is that in the former the motor can be worked quite free from the machine, being started by means of the pedals separately, and afterward connected to the road wheels through the medium of a clutch. In the latter it is necessary in starting the engine to propel the machine forward at the same time—a fatiguing process.

The two automobile ambulances of Roosevelt Hospital are very handsome vehicles, and were donated to the hospital. There is room for three reclining patients, and eight can be crowded in if they are able to sit up. The batteries are charged in position, and as their radius of action is 25 miles, there is little danger that they will become exhausted, as the calls are seldom for a greater distance than two or three miles. Powerful brakes can bring the vehicle to a stop within a very few feet, while running at full speed.

Public automobiles in Paris have been taken in hand by the police, and now they are subject in common with cabs, etc., to the official regulations and tariffs. While the exhibition was open, the drivers of these vehicles charged the public prohibitive prices for their use, with the consequent result that they were not regarded with much popular favor. Now the maximum tariff for an automobile carrying four passengers is 40 cents for the "course," and 50 cents per hour inside the city. It is anticipated that this official control of the automobiles will encourage their more general utility in the streets.

Motor car owners using petroleum spirit will appreciate a new form of can for storing purposes, made by a German firm. It claims to be possessed of two valuable features. In outward appearance the can resembles those generally used, but inside there is a pipe which extends from the outlet to the bottom, and is pierced with holes throughout its entire length. Round this pipe is a gauze covering, which acts like the covering of the Davy miners' lamp in preventing flame coming in contact with the spirit. A new form of plug is used, which has a brass cap held in position by a fusible solder, which will melt in case of an outbreak of fire, and so allow any gas generated in the can to be liberated and prevent explosion.

Experiments were recently carried out in France for the purpose of ascertaining the quantity of fuel consumed by automobiles. The course extended from Suresnes to Meulan and back, a total distance of nearly 44 miles. Ninety-six vehicles competed in the trial. The premier position was secured by a moto-cycle, which piloted a quadricycle of 5 horse power, carrying two persons, and which only consumed about 4½ pints of fuel. The Comte de Chasseloup-Laubat, who traveled in a 24 horse power machine, covered the distance in 1 hour 43 minutes with a consumption of about one gallon. All the vehicles succeeded in covering the journey, and the results of the tests prove that the cost of running automobiles is considerably less than is generally supposed.

Infectious Diseases in London.

In the parish of Lambeth (London) within less than three weeks 105 cases of infectious disease were reported to the medical authorities, comprised mostly of typhoid and scarlet fevers. The investigations into the outbreak reveal the distribution of the contagion in a curious manner. The locality affected is inhabited mostly by the artisan class, the wives of whom, after washing their clothes, are in the habit of sending them to some neighbor or neighbors who possess a mangling machine, to have them wrung out or mangled. Consequently, the infected linen taken from one house to another to be so treated contaminated the mangle, which conveyed the infection to other non-infected clothes.

LIQUID AIR AUTOMOBILE.

Among the novelties displayed this year at the Automobile Show in New York city was an "auto" driven by liquid air. Any doubts that the public may have had as to whether this machine would operate were dispelled by nightly exhibitions upon the track in the center of the main hall, where the automobile, which is herewith illustrated, was run around the track and handled with the same facility as the steam and other automobiles.

There is no reason to doubt the ability of the machine to run; but upon the question of its range of operation, or "radius of action," if we may borrow the term, there is no further information than is contained in the printed literature of the company, which claims that in this particular machine enough liquid can be carried for a continuous journey of 50 miles. It is also claimed that the machine can be operated at a cost per mile which compares favorably with the cheapest forms of power which are used on other types of automobiles. In reply to queries, the operator stated that the Tripler Liquid Air Company would supply liquid air at 15 cents a gallon. As the capacity of the tank is 10 gallons, this would work out at a cost of 3 cents per mile.

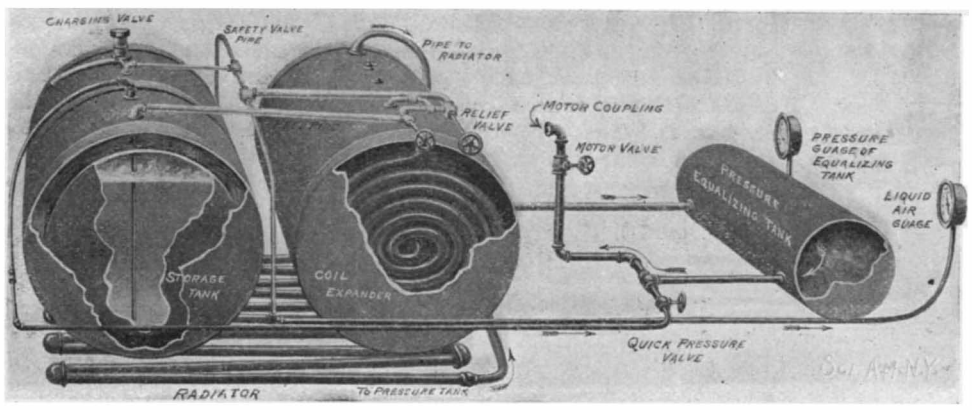
As may be seen from the accompanying illustration, the carriage bears a striking resemblance to the carriages of the steam-driven type, and, in fact, it is neither more nor less than a locomobile, as far as the wheels, frame, body and engines are concerned, the only point of difference being the substitution of liquid air tanks and piping for the gasoline and water tanks and the boiler of the steam-driven machine. Bearing this in mind, the reader will understand that the novelties in the machine are contained in the accompanying perspective view of the liquid air equipment.

Immediately behind the seat, in the body of the car, is carried a copper storage tank for the liquid air. In front of it and beneath the seat is another copper tank, known as the coil expander; while in front of the vehicle, in the position occupied by the gasoline tank in the steam automobile, is another cylinder, known as the pressure equalizing tank. In the carriage illustrated the storage tank and expander are arranged side by side. The storage tank consists of an outer and an inner cylinder with an air space between them which is filled with a non-conducting material. The inner tank is filled with liquid air. Arranged along the top of the outer cylinder are four connections. The first of these (see perspective view) is a feed pipe, which passes through both cylinders and leads to the bottom of the inner cylinder, and is used to draw off the supply of liquid air for evaporation in the coil expander and ultimate use in the engines. The next outlet is a pipe which leads from a coil within the liquid in the inner cylinder to what is known as the quick-pressure valve. The third outlet is a pipe which leads from the top of the liquid air to the safety valve. The fourth connection is an ordinary inlet for charging the tank.

Liquid air, if exposed to the heat of the atmosphere, will evaporate rapidly, and therefore the inner tank has to be carefully insulated. Mr. Tripler claims that the insulation is such that it would take ten hours for the pressure within the tank to reach 100 pounds to the square inch. The normal pressure is maintained by means of a safety valve. The operation is as follows: To start the engine, the feed valve, whose hand-wheel is the rearmost of the two which are seen at the side of the carriage, is opened, admitting the liquid air to a coil of pipe within the expander. Here the liquid is evaporated by the heat of the atmosphere, and after leaving the cylinder, the air passes to what is called the radiator, a set of pipes which are arranged immediately below the two tanks. From the radiator, in which the air is brought up to the temperature of the atmosphere, it passes into a pressure equalizing tank, which, by providing a considerable volume of air, avoids the sudden variations of pressure at the cylinders which might result if the radiator communicated directly with the motor. A pipe leads from the equalizing tank directly to the motor. There are two gages on the dashboard, one of which records the pressure in the liquid air tank, and the other the pressure in the equalizing tank. A quick-pressure valve is provided on a pipe which leads directly from the pressure tank to the coil within the liquid air tank; when this valve is opened, air at normal atmospheric temperature, passing through the coil, produces rapid evaporation of the liquid and a quick rise of pressure.

Immediately in front of the valve controlling the supply of liquid air to the coil expander is a relief valve, by opening which air may be admitted direct from the top of the storage tank to the expander.

LIQUID AIR AUTOMOBILE.



LATEST ARRANGEMENT OF LIQUID AIR TANKS AND CONNECTIONS.

American Rolling Stock for South Africa.

Considerable excitement has been caused in English engineering circles by the announcement that large orders for the supply of new rolling stock for the South African and Transvaal railways, to supplant that destroyed by the Boers, had been placed in this country. A short while ago the various corporations on the Rand requested the military authorities, who are controlling the railways, to replace the rolling stock with the greatest possible expediency. The military Director of Railways replied that if the orders were to be dispatched through official circles, about one year would elapse before the contracts would be fulfilled, and under these circumstances he advised the corporations to place the orders themselves, and to hand it over to the military authorities upon its delivery until military operations had ceased. This course was adopted, and Messrs. Wernher, Beit & Company were intrusted with the placing of the contracts. When the principal English firms were approached, they replied that it was quite impossible for the material to be delivered for several months, since their output was already taxed to the utmost capacity. The American manufacturers were then approached, and they agreed to fulfill the contracts within three months, which was four months quicker than the earliest English promises. Their price was also about one-third cheaper than that of the English manufacturers. Under these circumstances it appears that part of the contract will be undertaken by the English manufacturers, and the remainder, owing to the urgency of the case, has been placed in this country. Some idea of the high pressure at which the English manufactories are working may be had from the fact that one railway company placed an order for 40 locomotives nearly two years ago, and they have not been delivered yet. The Midland Railway Company has just placed an order for 130 locomotives, divided among the four leading locomotive builders in the country. It will be remembered that it was this company which purchased several American locomotives from the Baldwin Works some months ago, but these engines do not appear to have given that complete satisfaction upon the English railways that was anticipated. Another order for railway rolling stock to the extent of $5,000,000 was placed with another prominent firm for immediate delivery.

Bacterial Light.

We are indebted for a good many things to the wondrous synthetic and analytical powers of micro-organisms. Bacteria are being utilized in the arts and manufactures and they promise soon to be the effectual scavengers of the offensive products incidental to the existence of human life, says The Lancet. Indeed, it would seem that the great species of bacteria around us present a variety of functions which doubtless could be turned to many a good account. Bad microbes we know there are, whose subtle operations set up the specific poison of disease, but it would indeed be a very odd circumstance if time should prove that the microbe can be so manipulated as to afford us artificial light. Yet there exists a microbe which when properly fed will grow and multiply enormously, emitting during its development a strange phosphorescent light. In the past we have been wont to look upon phosphorescence as a phenomenon due essentially to the presence of phosphorus somewhere. We now know that this is a mistake, for phosphorescence occurs in a very great number of instances in the entire absence of phosphorus. Phosphorescence is undoubtedly a manifestation of chemical or physical change, but the change of course may not always be due to the working of countless microscopic organisms. It certainly is in the case of the phosphorescence of the sea. In this case the phosphorescence is best when the sea is disturbed, and the maximum of light is emitted from the crest of a short, rapid wave or in the foam produced by some disturbance. This is due to the fact that the phosphorescent bacteria or photo-bacteria are much more active in the presence of an excess of oxygen. Indeed, the respiratory exchange or oxidation of the bacteria is the cause of sea phosphorescence, since if the micro-organisms be killed or oxygen be excluded the light is quenched at once, while on adding an abundant supply of combustible food-stuff such as sugar, the light is intensified. The glow of ordinary yellow phosphorus is, of course, due to direct oxidation without the agency of micro-organisms. The peculiar greenish glow seen upon stale haddocks and other sea fishes is produced by this remarkable photobacterium, and is in no way connected with the presence of phosphorus. It is possible to cultivate the phosphorescent bacteria so as to obtain a fluid which is very strongly phosphorescent. Thus by placing the flesh of fresh haddocks or herrings in a two to three per cent solution of common salt and keeping at a low temperature—about seven degrees above freezing—it will be found that after a few days not merely the fishes, but also the whole of the liquid in which they are immersed, give off a pale greenish light which becomes much more brilliant if a little sugar be added. Pure cultures may thus be obtained exhibiting such a strongly phosphorescent light that by protracted exposure they may be photographed by their own light. It is not possible to say whether the culture will ever be carried to such a pitch that the vessel containing it may be used with advantage as a street lamp or a lamp upon our tables or a Chinese lantern at our garden parties. But the wonderful functions of bacteria are many, and the possibilities of using their powers multifarious.

A New Electric Fountain.

A new electric fountain has been devised. The idea is to combine tableaux-vivants with a display of brilliantly illuminated pouring water. A fountain of this kind has been built at Heine Park, Kansas City. In the center there is a platform for persons who are to impersonate various statues and groups. Outside of this circular platform are jets which are illuminated by electric lights. The space in the center being dry, pyrotechnic display will be used in conjunction with the aquatic figures.

THE MAKING OF PICTURES IN WOOD.

Salem, Mass., counts among its residents a Mr. E. C. Larabee, whose peculiar art it is to make beautiful pictures from bits of wood, so skillfully that even a practised eye cannot always discover what material has been used. In the simplest method of constructing these pictures two panels of wood, a glass table which can be inclined at any angle, and a Fleetwood jig-saw are employed.

A pen and ink drawing of the picture to be reproduced is glued on a panel of wood $\frac{1}{16}$ of an inch thick. To the panel a wood backing of the same thickness is secured. Both pieces of wood are then sawed along the lines of the drawing. The sawed portions of the top piece are then removed, and the spaces thus formed are filled by the corresponding sawed portions of the lower panel. The finer the saw used, the less kerf will there be.

The reproduction of a picture in colors requires the most consummate skill. It is no mean task to arrange several hundred minute pieces of colored wood so that the tints will blend to produce the effect of an oil painting, without the slightest rigidity and without the faintest suggestion that wood has been employed. In order to secure a good effect, Mr. Larabee assures us that he has spent five hours seeking in his collection of rare woods a piece which was inlaid in five minutes.

The wood is not stained or in any way colored, but is employed in its native tints without any preparatory treatment. Much of the wood comes from parts of the world rarely visited by travelers. A certain sacred tree which grows in India and which formerly was employed only in the making of idols has furnished Mr. Larabee with many a precious bit. Rare woods from Cuba, Porto Rico, and the Philippines found their way into a portrait of President McKinley which now hangs in the White House. The "Parisian Street Musician" reproduced herewith is composed of many woods but little known. In the coat, for example, are pieces of Madagascar black ebony; the hat contains striped ebony from the River Congo; the trousers are inlaid with Alabama persimmon; the eyes are composed of English white holly; the cravat and cuffs consist of American maple; part of the vest is of gold and satin-colored babbool from India; the face and hands are of cream-colored olive-wood from Palestine; the shirt is made of cream quince from Massachusetts; the material of the violin-bridge is Cuban pepil; and parts of the trousers are made of ashen gray impee from Manila.

In making a picture ten by fourteen inches in size from four to six dozen imported Swiss saw-blades are worn out, and from six hundred to eight hundred pieces of wood, one-sixteenth of an inch in thickness, used. Often the sawing of the wood exacts the utmost patience on the part of the artist. Cocoabollo, for example, contains a gum which clogs the teeth of the saw so quickly that not more than six cuts at a time can be made. Some of the most beautiful woods are so rich in oil that they must be baked and partly dried in order that the glue may hold.

Governmental Supervision of Forestry.

During the past year considerable work has been done in private tracts under advice from the Division of Forestry of the Department of Agriculture. In October, 1898, an offer was made to give advice and assistance to private owners in handling their woodlands. This year applications were received from owners in thirty-five States, and the total area covered with these applications was about 1,600,000 acres. Sixty students have taken up forestry as a profession under the instruction of the Division of Forestry, and they have been at work in the forests of the various

"A PARIS STREET MUSICIAN"—PAINTING REPRODUCED IN INLAID WOOD.

States during last summer, under the supervision of trained foresters. The results are of great value. All the expenses of the students are defrayed by the government while the men are in the field. The ultimate object is to prepare the students for service in the Forestry Division of the United States government. At the present time the call for experts is comparatively slight, but is increasing with great rapidity.

THE NEW ARMORED CRUISERS OF THE "CALIFORNIA" AND "MARYLAND" TYPES.

No feature of our latest naval programme shows more forcibly the impress of the lessons learned by our late war with Spain than the new armored cruisers now nearly ready for the bidding contractors. Our new battleships are typically fine craft and thoroughly up to date; but it is the armored cruiser that marks most sharply the pace we have cut out for ourselves. The armored cruiser, besides being the eyes and ears of the fleet, will take its place if need be in the line of battle. The "New York" was an advance upon her British prototype; the "Brooklyn" was an improvement; but the "California" and her class are really second-class battleships with armored-cruiser speed, any one of which against the combined batteries now on the "New York" and "Brooklyn" could hold its own with a very fair prospect of giving the two other ships a pretty bad drubbing. Such is the rapid rate of naval development to-day. The six ships in question were provided for by the acts of Congress of March 3, 1899, and June 7, 1900, respectively, three ships being appropriated for at each time; and those of the earlier act are required to be sheathed and coppered, while the last three allowed for were not so specified. Should authority be given to sheathe and copper the latter vessels, the contractors must stand ready to do so.

The general dimensions of the sheathed and coppered ships are as follows:

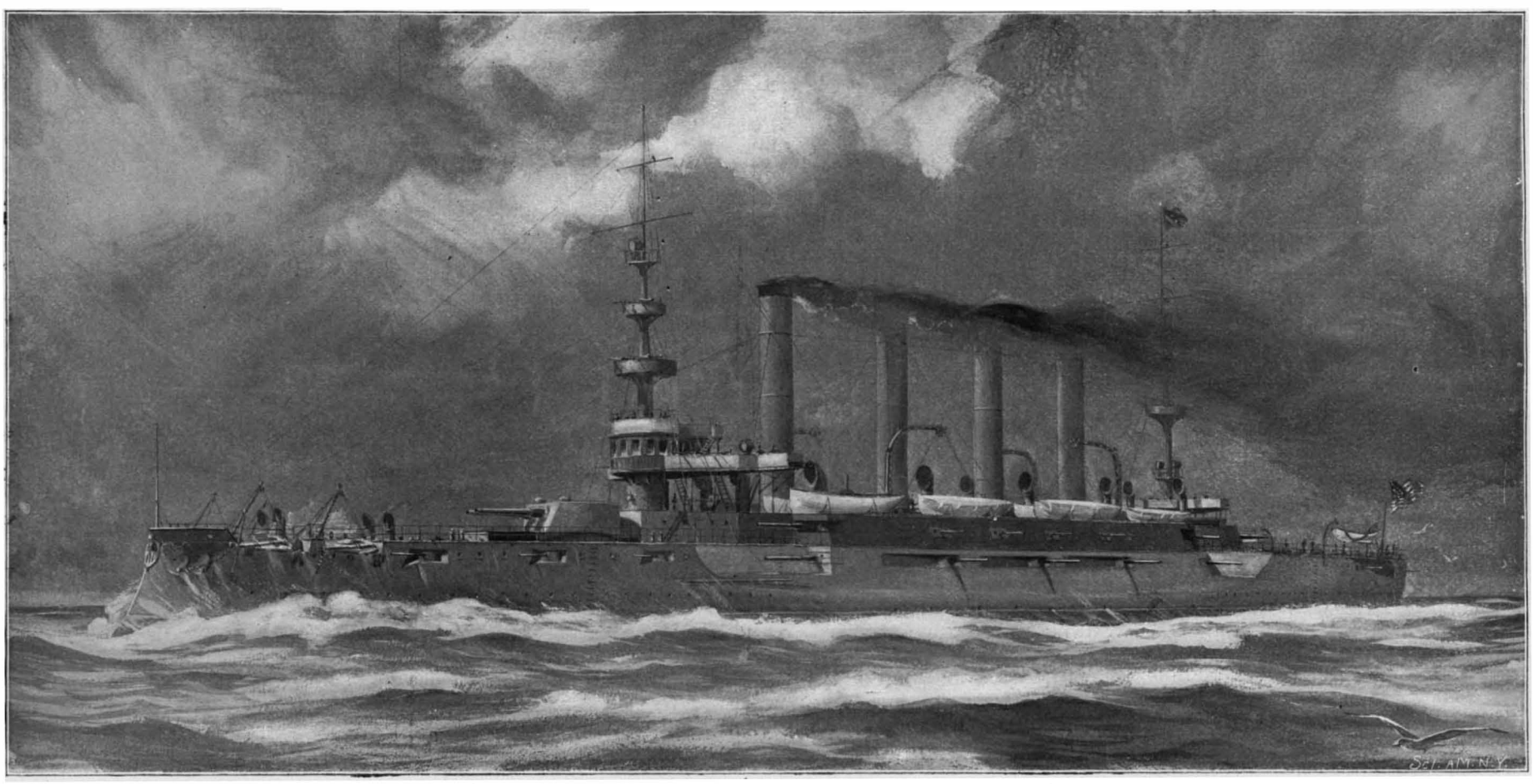
Length on load water-line	502 feet.
Beam, extreme, at load water-line	70 "
Trial displacement, about	13,800 tons.
Mean draught at trial displacement, about	24 feet 6 inches.
Greatest draught, full load	26 " 6 "
Coal carried on trial	900 tons.
Total coal bunker capacity	2,000 "
Feed water carried on trial	75 "
Speed not less than	22 knots.
Maximum indicated horse power	23,000

The only dimensional particulars in which the unsheathed ships will differ from the others are a maximum beam six inches less and a lighter trial displacement by 400 tons; in other respects they are alike.

The ships will have the usual extensive bulkhead system and close water-tight subdivisioning common to all modern fighting ships, and the double bottom will be so arranged that a reserve supply of fresh water may be carried there. The ships will have both docking and bilge keels. The main deck will be the only wooden deck, the others being laid with linoleum; and the use of wood will be restricted to the last degree, all of that within the vessels being fire-proofed.

The fighting positions and the "vitals" will all of them be sheltered behind walls of Kruppized steel, and the arrangement of armor protection will be as follows: First, a water-line belt 7 feet 6 inches wide extending from bow to stern. The belt carries its maximum thickness 4½ feet from the top down, whence it tapers to the armor ledge. For a distance of 244 feet amidships, the armor will have a maximum thickness of 6 inches and a minimum of 5; thence to the bow and to the stern the belt will have a uniform thickness, top and bottom, of 3½ inches. For a distance of 232 feet amidships, above the water-line belt and up to the main deck, the sides will be reinforced by 5-inch armor; transverse bulkheads, turning inboard at the ends of this side armor, will complete the central casemate housing the ten 6-inch guns. These transverse bulkheads will be 4 inches thick. The protective deck will be continuous from bow to stern; on the flat it will be 1½ inch thick and on the slopes 4 inches thick. Above this protective deck, a cellulose belt 3 feet thick will be worked along the sides from one end of the ship to the other. It is required that the water-line armor belt be so placed that at least a foot of it will be out of water at deepest load draught.

The armament will consist of: A main battery of four



Drawing by R. G. Skerrett.

NEW ARMORED CRUISERS OF THE "CALIFORNIA" AND "MARYLAND" TYPES.

Length, 502 feet. **Beam,** 70 feet. **Displacement,** 13,800 tons. **Speed,** 22 knots. **Bunker Capacity,** 2,000 tons. **Armor:** Belt, 6 inches; deck, 1½ to 4 inches; gun positions, 6 inches. **Armament:** Four 45-caliber, 8-inch; fourteen 50-caliber, 6-inch; and eighteen 50-caliber, 3-inch rapid-fire guns; thirty smaller guns. **Torpedo Tubes,** 2 submerged. **Complement,** 822.

45-caliber, 8-inch, breech-loading rifles and fourteen 50-caliber, 6-inch, breech-loading rifles; and a secondary battery of eighteen 14-pounders, twelve 3-pounders, four 1-pounder automatic guns, four 1-pounder single-shot guns, two 3-inch field guns, two machine guns, and a half a dozen small caliber pieces for boat service. There will be two submerged torpedo-tubes, to be placed on the broadsides pretty well forward. The 8-inch guns are to be mounted in two balanced elliptical turrets on the main deck forward and aft of the superstructure. These turrets will be generally 6 inches thick with slanting faces ½ inch thicker. The turrets are to be controlled electrically, and are to fire through arcs of 270 degrees. The rate of ammunition supply is one complete round of powder and projectile to each electric hoist every fifty seconds.

The four 6-inch guns mounted on the main deck are to be placed in sponsons at the four main corners of the superstructure, and are to fire through arcs of 145 degrees—the forward ones from dead ahead aft, and the after ones from dead astern forward. These guns are protected by 5-inch armor. The ten other 6-inch guns, five on each broadside, are to be placed amidships on the gun deck—the forward ones firing dead ahead, while all the other guns on each side will have arcs of fire of 110 degrees, and will be arranged to house within the side line. These guns will be separated by 2¼-inch splinter bulkheads. The ammunition hoists will be run by electricity, and are to supply each 6-inch gun with three complete rounds every minute. The 14-pounders will be mounted on the gun deck and up in the superstructure, two forward and three aft of the 6-inch battery on each side, and four on each broadside between the 6-inch guns up in the superstructure. The 3-pounders are to be mounted on the superstructure deck and on the bridges, while most of the 1-pounders are to fill the military tops. Each 14-pounder is to be supplied six rounds a minute, while the 3-pounders are to have ten.

The firing stations for the torpedoes will be sheltered from the reach of 6-pounders and lighter pieces, and are to be located above the torpedo tubes. The conning-tower, located at the fore end of the superstructure, will be of steel 9 inches thick, and the signal tower, located at the after end of the superstructure, will be of steel five inches thick. The pilot-house will be of bronze. All magazines are to be carefully insulated, and certain of them are to be chilled by the refrigerating plant. All are also to be easily susceptible of instant flooding.

Because of the extensive application of electricity, the ships will carry pretty large generating plants, having a total output from the seven units of 6,250 amperes at 80 volts—power enough to run all the ammunition hoists, work the turrets, drive some of the ventilating fans, run the machine shop, and furnish power for the steam laundry which is to do the major share of the officers' and crew's washing. Owing to the high freeboard of the ships and to the fact that it is carried uniformly from bow to stern, very excellent accommodations will be provided for the officers and enlisted men, of which the complement will consist of: 1 flag officer, 1 commanding officer, 1 chief of staff, 20 ward-room officers, 12 junior officers, 10 warrant officers, and 777 enlisted men, a total of 822 persons.

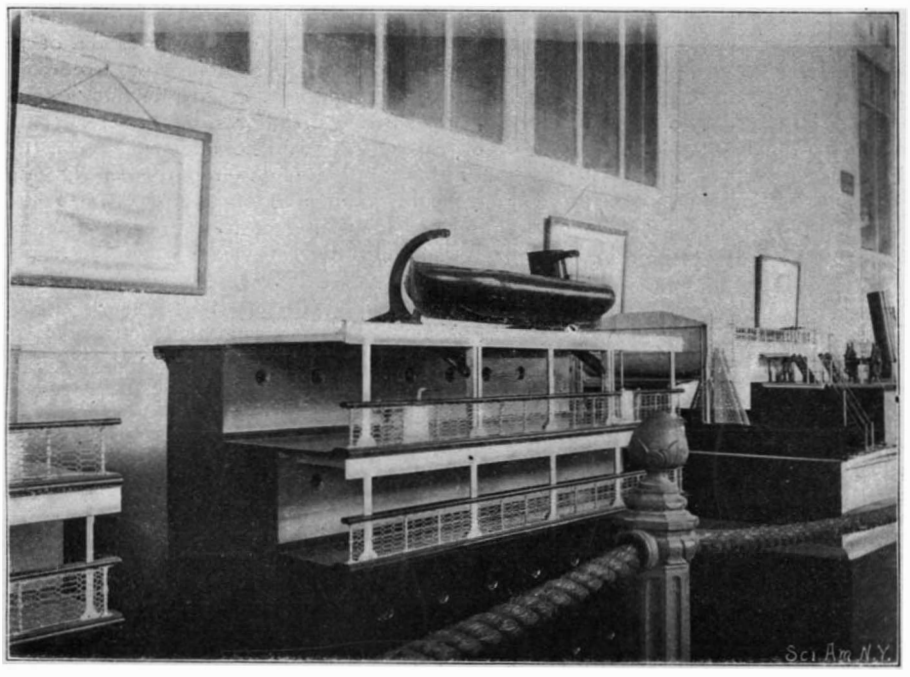
The ships will have twin screws, driven each by its own triple expansion engine of the four-cylinder type. The high-pressure cylinders will be 36 inches in diameter, the intermediate-pressure cylinders will be 59½ inches in diameter, and the two low-pressure cylinders of each engine will be 69 inches in diameter. They will have a common stroke of 45 inches, and the engines will make about 133 revolutions when developing the maximum indicated horse power of 23,000. Steam will be supplied by 30 boilers of the straight-tube water-tube type placed in 8 water-tight compartments. They will have a combined grate surface of at least 1,590 square feet and a total heating surface of quite 68,000 square feet. The four funnels will rise 100 feet above the grate bars. The normal reserve of fresh water will be 150 tons—just half of that carried on trial, and, excepting coal, the trial displacement will call for two-thirds of all other stores.

The ships will carry ammunition enough to put up a good long fight; 500 rounds being allowed the 8-inch guns, 2,800 rounds for the 6-inch guns, 4,500 rounds for the 14-pounders, 6,000 rounds for the 3-pounders, and a pretty liberal supply for the rest. Provision is to be made for closing many of the water-tight doors automatically, i. e., from a single controlling station, and every care has been taken to minimize the consequences of accident or injury. Three years is the maximum time limit for construction, and the maximum limit of cost is $4,000,000 in the case of the ships of 1899 and $4,250,000 in the case of the ships provided for during the present year.

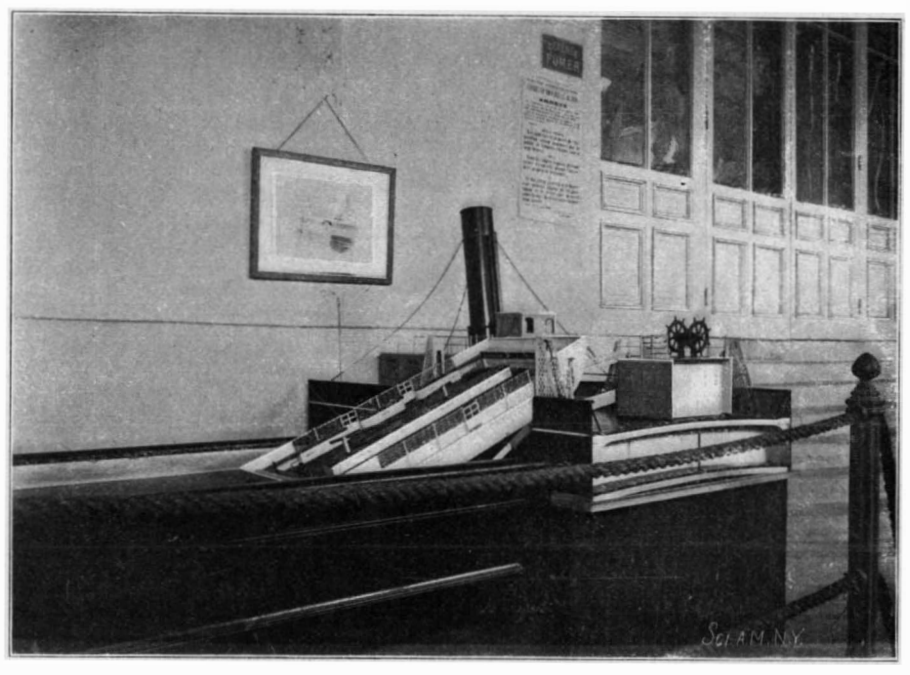
We have ample reason to be proud of these latest products of our naval designers; and in either peace or war they are bound to command a wholesome respect.

THE POLLAK PRIZE FOR LIFE-SAVING DEVICES.

The competition for the Pollak prize offered for the best life-saving devices brought together an extensive exhibit, which was contained in the Navigation building of the Paris Exposition. Mr. and Mrs. Pollak, of Washington, D. C., were among the passengers lost on the ill-fated vessel "Bourgogne," and their heirs decided to found a memorial prize of $20,000 to be awarded for the life-saving devices which, in the opinion of a committee of experts, would be the most efficient in preventing such disasters or in saving the passengers in case of shipwreck. Circulars were issued by the United States government stating the conditions of competition, and the Paris Exposition was selected as the most appropriate place for the assembling of a collection of this kind. The French government and the different foreign commissioners also issued circulars in their respective countries calling for inventions of this nature. As a result, more than four hundred competitors from Europe and America sent models of life-saving devices, or plans and descriptions, and these were seen in the Navigation building, near the Seine. An international committee of naval experts was appointed, including prominent naval officers or constructors from different countries, among whom may be mentioned Lieutenant Sims, late United States naval attaché at Paris; Commander Clavaud, director of the French life-saving society; Captain Siegel, German naval attaché at Paris; Rear-Admiral Naoumoff, chief inspector of the Russian life-saving society; Signor Pasella, naval constructor, professor at the Italian school of naval architecture; M. Couvert, president of the Chamber of Commerce at Havre; Captain Wallenberg, of the



The Roper System of Launching Lifeboats



The Roper Life-Raft in the Act of Launching.

Some of the American Inventions.

Individual Life-Saving Appliances.

COMPETITION FOR THE POLLAK PRIZE OF $20,000 AT THE PARIS EXPOSITION.

Swedish navy; Captain Nepean, director of the English life-saving society, etc.

According to the rules, the jury had the right to award the whole of the prize to one person or divide it among several competitors; the awarding of the prize was not obligatory, and it could be withheld for a future competition. As a result of the examination of the different systems, the jury found that the appliances designed by Mr. Leopold Roper, an experienced English naval architect, came the nearest to a satisfactory solution of the problem; as, however, the final solution had not yet been reached, and there was still room for considerable improvement, the jury decided not to award the whole of the prize at the present contest. The sum of $2,000 and a gold medal was awarded Mr. Roper, as his system was considered by far the best in the present series. A description of these devices will be useful in showing what lines should be followed by inventors who wish to enter the next competition for the prize. These devices include, first, an improved system of life-boats and davits, and second, a life-raft which the committee think is the most valuable.

The system of life-boats will be readily understood by referring to the figures, which represent the working models shown in the section. The first of these shows the boat suspended from the davits in its normal position. The davits are of steel channel and are light and strong; they are pivoted below the deck and carry in the rear a pivotal support which is attached at the level of the deck to a guide-piece which slides back and forth in a hollow deck beam by means of a large screw. This screw is operated by a winch at the side, worked by one man. When the winch is turned, the davits rise, being pushed up by the rear arms. The boat is then ready to be lowered. This is done by a second winch in a corresponding position on the other side, which unwinds the steel rope which supports the boat, and the boat may thus be lowered to either of the decks and to the water in a very short time by the man in charge. The use of a single steel rope is a great improvement over the ordinary block and tackle; when not in use it is for the most part inside the davit, and consequently well protected from the weather, and there is no complicated arrangement of ropes to become tangled up when the boat is released. As both ends are let go at the same time, there is no danger of tipping up the boat and throwing out the occupants, as often happens. The advantages of such a system over the ordinary davit with block and tackle are at once apparent. The boats themselves were also recommended by the committee. They are built of steel and are lighter and stronger than the present wooden ones, besides not being subject to warping or leaking when exposed to the weather. They are made with double bottom and a series of air-tight compartments, and are one-fifth lighter than other boats of the same size. On account of their great buoyancy they may be fully crowded with passengers without danger of sinking. The "Campania," of the Cunard line, has been fitted with twenty boats on this system, and it is of interest to compare the figures with relation to the ordinary boat. On the "Campania" the weight of each boat of the ordinary type is 3½ tons, making a total of 70 tons. Each boat carries 60 passengers, or in all 1,200 persons are taken. The forty davits each weigh 2,600 pounds, or a total of 52 tons, and the weight of boats and davits is 122 tons. To lower all the boats, allowing 10 men for each, requires 290 men. By Roper's system, each boat weighs 2½ tons, or 50 tons total; the boats carry 110 persons each, providing for 2,200 passengers. The 40 davits weigh each 1,800 pounds, making 36 tons, or for the whole system, 86 tons. Two men are required to lower the boats, making only 40 men. It will be seen that 2,200 persons are provided for, against 1,200, and the system weighs 86 tons against 122 tons; the greatest advantage is in the small number of men necessary, or 40 against 200 by the old system. For these reasons the committee consider that this system of life-boats is a great advance upon the present system and recommend its adoption; it is, however, the life-raft designed by Roper which is considered to be a step in the right direction toward solving the problem.

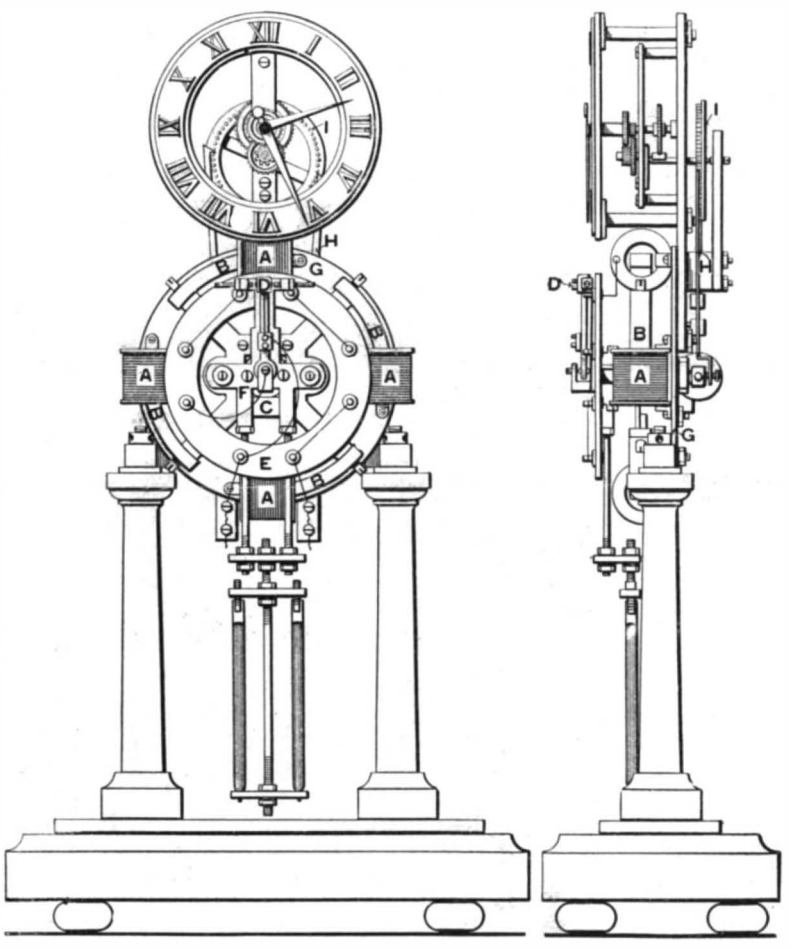
Our second engraving shows the appearance of this raft, which is large enough to carry 600 persons. It is built of steel, with double bottom, and divided into compartments forming air chambers; in some of these supplies of water, provisions, etc., are carried. The raft is supported normally above the deck and serves the purpose of the captain's bridge, it thus does not take away any extra room, and costs but little more than the ordinary form of bridge, this being estimated at $2,000. The raft is supported on each side by a heavy angle-piece, serving as a guide, in which it may slide back and forth by sets of rollers placed at intervals along the bottoms and sides. These cross-pieces are supported at each end by solid uprights, which are firmly secured to the deck; the cross-pieces are held in place by a simple clamp device, which may be instantly released by moving a lever. In case of shipwreck the raft is loaded with passengers, and a man at each side releases the clamp, thus lowering the guide-pieces at that end, and the boat rolls out by its own weight to the water's edge. This movement is shown in our engraving, where the oblique position of the guides will be observed, also a second guide-piece in front, which normally forms part of the upright support, but is now lowered, and serves to guide the boat into the water. As will be seen, the whole arrangement is one of great simplicity and not likely to get out of order, and can be operated by a few men. In the compartments may be placed provisions for six days, besides sails and tackle, etc. The buoyancy of the raft is amply sufficient to keep it afloat even if some of the compartments should become damaged. It may be remarked that the raft may be utilized under ordinary circumstances for landing troops, horses, etc., and can give good services in this way. This system of life-rafts has been tested practically upon H. M. S. "Polyphemus," which was provided with two of these rafts, of practically the same design as shown in the present model; the trials showed that they fulfilled all that was claimed for them, as each raft contained 200 men with supplies, etc., and the launching was carried out in about 45 seconds.

The committee are decidedly in favor of life-saving en masse, and for this reason have approved Mr. Roper's life-raft as the only device in the present competition which answers to this idea in a practical manner. Most of the inventions, outside of individual life preservers, seem to have been made by persons who had but little practical knowledge of the conditions to be met with. It should be observed that all appliances which require skill in putting together at the moment of shipwreck are almost valueless, as there is generally not sufficient time to manipulate such devices, and the crew of a transatlantic liner, composed as it is of untrained men, many of whom may have been taken on board at the moment of starting, cannot be depended upon for any great service in this connection; devices must be looked for which take only a few men to operate for the saving of a great number of passengers, such as the large life-raft. The type designed by Roper is, however, somewhat large, as a heavy raft for 600 persons might cause some trouble in getting started; by using a small-sized raft and increasing the number, a more satisfactory result would, no doubt, be obtained. The committee do not favor the system of water-tight compartments for vessels, on account of the cost and diminution of the capacity of the vessel; in a severe collision, such as that of the "Bourgogne," the system would not have availed much. Another point that should not be overlooked is that a vessel sinks end first, and accordingly many of the detachable deck-houses and other similar devices would fail to work. As it was not to be supposed that a first competition would be entirely successful, it has been decided to hold a second in the autumn of 1901, and a circular to that effect will be issued probably before the end of this year; it may be held at some point on the English Channel, as this will give a favorable opportunity to try some of the devices in actual practice.

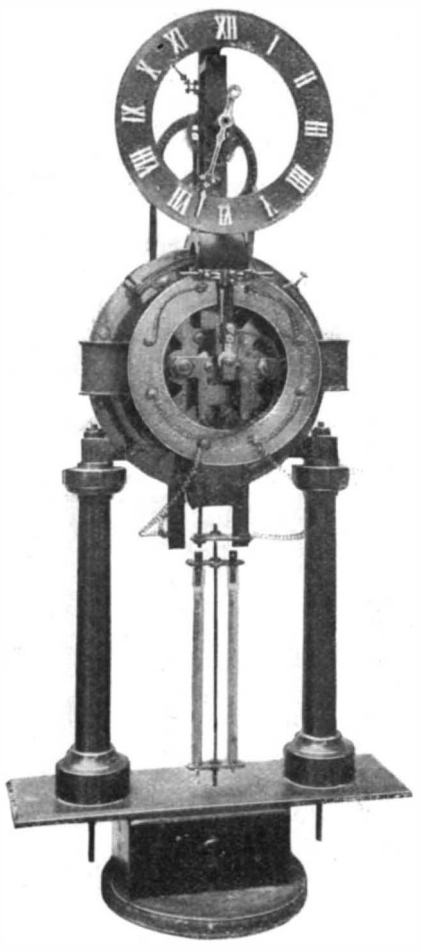
Out of the great number of devices a few have been selected for illustration as showing the general character of the exhibit.

One of the views shows some of the American inventions. To the right are two systems of improved davits and life-boats, and in the center is a model of a "marine brake," consisting of a large plate which is pivoted against the side of the vessel and may be swung out at will, thus slowing up the vessel by the resistance-surface it offers. Of the two larger models below, that to the left shows a type of inclosed life boat for a great number of persons, built of copper, and the second model represents a method of lessening the effect of collisions by surrounding the vessel with a series of rubber buffers. On the wall are several rubber garments which are inflated with air, etc. A great part of the exhibit is made up of individual life-saving devices, which are inflated or made of cork, air cylinders, etc. One view shows a number of these devices. The figure on the left has garments which may be inflated, also a rubber air belt, and next it is a vest made of cork and chamois skin. The two figures in the center carry a kind of long life-belt made of a number of sections of impervious material stuffed with a mixture of lamp-black and cork, and near it is a belt made up of semi-cylindrical air-chambers of waterproofed leather.

Two English systems of water-tight doors for the compartments of vessels are shown. The door seen on the left is normally held open by a catch which is released at will by an electro-magnet or a hydraulic cylinder and the door swings shut and is locked automatically. In the second system the doors slide into place, forming a water-tight joint, and all the doors of the vessel are controlled from a central point. Either hydraulic pressure or electric motors are used for the closing. The motor on the left pushes the door into place by means of a long screw, which is turned by gearing and works in a nut on the door. On the right is a hydraulic system for accomplishing the same movement; above and below are the cylinders whose pistons act upon the door, and it is closed or opened by sending the pressure into the forward or rear pipe. Both systems are worked from a central point either by a series of valves or electric switches.



FRONT AND SIDE ELEVATIONS OF ELECTRIC CLOCK.



ELECTRIC CLOCK RUN BY EARTH PLATES.

ELECTRIC CLOCK RUN BY EARTH PLATES.

Our occasional contributor Mr. N. Monroe Hopkins has prepared with a great deal of care an article on a new electric clock of his devising, which is well-nigh perpetual in its action, besides being accurate and practically noiseless.

The general appearance of this clock is shown in the perspective view, and much of the detail is given in the outline side and front elevations. The design and its carrying out are so novel and attractive that we have given in the current SUPPLEMENT the author's article in full, with many additional illustrations, the whole being sufficiently explicit to enable a careful workman to make it. The clock shown in the perspective view was mounted on a suitable base and inclosed in glass.

The back plate, *G*, which supports the entire mechanism, is secured to the caps of the pillars, and has, at its center, the knife-edge bearing of the pendulum. To this back plate are secured four magnetic spools, *A*,

at equidistant points, and a brass spider, to which all the parts of the pendulum are attached, has a knife edge which rests in the groove in the support projecting from the back plate, *G*. The knife edge and its support are hardened in cooled mercury, thus rendering them practically indestructible by wear. To the arms of the spider are attached four curved bars of soft iron, which in the regular operation of the clock are drawn into the magnetic spool and released once every second. To the front of the spider is secured a frame, *F*, from which is suspended the pendulum weight. The weight in this case consists of a rod and two cross-arms, and two tubes filled with mercury which rest on the lower cross-arms, the upper ends of the tubes being supported by screws passing through the upper cross-arms into the tubes.

The frame, *F*, has an arm which extends upwardly and carries two screws, the one on the left being platinum-pointed. The arm of the hard rubber hammer, *D*, is pivoted to the frame, *F*, at the center of oscillation and carries a platinum point capable of making an electrical connection as the hammer, *D*, swings over and carries it against the platinum-pointed screw. The magnetizing coils are connected in series and the terminal wires are connected one with the arm of the hammer, the other with the platinum-pointed screw.

Above the pendulum, and behind the dial, is supported a train of gears which moves the hands and is moved by the large pin wheel, which takes its motion from a pawl vibrated by the pendulum. A second pawl prevents the pin wheel from moving when the actuating pawl is drawn down for a new movement.

The clock receives its current from an earth battery consisting of ten pairs of zinc and copper plates, each twelve by eighteen inches, buried in earth at a sufficient depth to be kept constantly moist, and connected with the clock by rubber-covered wires. With a battery of this kind the clock will run until the plates are destroyed. If desired, it may be operated with four to six cells of gravity battery.

The various parts of this clock must be perfectly balanced, and the regulation by changing the length of the pendulum must be done with considerable care.

Notes on the National Academy of Sciences Meeting.

BY WILLIAM H. HALE.

Many pictures were shown of the forms of cephalopods from their first appearance, which was probably in the Potsdam, certainly in the Quebec group, below the Chazy, which is the base of the Ordovician, down to the present time. Also pictures of the development of individuals from embryonic to senile stages.

Also the development of many morphological characters was shown in a sequence of formulas as a mathematical statement. The development of these animals, both secular and individual, was shown to be a harmonious chapter of the grand evolution of life, precisely parallel to what Cope has shown for vertebrates and Beecher for branchiostomidæ. Space limits me to mention a single cycle, the change of form. Beginning with straight shell, curled forms follow. Very late, they straighten out again. This connects ammonites with the young of orthoceras. Every bilateral part of the shell is affected by this coiling and uncoiling, whereas the median line is not.

Forms acquired late in life appear earlier and earlier in the embryo, till finally they disappear, owing to the superior power of the embryo. This is called tachygenesis.

The embryo of straight form is coiled, recalling the adult form of its ancestors.

In old age there is a gradual decrease of acquired characteristics.

When a new form is developed late in life, it goes through the same series of changes as the embryo.

It is not till many phases of evolution have occurred that old age shows any distinctive characteristics. Thus in the Silurian it is difficult to find any animal which shows any effect of old age.

After certain forms have developed there is a reversion to simpler forms. Just as old age becomes a second childhood, so forms of earlier geologic age reappear today. The life cycle of the middle group corresponds to the secular cycle of the entire group.

IT seems impossible, when electric traction has so firmly established its superiority over any other means of power for the propulsion of street cars and light railways, that the obsolete cable system should be decided upon in a large city like Edinburgh (Scotland). At a recent meeting of the Municipal Council of that city the question of erecting a new cable power station for a section of the tramway was discussed. One councilor, who is a firm advocate of the cable system, emphatically averred that Edinburgh possessed the finest tramway system in the world, and by dint of persuasive eloquence succeeded in carrying the vote favoring the erection of the cable station. This will involve an outlay of $100,000, a sum sufficient, as another councilor remarked, to convert the whole section for which the station is being erected to the overhead trolley system.

The Current Supplement.

The current SUPPLEMENT is No. 1300, the first number having been issued January 1, 1876, and as the paging has been consecutive throughout this long period, the last one bears the number 20846. The front-page engraving is an excellent portrait of Giuseppe Verdi. "High Water Protection Methods of the Lower Mississippi River" is by William Joseph Hardee. "A Graphic Description of the Efficiency of Naval Guns" is a most important technical article. "Salt Water Aquarium at the Paris Exposition" illustrates the most modern type of aquarium. "An 'Electric Earth Clock' and Its Construction" is by N. Monroe Hopkins, and is accompanied by working drawings.

Contents.

(Illustrated articles are marked with an asterisk.)

RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

CULTIVATOR.—FERGUSON G. BRIGHT, Commerce, Mo. The cultivator has two shovel-beams sustained at their front ends. A rod extends rigidly between the rear portions of the shovel-beams. On the front portions of the shovel-beams a foot lever is mounted, each having a return bend permitting the rod to pass beyond each side of the longitudinal line of the foot-lever. Chains or other flexible connections pass between the foot-lever and the shovel-beams and run over the axle of the machine. The chains serve to limit the downward movement of the beams, and consequently the depth at which the shovels enter the ground. The foot-levers, when pressed down, will throw the beam up and disengage the shovels from the ground.

HORSE-HOE AND CULTIVATOR. — EDWARD J. BRYAN, 1504 Twentieth Street, South Highlands, Birmingham, Ala. The inventor provides an improved mechanism by the use of which he is able to bar off or scrape to narrow ridges the beds forming the row; to chop or hoe the desired space out of the row of plants; to dirt the plant after hoeing, means being provided to prevent the covering of the plant; and to plow, pulverize, cultivate, or rake the full width of the row.

PROCESS OF AN APPARATUS FOR PROTECTING TREES OR VEGETATION AGAINST COLD.—JAMES F. TUCKER, United States Department of Labor, Washington, D. C. The inventor has observed that tender vegetation on the south shore of a body of water usually escapes the blighting effect of frost. In Florida the deep-water rivers and lakes are fed by springs which contribute to the heat treasured up from the long summer months, so that during a cold spell, the air is brought in contact with a body of water at a relatively high temperature. A cloud of fog or vapor is thus produced, completely enveloping the locality to the south and east and protecting the vegetation. The present invention comprises means for making an artificial fog in the orchard or over the ground to be protected. The essentials are heat and moisture applied in such a way as to make sensible the latent heat as an adjunct to the heat actually supplied.

Electrical Apparatus.

BARBER'S ELECTRICAL APPLIANCE.—MARTIN SCHUPNER, Nyack, N. Y. Mr. Schupner has devised an improved electrical apparatus arranged to permit a barber or other operator to apply a current of electricity of desired intensity to the human body, mainly, however, to treat the scalp for strengthening, drying, or assisting the growth of the hair.

Engineering Improvements.

STEAM-TRAP.—GEORGE H. GROTE, St. Louis, Mo. The object of the invention is to provide a steam-trap with a simple means for regulating the tension-spring, whereby it is made unnecessary to shut off or take the trap apart to adjust the spring, thus saving time and expense. A diaphragm divides the trap-casing into upper and lower chambers. The inflow of water acts upon the diaphragm in order to operate a valve, so that the proper level may be attained. The action is entirely automatic.

Mechanical Devices.

GAS-PRESSURE REGULATOR.—THEODORE HAHN, Kötzschenbroda, Saxony, Germany. The use of gas-engines with an intermittent gas-supply is accompanied by the disadvantage that in the gas-mains variations in pressure are perceptible. Ordinary gas-governors imperfectly overcome the difficulty, for the reason that only a single gasometer-hood is employed. According to the present invention the gas, before passing into the gasometer-hood which controls a gas-supply valve, passes through a special pressure-regulator loaded in conformity with the friction of the gasometer-hood and in such a manner that the gas can pass into the gasometer-hood without perceptible impulses occurring in the regulator and gas-main.

ROLLER-BEARING.—JOHN S. GODFREY, Harrington, Wash. A casing has the ends of its inner wall curved inwardly. Guide-rollers extended through the casing are supported by a cage. The ends of the guide-rollers are rounded. Antifriction-rollers are supported by the guide-rollers and have rounded ends. The rounded ends cause very little friction.

TYPE-WRITER.—MANUEL S. CARMONA, Mexico, Mexico. The type-writer is an improvement on Mr. Carmona's previous inventions in machines in which a small number of keys is employed which either singly or in combination govern the action of a type-locating mechanism and of a printing device. The present invention provides means for locating the type, which means are positive in action and are not liable to deteriorate by wear. The arrangement of parts is so simplified that the movement of the carriage will be relatively slight. An improved mechanism is furnished for effecting the impression.

SAW-FILING MACHINE.—GRANVILLE BARTLETT, 347 Trumbull Avenue, Detroit, Mich. The machine is of that form in which a pair of clamp-bars hold the saw-blade with its teeth uppermost and a sliding carriage or guide frame for the file-holder is arranged to be moved longitudinally along the clamp-bars and has guide-seats to receive the file-holder in its reciprocating movement across the saw. The present invention consists in the peculiar construction of the saw-clamp; the peculiar construction of the file-holder guide or carriage; and in the peculiar means for adjusting the angular position of the file in regulating the inclination of the teeth to be cut.

PHOTOGRAPHIC SHUTTER. — JOHN V. COATS, Saratoga Springs, N. Y. This spring actuated shutter can be regulated for time and instantaneous exposures. The winding mechanism is so controlled that the spring will be equal in action at all times and at no time fully exhausted. The camera-shutter is turned by the spring. Check-arms are carried by a trip-lever for engaging and stopping the shutter at the proper point in its revolution and for releasing the shutter.

MACHINE FOR MAKING SHOVEL-HANDLES.—AUGUSTUS R. FEISTEL, Philipsburg, Penn. This invention is a machine for cutting the D-holes in the blanks of shovel and fork handles. A handle-blank is clamped in a vertically tiltable holder pivoted in a horizontally-slidable carrier, by which it is fed to a rotatable cutter-head. The holder is tilted in vertical position while the cutter is forming the D-hole and is thrown back to a horizontal position as the carriage recedes. The blank is then reversed in the holder and the operation is repeated. The inventor assures us that a machine has been constructed and is now in successful operation.

DRAG-SAW.—JAMES H. PERKINS, Seattle, Wash. A very compact and serviceable machine is provided by the present invention. All the parts are carried snugly on the bed or framing in position to be easily reached for operation. On a framing a bracket is mounted to move, carrying a wrist-pin to which a connecting-rod is attached as well as a saw-beam. A tower is mounted on the frame. In the tower a movable sling is carried, which sustains the free end of the saw-beam. The sling is moved by winding devices at the top of the tower.

Railway Appliances.

VEGETATION-BURNER FOR RAILROAD-TRACKS.—CORNELIUS BURKE and JOHN TOOLE, Monroe, La. The invention provides a new and improved vegetation-burner for railroad-tracks, which burner is especially designed for use on a push or flat car. On a truck, levers are fulcrumed, extending rearwardly beyond the truck. These levers are provided with nuts between their ends, which nuts engage screw-rods on the truck. The outer ends of the levers carry a tube from which burner-pipes depend. A transverse sheet of flame is produced, which can be raised or lowered so that high or low weeds or grass can be readily destroyed.

Miscellaneous Inventions.

SAD-IRON.—IVER WICKLAND, South Superior, Wis. The sad-iron is heated by gas or vapor supplied from oil in a tank carried by the sad-iron. A box is fitted in the front portion of the sad-iron body and forms an oil-cup, the box being in communication with the oil-supply. A retort communicates with the box and a burner is situated rearwardly of the box.

BRIDLE BLIND.—FRANK MACK, Manhattan, New York city. Mr. Mack has devised blinkers or blinders which can be made completely to blind a horse and thereby to stop him. Each blinker comprises a pivotally-mounted shade movable on its pivot to cover or uncover the eyes of the horse, and a wheel with two cams to actuate the shade.

FOLDING FLASH-LIGHT BRACKET. — OTTO C. BOTZ, Sedalia, Mo. The bracket has a supporting-bar for attachment to a socket in the camera. An extension-rod is fulcrumed on the supporting-bar. Pivotally connected with the extension-rod is an extension-upright consisting of telescopic sections for carrying the flash-light material. A spring holds the sections as adjusted.

MAIL-BOX.—WILLIAM J. WEAVER, Leetonia, Ohio. This invention relates to mail boxes particularly adapted for use on railroad mail-routes. The box is of simple construction and may be opened by a man riding on a horse or sitting in a carriage. A signal is provided for the box, which signal indicates whether the box contains mail for collecrion.

BRUSH. — MAURICE ROSENTHAL, Manhattan, New York city. Paint, varnish and calcimining brushes require bridling to enable the bristles to be properly controlled. This is generally done by tying a string around the bristles just below the ferrule. Brushes are best when the bristles are long, thus giving elasticity, or, as painters call it, "life," to the brush. The inventor attains these ends by fastening a flexible center-piece to the brush within the mass of bristles and tying the bristles snugly around the center-piece.

BEDSTEAD FASTENING. — FRED C. F. PETERS, Monroe, La. The purpose of the invention is to provide a bedstead-fastening which will securely bind the parts of a bed together and prevent them from becoming detached by breakage or movement. The fastening comprises two sections, the first of which has a flat outstanding part and the second of which has two flat outstanding parts lying in parallel planes and receiving the outstanding part of the first section between them. A pin is carried by the first section and is disposed transversely to the corresponding outstanding part. The second section has a recess in one of its outstanding parts to receive the pin.

FITTING.—JOHN R. MOODY, Perry, Iowa. The fitting is designed for repairing broken pipes, and for connecting pipes with one another, with elbows, reducers, tees, valves, without the necessity of threading the pipe or the device with which the pipe is connected. The pipe-fitting has external threads and is adapted to receive the ends of a pipe. A collar is fitted on the pipe end, is removably secured, but is held against longitudinal movement. The collar abuts on the end of the fitting. A coupling is slipped over the pipe and screws on the threads of the fitting. A packing in the coupling is adapted to be compressed against the collar.

WASHBOILER. — HIRAM H. TUTTLE, 1210 Vine Street, Philadelphia, Penn. When heat is applied to the boiler, the water begins to boil; and a circulation is established downward along the sides and ends of the boiler. The water is forced up through lines of tubes from the bottom with a direct force and discharged by such direct force below the clothing to be washed. The clothing is thereby opened up and subjected to the action of the circulating water.

STAGE-ILLUSION APPARATUS. — MORGAN A. SHERWOOD, National Theater, Washington, D. C. The invention provides an apparatus for producing a scenic representation of the burning of a person at the stake, with wonderfully realistic and startling effect, and also means for producing fire and flame effects in connection with representation in general.

METALLIC PACKING.—WILLIAM H. PRENDERGAST, Savannah, Ga. The packing is designed to be used on piston-rods and in air-pumps and is composed of packing ring sections over which lies an equalizing plate having pocket-like seats at its ends. A spring fits over the equalizing-plate and is engaged at its ends.

MOTOR-VEHICLE.—AVON M. COBURN, Daunt, Cal. The inventor mounts his engine horizontally and causes it to drive a power-shaft journaled in the middle of the vehicle below the seat. The power is transmitted by a friction-pulley to an intermediate shaft and then by sprocket and chain to the rear axle. By this arrangement power is transmitted without jerk or jar to the driving-wheel.

Designs.

BARREL. — GORDON D. CANFIELD, Washington, N. C. The barrel has a central row of diamond-shaped openings which alternate in the direction of length of the barrel with tapered openings lying nearer the ends of the barrel and giving the latter a novel appearance.

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

NEW BOOKS, ETC.

MOTOR VEHICLES AND MOTORS: THEIR DESIGN, CONSTRUCTION AND WORKING BY STEAM, OIL AND ELECTRICITY. By W. Worley Beaumont. London: Archibald Constable & Company. Philadelphia: J. B. Lippincott Company. 1900. 4to. Pp. 636. Price $10.

Mr. Beaumont has the unique distinction of furnishing to the automobile world the most important contribution ever made to the subject. We cannot speak in too high terms of the style in which the work is gotten up; it is splendidly printed, with rubricated paragraph indexes on the margin. The illustrations, which number 450, are well executed and are on a liberal scale, there being many folding plates. On the whole the book may be regarded as a model piece of technical bookmaking. The subject is treated in a remarkably thorough manner, and no phase of it seems to have been neglected. About the only criticism which can be made is that American practice is not as well represented as it should be. It is an indispensable book for every constructing engineer.

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.

(7993) J. G. B. writes: Will you please tell me through the columns of your paper if the mouth of the Mississippi River is higher than its head waters? Has the subject ever been discussed by the North American Geographical Society? A. The mouth of the Mississippi River is several miles further from the center of the earth than its source is. This is due to the form of the earth, which has been affected by the centrifugal force of its rotation upon its axis. In this sense the mouth of any river which flows toward the south is higher than its source. It is not true in any proper sense of the term that the water of such a river flows up hill. It should not be thought, however, that this affects a water level. This is affected in the same way as the flowing river. The surface of the ocean is a water level from the equator to the poles. We do not know that any society has discussed this question.

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Beer, National Brewery Company ... 35,466
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Canned meats, F. Wolferman ... 35,474
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Coffee substitutes, D. H. Smith ... 35,468
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Gin, Tanqueray, Gordon & Company ... 35,465
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"Armoza," for cigars, American Lithographic Company ... 7,902
"Blue Label," for whisky, A. Forbes ... 7,913
"Crystal Rock," for beer, Cleveland & Sandusky Brewing Company ... 7,912
"Dotty Dimple," for canned tomatoes, United States Printing Company ... 7,897
"Horse Radish Jack," for horse radish, A. Cliff ... 7,899
"La Introduction," for cigars, Schmidt & Company ... 7,906
"Love Knot Brand," for canned tomatoes, United States Printing Company ... 7,896
"Montana Sport," for cigars, Schmidt & Company ... 7,905
"Murillo," for cigars, Cuban American Manufacturing Company ... 7,903
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"Oil of Vanilla," for an extract, D. Lamont ... 7,898
"Pa-kal," for a medicine, A. H. Olmstead ... 7,901
"Railway Supplies and Pulp Wood," for railway supplies, etc., L. R. Martin ... 7,916
"Sand Stone Brand," for butter, J. E. Amend ... 7,894
"Silver Creek Creamery," for butter, J. J. Powers & Company ... 7,893
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"The Famous Maryland Carpets," for carpets, J. Hines & Son ... 7,915
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