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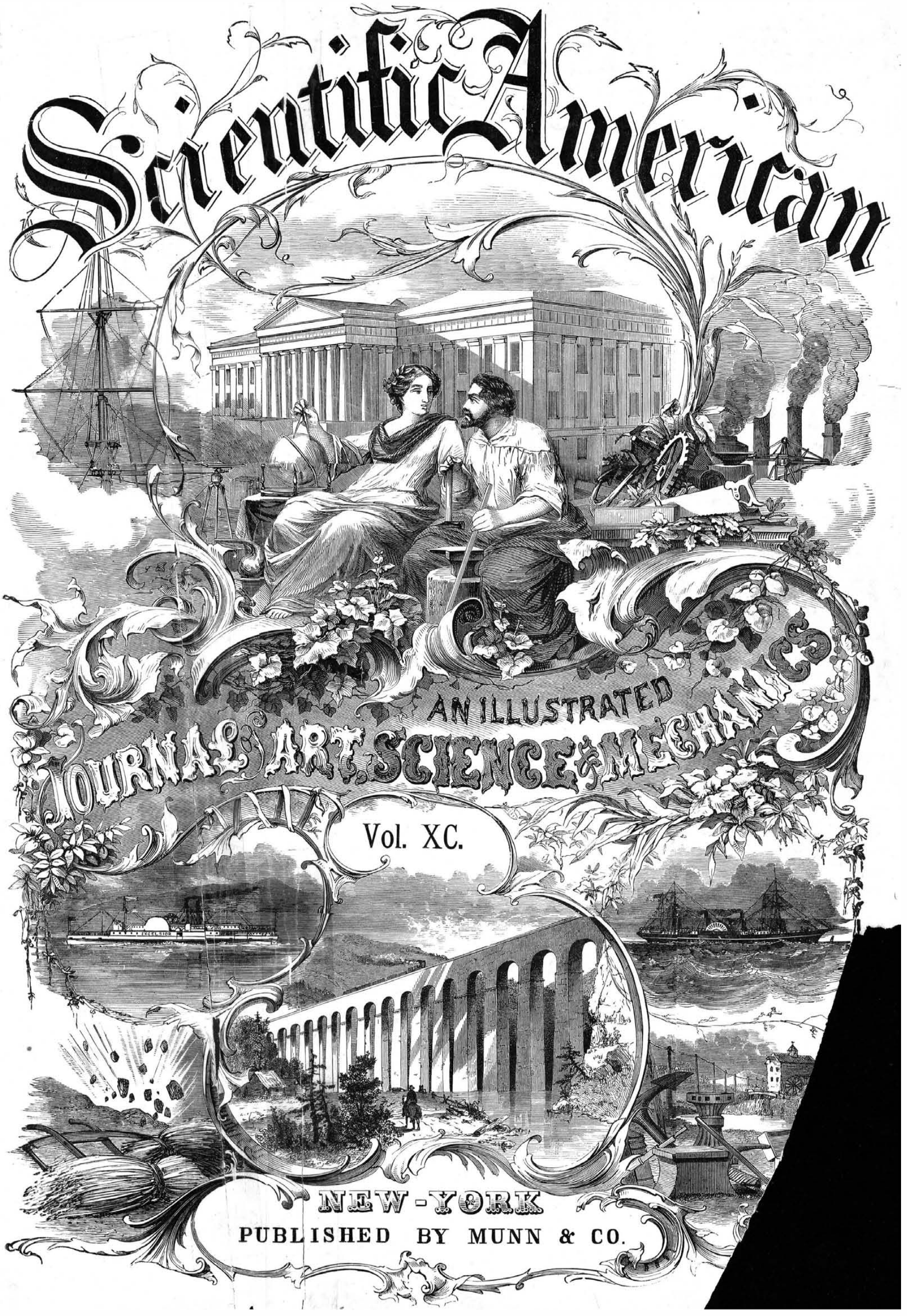

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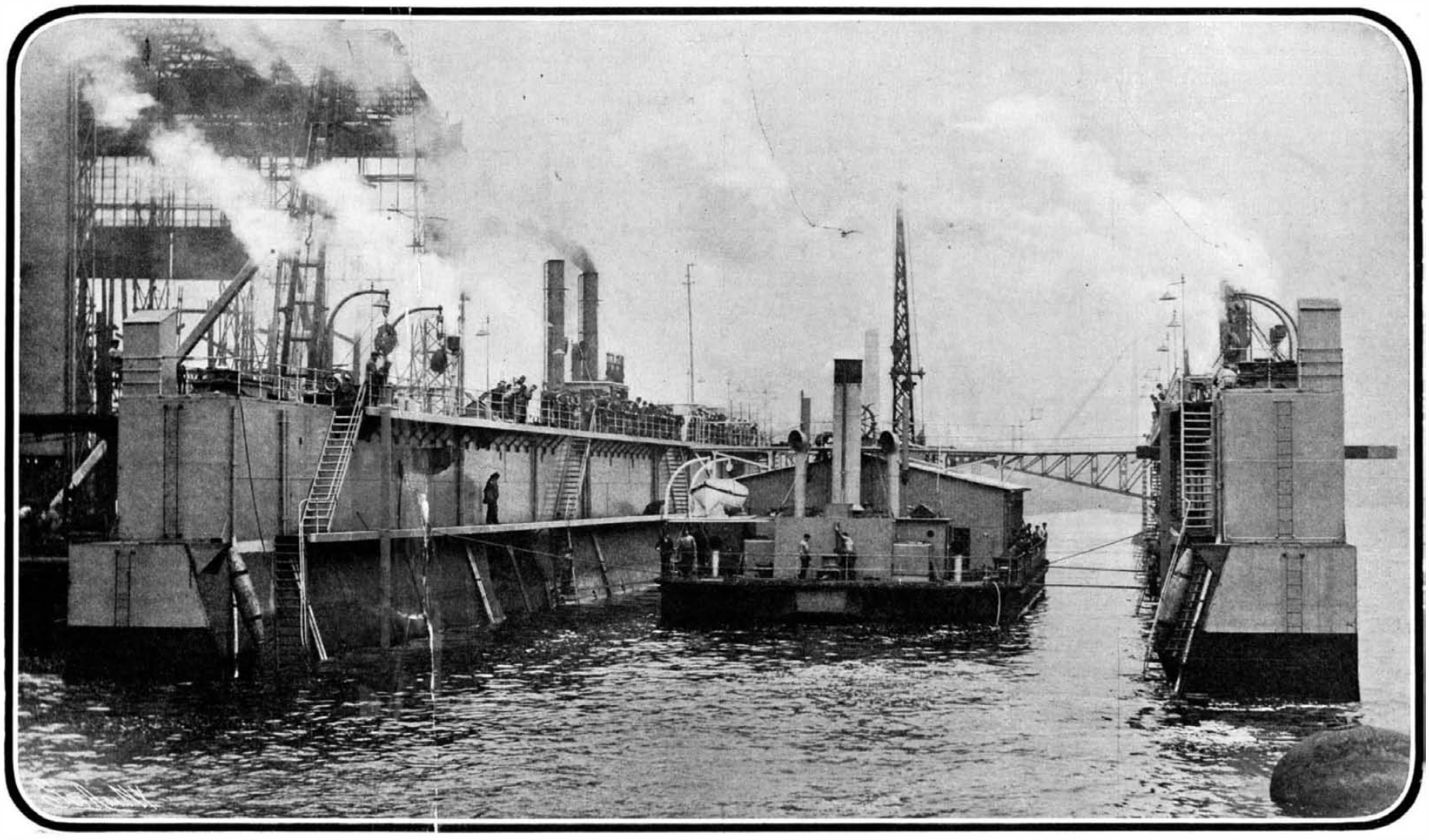
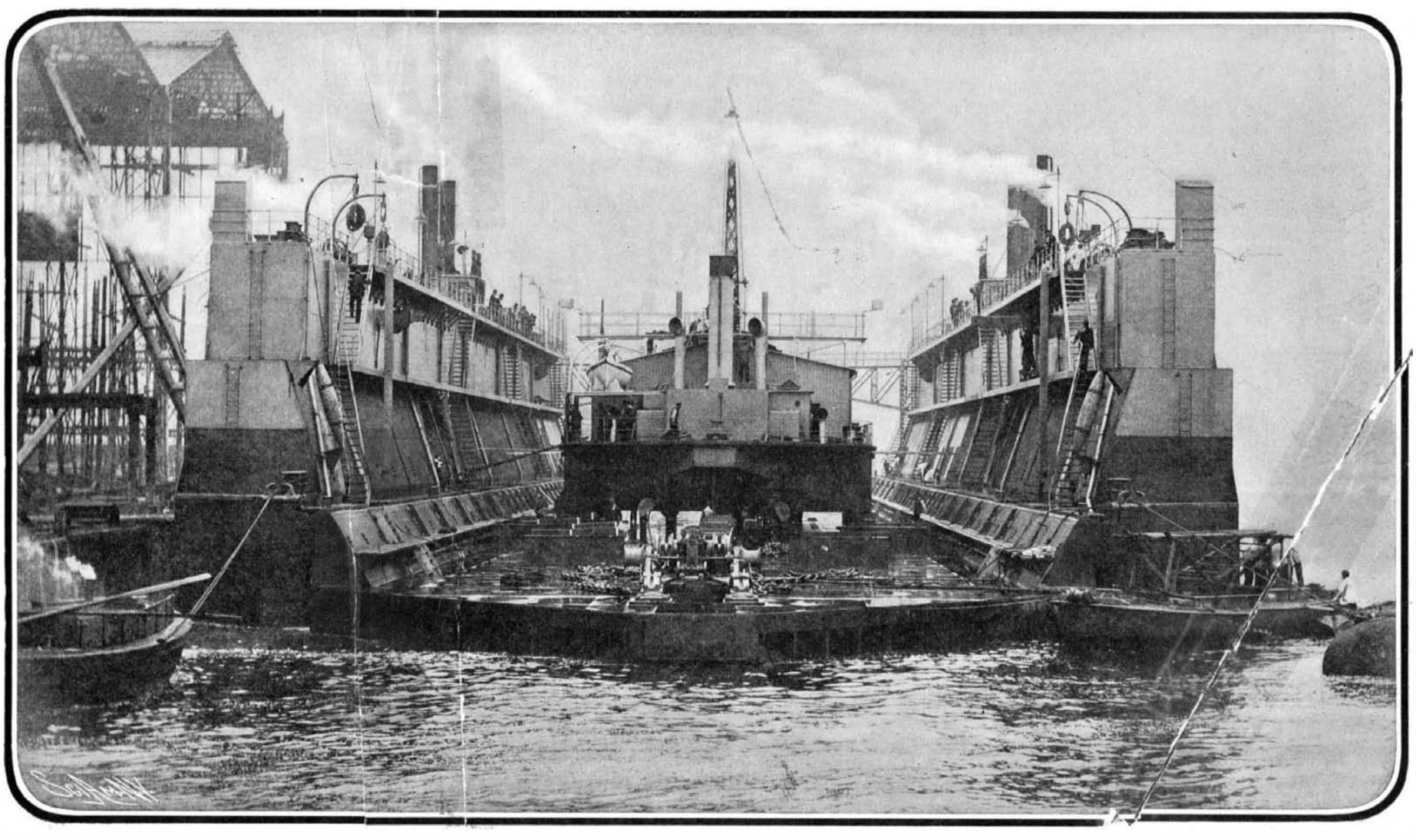


FLOATING DOCK ABOUT TO BE LIFTED, PONTOONS SUBMERGED.



THE NEW 8,500-TON FLOATING DOCK OF DURBAN, SHOWING FLOATING WORKSHOP ON DECK.—[See page 7.]

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NEW YORK, SATURDAY, JANUARY 2, 1904.

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

RETROSPECT OF THE YEAR 1903.

RADIUM.

In any review of the scientific events of the year that has just drawn to its close, it is certain that the determination of the extraordinary properties of radium should hold the first place both in point of fascinating interest and of far-reaching effect. The new element possesses so many startling properties, some of which threaten to overturn our whole system of chemical physics, that it easily takes rank as the notable scientific discovery of the year, and promises to be the scientific sensation of the twentieth century. The story of the discovery of the new element is too well known to call for any repetition here. Let it suffice to say that after months of patient research, the story of which is one of the most interesting in the annals of laboratory work, M. Curie and his wife succeeded in precipitating a few crystals of salt, whose properties were so subversive of many of our accepted theories of force and matter as to produce a veritable panic among both masters and disciples in the world of natural physics. It is impossible within the limits of the present review to enter in detail into a description, to say nothing of a discussion, of the new element; but there are two of its properties which, because of the fact that they seem to completely overturn two fundamental propositions in natural science, serve to give to radium its chief interest. In the first place, then, it has been proved that radium has a temperature which is a few degrees above that of the atmosphere and, wonderful to relate, *that it maintains this relative temperature constantly without any sensible loss of weight;* that is to say, the loss of weight is so infinitesimally small that the figures which express it become purely symbolical. Now, here is a fact which alone was sufficient to strike a staggering blow to one of the foundation postulates of modern science, namely, the theory of the conservation of energy. It was as though M. Curie had held up to the view of the world a small fragment of burning coal which burned but was never consumed, or was consumed so slowly that according to an estimate of the loss of weight by radium made by Becquerel it would take thousands of millions of years before it was entirely burned away. We were but just recovering from the first rude shock, when Prof. Ramsay rendered confusion worse confounded by stating that he had been able to find in the spectrum of the gaseous emanations of radium the characteristic yellow line of helium. He promptly announced this discovery before a learned society, and in the course of his address did not hesitate to voice broadly the thought that must have been uppermost in the mind of his audience, when he exclaimed, "What is this but an actual case of that transmutation of one element into another in which the ancient alchemist believed?" It is natural that in the presence of these disturbing facts, the scientist should search for some explanation which will reconcile the apparent contradictions, and permit our present theories of force and matter to remain as part of our scientific creed. Thus it has been suggested that radium possesses the power of intercepting and making manifest certain invisible and hitherto undetected rays of the sun, and that the wonderful heat phenomena displayed by the new substance are derived from the sun—radium playing the same part with regard to the sun that the fluoroscope does to the X-rays. The mystery of the transformation of radium into helium is more difficult of solution, and, indeed, no explanation that is worthy of consideration has been offered. It is true, however, that the presence of the helium line in the spectra both of radium vapor and the sun, and the possession by the ultra-violet rays of the sun and of radium rays of the same curative qualities, suggest that they have a common origin. The new element emanates three different kinds of rays, one of which travels at the speed of 100,000 miles per second. It is already recognized as likely to have a useful place in the treatment of certain diseases, particularly those that lie near the surface of the body. If small animals are exposed to its action for a few hours, it will prove fatal, if not during the application, at least within a measurable time thereafter. Its discoverer had occasion to carry a small tube containing radium in his vest pocket during a journey to London; and not many days thereafter a painful and troublesome sore developed on the surface of the body beneath the vest pocket. It renders luminous certain precious stones, and will instantly detect the true from the false diamond, the latter refusing to respond to its luminous influence. It is probably the most precious substance in the world today. A few weeks ago M. Curie stated that it was worth three thousand times its weight in gold; to-day, as the result of the disclosure of its wonderful qualities and the increasing demand for the smallest portion of it for scientific and other purposes, its price has risen until it is now worth five thousand times its weight in gold. It is idle to speculate as to the future. It will be time to do that when we have solved the momentous scientific problems that are presented by this, the most wonderful of all known substances.

MERCHANT MARINE.

The most notable event of the year in the American merchant marine was the launch, early in the year, of the "Minnesota," by far the largest ship ever built in this country. She has a length over all of 630 feet, a breadth of 73 feet 6 inches, and a molded depth of 56 feet. Toward the close of the year, however, there was launched for the White Star Company what is considerably the biggest ship ever constructed. This is the "Baltic," which lacks only 200 tons of having 40,000 displacement on her maximum load draft. She is 725 feet 9 inches in length, 75 feet broad, and 49 feet in molded depth. Previous to her advent the "Kaiser Wilhelm II.," which made her maiden trip during the year, was the longest ship, being 706 feet 6 inches in length, 72 feet in beam, and 44 feet in molded depth. A notable event is the subsidizing of the Cunard Line by the British government, and their loaning to that company of the necessary capital for the construction of two great steamships, which are to surpass everything afloat in size and speed. These vessels will be nearly 800 feet in length by 80 feet in beam, and with 70,000 horse power, and are expected to reach a speed of 26 knots an hour. The turbine continues to make progress in the merchant marine. The turbine cross-channel steamer "Queen" is running successfully and has shown a speed of 22 knots an hour, while the Cunard Company have organized a commission of leading marine engineers that is now engaged in making an exhaustive inquiry into the capabilities of the steam turbine, with a view to placing it in the new ships. The publication of their report should form one of the most important engineering documents of the year 1904. The most decided step in the application of the turbine to ocean-going ships was the placing of a contract by the Allan Line for a large trans-atlantic liner, to be propelled by this type of engine. Although the vessel is to have the moderate speed of only 18 knots, the great size of the ship, and the fact that she will have to meet the wind and weather of the Western Ocean, will definitely settle the status of the turbine in regard to ocean-going ships. An event occurred during the year in the propeller experiments with the British armored cruiser "Drake," which promises to exert a powerful influence upon the future speed of both war and merchant vessels. The "Drake" was designed for and made a speed of 23 knots, with propellers of the normal, narrow-bladed type. On substituting propellers with 30 per cent. more area, the ship made a knot more speed (24.1 knots) with the same horse power. To make the additional 1.1 knots with the old propellers would have required 10,000 more horse power. The propeller is a fruitful field, evidently, for experiment.

ELECTRIC TRACTION.

Unquestionably the event of the year in the field of electric traction was the brilliantly successful culmination of the experiments in high-speed electric traction in Germany. The trials, which had been discontinued the year before because of the weakness of the track, were taken up again after the track had been rebuilt, and the speed was increased in successive trials. Finally the 100-ton experimental car, taking 14,000-volt current from the line, ran from Berlin to Zossen, a distance of 14 miles, at an average speed of 107 miles an hour from start to finish, and attained the unprecedented maximum speed of 130½ miles an hour. The chief significance of this performance lies in the fact that it was achieved by the use of alternating-current motors, for it cannot be denied that the event foreshadows the use, for high-speed, long-distance travel, of the modern system in place of our low-pressure, direct-current methods. Another fact of great importance during the year has been the placing in service upon a suburban line in Berlin of a trolley car driven by a new single-phase, alternating-current motor which takes its current at 6,000 volts direct from the line to the motor without the use of transformers or converters. If no unforeseen difficulties develop this should prove to be the motor of the future, and especially valuable will it be for long-distance travel. During the year both the promise and performance of the much-talked-of electrifying of steam railroads have made a decided advance. One large steam railroad, the North-Eastern in England, has completed an extensive electric equipment of some 40 miles of its suburban roads, and the cars are running. The New York Central Railroad has drawn up complete plans for electric traction on its suburban service in New York city, and the contracts for a considerable portion of this work have been let. The trains will be hauled by electric locomotives of 85 tons weight, two of these being coupled up for hauling the heavier trains. The specifications require that the two locomotives shall be together capable of hauling a 500-ton train at an average speed of 60 miles an hour. Referring again to the Berlin-Zossen trials, it must be understood that while they prove these high speeds to be mechanically practical, there is no suggestion that they are commercially so. It took 1,600 horse power to drive this single car at 130½ miles per hour. The same horse power in a steam locomotive will haul a whole train of cars at 60 miles per hour. The atmosphere presents the greatest source of resistance at this high speed, and the bulk of the work of overcoming it falls upon the first car. However, in a train of cars identical with the Berlin-Zossen car, the horse power necessary for each car would be only a fraction of that necessary for a single car in running at the speed attained. We shall probably see a high-speed road installed and running within the next few years.

AERIAL NAVIGATION.

It is a curious anomaly to have to admit that while science and nature alike point to the aeroplane as the proper type of machine for mechanical flight, the practical results of the year, with one exception, point with equal emphasis to the cumbersome dirigible balloon as affording, for the present at least, the only solution of the problem. While Spencer, Santos-Dumont, and Lebaudy are navigating the air with a degree of certainty and security that compels one to an increasing belief in the possibilities of the balloon, Langley's aerodrome scorns its native element, and dives incontinently into the waters of the Potomac. As an offset to the failure of the aerodrome is to be recorded the successful flight of a motor-driven aeroplane built by the brothers Orville and Wilbur Wright—an event of supreme importance in the history of aeronautics, inasmuch as it is the first case of an aeroplane, carrying its own engine and an operator, making a trip over several miles of distance. The machine, which has a surface of 510 square feet and is driven by a 16-horsepower motor, is stated to have carried Mr. Wright for a distance of 3 miles against a 20-mile-an-hour wind at a speed of about 8 miles an hour—an actual speed of nearly 30 miles an hour through the air. This feat marks the commencement of an epoch in the history of the aeroplane; for now that an aeroplane has been built that can fly, the work of gathering experimental data will proceed with a rapidity which was impossible when aeroplane flight, at least on a full-sized scale, had never gone beyond the theoretical stage.

The event of the year in the development of the balloon airship, on the other hand, was the successful flight of the Lebaudy airship, when the two brothers traversed the 46 miles from Moisson to Paris in one hour and forty-one minutes, a speed of about twenty-two miles an hour. The significance of this performance lies in the fact that, though the wind was blowing diagonally across the course, the aeronauts had sufficient control of the machine to make the desired point. Comparing the aeroplane with the airship, the problem in the balloon type is to provide sufficient horse power to overcome the enormous atmospheric resistance due to the huge bulk of the balloon. In the aeroplane the chief problem is one of balance and control, and a great step will have been made toward successful flight when some method of control, semi-automatic in action, has been devised, by which a machine can at all times maintain itself in perfect balance, adjusting itself to the varying currents with something of the instinct of a bird on the wing.

CIVIL ENGINEERING.

In the field of civil engineering the most notable event of the year was the opening of the new East River Bridge at New York, which has the distinction of being the longest suspension bridge in the world, and the heaviest, and of providing a width and capacity of roadway which is so great that the structure stands in a class by itself. The next event of importance is the series of political changes at Panama, by which the last difficulties have been removed to the construction of a canal across the Isthmus. The inauguration of another great engineering work was assured by the overwhelming vote by which

the people of this State recently declared in favor of the construction of the enlarged Erie Canal. Of the great Croton dam, all that can be said for the year's progress is that the engineers have been engaged in carrying out important modifications which the Merchants' Association, with well-intentioned but misdirected zeal, is endeavoring to prove to be altogether unnecessary. The important Spier Falls dam and power plant has been carried practically to completion during the year, and the Wachusetts dam for the water supply of Boston, the largest reservoir of its kind in the world, with double the capacity of the new Croton dam, has made good progress. The close of the year finds the Pennsylvania Railroad Company's great project for a $50,000,000 system of tunnels and terminal station in this city advanced to the point where the bids for construction are in the company's hands; while the Rapid Transit Subway, in spite of serious delays, is so far ahead of the contract time, that the greater part of the road will be open for traffic early in the spring of this year. We venture to say that, in spite of the widespread attention that has been attracted to the Subway, the public, even in the city itself, have never quite appreciated what a splendid addition it will make to the transportation facilities of New York. In addition to a rapid and frequent local service, there will be a two-minute service, during rush hours, of eight-car express passenger trains, which will run at an average speed of between 30 and 40 miles an hour including stops, over tracks that will be as heavy and well-ballasted as those of any of our first-class steam railroads. It will be possible for business men to travel from City Hall to 42d Street in six minutes, and from the City Hall Park to the Harlem River in a little over a quarter of an hour. Toward the close of the year the Metropolitan Street Railway Company announced its intention, if it could get the necessary permission, of building two subway lines of its own, one beneath Second, and the other beneath Eighth Avenue in this city. The extension of the Subway to Brooklyn is making good progress, and the work bids fair to be finished within contract time. Other notable engineering works that can be merely mentioned are the Philadelphia filtration plant, the completion of the Buffalo harbor breakwater, the completion of the substructure of the Blackwell's Island Bridge, the important improvements of the Ohio River, the work upon the old Hudson River tunnel, one of the tubes being now driven to within a few hundred feet of the Manhattan shore, the successful prosecution of work on the great Simplon tunnel, 10½ miles out of the total of 14 being completed.

WIRELESS TELEGRAPHY.

The record of the year in wireless telegraphy looks barren in comparison with that of the two or three years that immediately preceded it. Experimentalists in this field have been rather finding out what they cannot do than what they can do. We refer to the widespread attention which has been given to the question of tuning or syntony—the development of some means by which the messages between any two or more stations may be receivable by those stations alone. As soon as the idea of utilizing wireless telegraphy for commercial purposes was suggested, it was recognized that some method of secrecy, some system of syntonic safeguard, must be devised before the public would leave the submarine cable for the aerial telegraph. It must be admitted that the most significant fact of the year is the complete way in which the various attempts at syntony have failed. Rival companies seem to have no difficulty whatever in completely disorganizing each others' service, and, indeed, it must be admitted that many of the antagonistic interests have devoted more time and money to destructive tactics than they have to the development of the art of wireless telegraphy itself. It is to be regretted that there is such a complete lack of harmony in the prosecution of this wonderful discovery. Many separate devices of great utility are receiving no practical application whatever, simply because of the unfortunate jealousy of rivals and the determination of each company to work out its own system from Alpha to Omega. An attempt was made during the year to supply news by wireless telegraphy from the United States to the London Times, and a few wireless telegrams were printed. The service, however, was soon discontinued for the alleged reason that important improvements were being carried out at the Marconi station. Among the new systems that have been made public is that of Lodge and Muirhead, who have produced a receiver which consists of a little steel disk which rotates on a globule of mercury that is covered with a fine film of oil. Another device is the Cooper Hewitt interrupter, an outcome of his well-known mercury vapor light experiments. Wireless telegraphy has taken its place as one of the useful inventions of the day. It has a recognized sphere in the merchant marine and the navy, where it has been doing some excellent work. That it will very seriously rival the submarine cable is unlikely, unless, indeed, some more robust apparatus can be devised and some reliable system of syntony developed.

THE AUTOMOBILE.

At the present stage of its development it is probable that the mere mention of the automobile suggests more than anything else to the popular mind the truly astonishing speeds with which it has been credited during the year. And yet the speed of the automobile is, or should be, of but secondary importance in making a review of the year's progress. The most encouraging feature just now is the fact that for the ordinary give-and-take of every-day travel on the roads at normal speeds, the automobile is showing great reliability, while the power of endurance developed under the more exacting conditions of travel is full of promise for the future. Another mark of progress is the great hold which the automobile is obtaining upon public favor. It is a repetition of the history of the bicycle. First prejudice, then toleration, and lastly unqualified approval. No one supposes, however, that the automobile is by any means such a perfected machine as the bicycle. There are several points upon which the attention of manufacturers is still centered in the endeavor to eradicate serious defects; and chief among these should be mentioned the speed gear, in which, on the majority of machines to-day, there is still room for decided improvement. Automobile racing and endurance runs continue to hold the popular interest. The most notable and certainly the most tragic event of its kind was the abortive Paris-Madrid race, which was called off at Bordeaux, because of the frightful fatalities and accidents to the contestants. The winning machine from Paris to Bordeaux maintained an average speed of 63.43 miles an hour, which is about the average speed of the celebrated Empire State Express in this country. Later, in the James Gordon Bennett International Cup Races in Ireland, where the conditions were less favorable to speed, the winner maintained an average rate of 56¼ miles an hour. The world's record for speed for a short distance was broken in Ireland soon after the cup race, in a series of trials in Phœnix Park, Dublin, when Baron de Forrest covered a kilometer at the speed of 86½ miles per hour. This is only 3½ miles per hour less than the highest officially-timed speed for a mile on steam railroads. Perhaps the most gratifying event in the annals of the American automobile during the year was the good behavior of American-built cars in the extraordinarily severe 800-mile contest from New York to Pittsburg, during the fall of the year. The weather was more or less unsatisfactory throughout the whole trip and was about as bad as could be conceived for two whole days. The extraordinary rainstorm of October 18 and 19, which caused a total precipitation of 10 inches, turned the roads into rivers of mud and water, through which the cars plowed as best they could, the majority of them making headway with considerable difficulty only by the continuous use of the low-speed gear. In spite of the severity of the contest, out of the thirty-four machines which started, twenty succeeded in reaching Pittsburg on the same day, and five more concluded the run, making a total of 73½ per cent of the contestants who succeeded in getting their cars through. No test of this severity has ever been made before, and the results bear encouraging testimony as to the good workmanship and design of the average American automobile of to-day.

NAVAL AND MILITARY.

The past year has not been in any sense a notable one in the development of naval and military material. We note the continued tendency to increase of size in battleships and cruisers, the latest designs for British battleships calling for a total displacement of 18,000 tons, although it is now rumored that the new ships are not to exceed the "King Edward" class in size, which means, if it be true, that their displacement will be about 16,500 tons. The largest ships in the United States navy are the five battleships of the "Connecticut" class, which will have a maximum displacement of 16,000 tons and a speed of 18 knots. These vessels will carry the heaviest armament of any battleship afloat. It will consist of four 12-inch, eight 8-inch, and twelve 7-inch, long-caliber, breech-loading rifles, and twenty 3-inch rapid-fire guns, besides thirty smaller automatic and machine guns. The particulars of the two 13,000-ton battleships have been determined upon. They are to be of 3,000 tons less displacement, and one knot less speed than the "Connecticut" class, and they will be armed with four 12-inch, eight 8-inch, eight 7-inch, twelve 3-inch, and twenty smaller guns. They will thus carry four less 7-inch guns and will have one knot less speed than the "Connecticut." But to our thinking they will have an important advantage in the fact that they will carry the submerged torpedo, the omission of which from the "Connecticut" class we cannot but regard as a very serious error of judgment. Our latest type of armored cruiser is represented by the splendid vessels of the "Tennessee" class. These ships will be 502 feet in length, and will have a speed of 22 knots an hour. They will carry the tremendous battery, for a cruiser, of four 10-inch and sixteen 6-inch guns, and a protection of 5 inches on the belt, 9 to 5 inches on the turrets, and 7 to 4 inches on the barbettes. They will thus have the offensive power of the battleship, and will belong to that intermediate class between battleship and armored cruisers which is becoming increasingly popular among the navies of the world. Naval and military ordnance still continues to give most excellent results, the new smokeless powder, in particular, showing satisfactory stability and the guns presenting but little signs of erosion, that *bete noir* of the modern artillerist. An event of considerable interest was the official test early in the year of the great 16-inch 130-ton coast-defense gun, which was built at the Watervliet Arsenal. A projectile weighing 2,400 pounds was fired with a muzzle velocity of 2,306 feet per second, and a muzzle energy of 88,000 foot-tons. The army smokeless powder, which contains about 25 per cent of nitroglycerine, showed no erratic action, even in the enormous charge of 640 pounds, which was used to obtain the velocity above mentioned. This gun is the heaviest and most powerful weapon ever built, the nearest to it in weight being the Armstrong guns of 16¼-inch bore, carried on the British battleships "Benbow" and "Sanspareil," which have shown a muzzle energy of between 54,000 and 55,000 foot-tons; while the next gun to our 16-inch gun in power is the Krupp 12-inch rifle, which with a velocity of 3,330 feet per second has a total energy of about 60,000 foot-tons. The tendency in ordnance is toward larger powder charges, greater length of bore, and higher velocities; and it is quite likely that the next pattern of navy gun will have a service velocity of 3,500 feet per second.

Our own experience with the submarine has not been such as to justify the great expectations which have been held in some quarters regarding the range of usefulness of this type of craft, and the opinion of our army and navy experts, based upon the submarines of the Holland type, is that there is every indication that the submarine will have a limited range of action, and will be confined chiefly to harbor defense. In any case, in its present stage of development its effect will be more of a moral than a practical character, and its work will be strictly defensive. The same opinion seems to prevail in the British service, where extensive maneuvers are being carried on with a few submarines of the Holland type, built by the Vickers-Maxim firm. On the other hand, French naval officers, who have had an extended experience with the submarine, speak in high terms both of its offensive and defensive qualities. Early in the year, the French government published the reports of the various French commanders who participated in the submarine boat maneuvers off Cherbourg; and there seems to be a consensus of opinion among them that it will be possible for the French submarines to leave their stations, and menace any hostile squadron that may be at moorings anywhere within the radius of action of the submarines; that watches on board ship will be of no avail, and that artillery fire will be ineffective. They consider that to insure absolute safety to a squadron anchored within the harbor, it will be necessary to protect the entrance by a system of electric wiring and contacts. But even the French do not speak with enthusiasm of the availability of the submarine for outside work on the high seas.

MISCELLANEOUS.

In drawing to the close of this necessarily brief review of the scientific and engineering events of the year, we cannot but realize how much has been passed by for want of greater space. We would fain speak in detail of the remarkable electro-chemical work being done at Niagara Falls in reducing nitrogen from the atmosphere and in combining new materials for use in the industrial arts; of the discovery of a process for the artificial production of camphor—a method which will, in a measure, render us independent of the Formosa camphor monopoly; of Cooper Hewitt's static converter (an outcome of his brilliant experiments with the mercury-vapor tubes), by which a small glass bulb will take the place of the bulky and expensive static converters, which form so costly an element in our system of electric power and light production and distribution; of the experiments made during the year in electrical canal haulage, which have been so successful as to render it likely that in the near future the trolley will take the place of the mule on the towpath; of that beautiful invention, the telegraphone; of Ruhmer's work in light telephony, and his successful attempt to talk across a beam of light for a distance of 4¼ miles. These achievements and many another that we have not chronicled, combine with the brilliant discoveries in the world of chemical physics with which we opened the present article, to render the year that has just drawn to a close one of the most fruitful in the history of the scientific world.

THE HYDROBION.

BY THE BELGIAN CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

The hydrobion is an apparatus which has recently been invented by Dr. N. von Lorenz, of Marienbrun, Austria, for the carriage of live fish, and which is based upon the injection of oxygen into the water of the tanks during transportation. Of the two accompanying illustrations, Fig. 1 represents the entire apparatus, with its oxygen-injecting devices. The oxygen-injector (Fig. 2) is placed at the bottom of the transportation tank filled with water and fishes. *A* is a steel cylinder containing compressed oxygen gas. When the cock which closes the cylinder, and which is seen in the figure in the form of a horizontal projection of a disk provided with apertures, is opened, the oxygen escapes from *A* through the reduction valve *B*, passes into the regulating valve *C*, and thence, through a rubber tube, into the oxygen distributor *D*. This latter consists of a diaphragm of inorganic material, say a porous cylinder having thick walls and a narrow axial bore. The oxygen finally becomes diffused in minute bubbles through the water containing the fish. These bubbles ascend very slowly through the liquid and become dissolved therein to an extent that depends upon their surface, their ascensional velocity, and the degree of gaseous saturation of the water. The non-utilized excess escapes. This solution of oxygen in water, which is obtained with a minimum consumption of gas, is what keeps the fish alive, and is constantly renewed in measure as it is consumed by the latter. In Fig. 1 is represented a complete arrangement for fish transportation. *A* is the tank; *B*, the oxygen apparatus; *C* and *D*, the grills with which the latter is covered in order to protect it against injury by the fish after it has been placed in the tank.

The practical manipulation of the hydrobion is so simple that it may be intrusted to any person of ordinary intelligence. The four constituent parts of the apparatus having been fixed immovably upon their base, all that has to be done is to turn on the cock, and take the apparatus by its two handles and place it at the bottom of the tank. It now begins to operate, and it only remains to fill the tank with water and put in the fish. It is necessary, of course, to regulate the discharge of the oxygen according to the number of fish contained in the tank, and according to the consumption of gas by the various kinds of fish. Finally, it is necessary also to proportion the capacity of the oxygen cylinder to the time consumed in the transportation. It is of the utmost importance, too, to take into calculation the strict minimum of water that the fish need during carriage, thanks to the hydrobion. The inventor has calculated all such data for most varieties of fish which in all likelihood may be transported alive, so that any one who employs the apparatus has only to follow the indications determined by the inventor once for all.

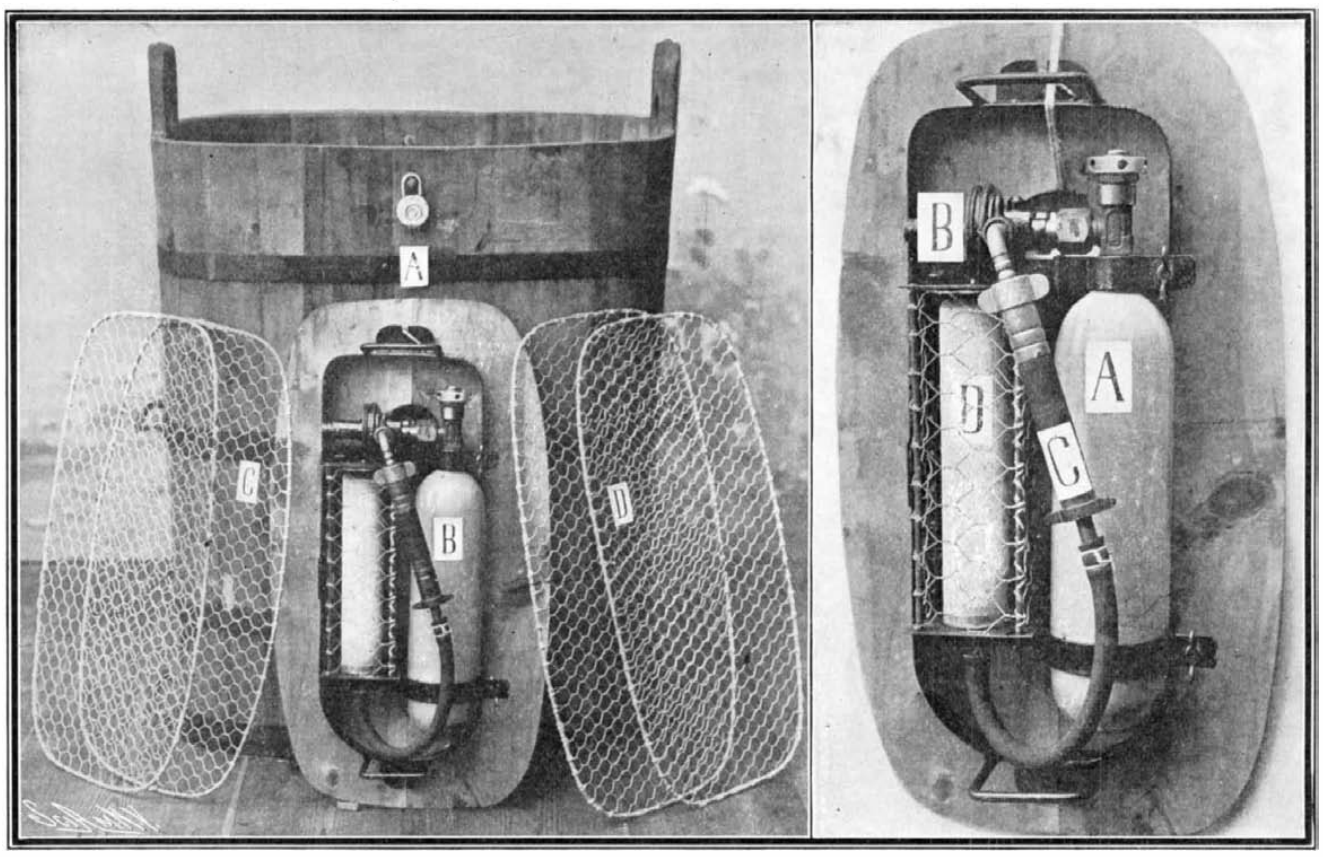


Fig. 1.

Fig. 2.

AN APPARATUS FOR THE TRANSPORTATION OF LIVE FISH.

The mines in Pennsylvania have already shipped this season over 12,000,000 tons more anthracite than the total shipments of 1902, and all indications favor total shipments this year of fully 60,000,000 tons, making an output far in excess of any previous year's record. This increase is due largely to the great strike, which cleaned up the supplies of anthracite all over the country.

THE ILLUMINATION OF THE EAST RIVER BRIDGE.

At about ten minutes before 8 o'clock on the evening of December 19, the shrill whistle of a police boat gave the signal for the general rejoicing at the opening of the new East River Bridge. One whistle after another from the myriad boats that swarmed on the river answered the signal. Every factory and building on the shore that had a siren blew out a mighty blast in answer. The roar grew louder and louder, and was maintained up to 8 o'clock. On both sides of the East River, the streets were crowded with sightseers, who had come to watch the fireworks. The great bridge had been outlined in electric lights. In the middle of the span was a giant American flag formed of red, white, and blue electric lights. Bombs and skyrockets, Roman candles, and all manner of streams of light shot up from the bridge. To the right of the great electric flag, which faded away in this brilliant illumination, there flared up a fine portrait of Andrew H. Green, the "Father of Greater New York." For about an hour there was a riot of fire and explosion and color, the like of which New York city, nor any other city of this country, had never before seen. The staff photographer of the SCIENTIFIC AMERICAN was enabled to take the accompanying picture at the very height of the illumination. An account of the construction of the bridge, from an engineering standpoint, will be found in the SCIENTIFIC AMERICAN and SCIENTIFIC AMERICAN SUPPLEMENT of December 19, 1903.

THE ILLUMINATION OF THE NEW EAST RIVER BRIDGE ON THE NIGHT OF ITS OPENING.

The Current Supplement.

The current SUPPLEMENT, No. 1461, opens with an article by W. Frank McClure on "Ice Harvesting," illustrated by four engravings, which clearly show the methods employed. Dr. Bissell presents an exhaustive account of the effect of lemon juice in lemonade upon typhoid polluted water. Lieut. John Halligan, Jr., concludes an excellent paper on the development of the submarine in the direction of increased scope. "In the Land of Opium" is the title of an article which presents an impartial account of the opium industry and of the effect of opium upon the human body. Prof. G. B. Howes writes on the morphological method and progress. Mr. Albert P. Sy presents a very exhaustive account of stability tests for nitrocellulose and nitrocellulose powders. The usual trade notes, electrical notes and consular information will be found in their accustomed places.

THE DURBAN FLOATING DOCK AND WORKSHOP.

BY THE LONDON CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

In the SCIENTIFIC AMERICAN of August 9, 1902, some account was given of the great floating docks of Bermuda and Algiers, while in the issue of July 11, 1903, the 6,000-ton dock for Barcelona was described. Photographs are now given of the 8,500-ton floating dock which has just left the yard of Messrs. Swan, Hunter & Wigham-Richardson, Ltd., of Wallsend-on-Tyne, England, for the port of Durban.

The former dock built by this firm—who also built the Bermuda dock, and who are building one of the new 25-knot Cunarders—went ashore some time ago in Mossel Bay on its way to Durban. Photos are also given of the new floating workshop for Durban, which was sent out on the floating dock.

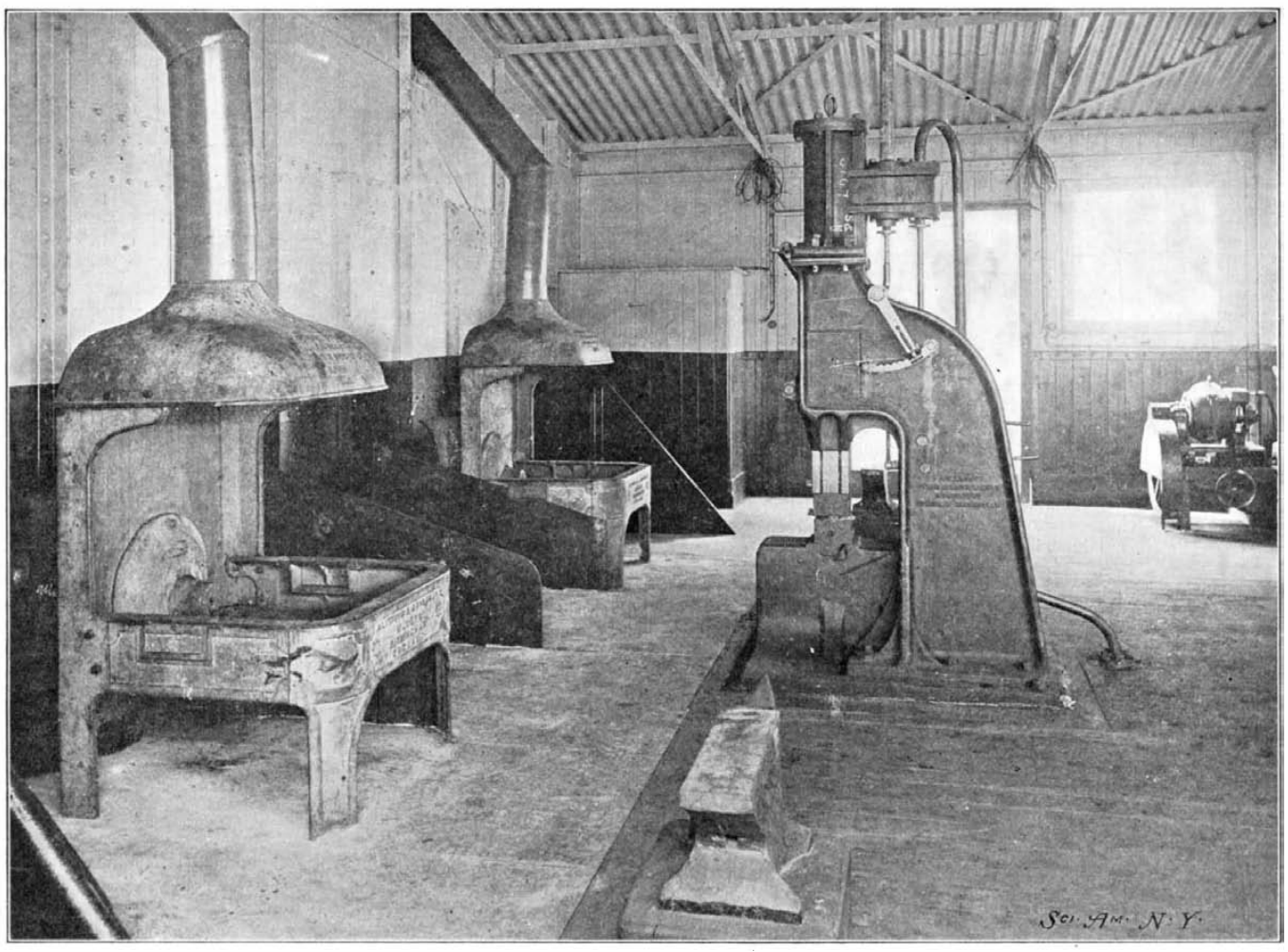
The new Durban dock is of the same type as that at his Majesty's dockyard at Bermuda, and also of the one that was built for the port of Durban last year. It has a lifting power of 8,500 tons. Its extreme length is 475 feet, and its width 96 feet 2 inches. The distance between the guard timbers on the side walls is 70 feet, so that the dock can accommodate vessels up to 68 feet beam, and while still retaining a freeboard of 4 feet 3 inches, it can take a vessel drawing 23 feet over keel blocks 4 feet high.

The dock proper consists of three pontoons and two side walls, to which the pontoons are connected by means of movable joints, so that any of the pontoons when required can be removed and lifted by the dock itself, thus making it self-docking in all its parts. The machinery is contained in the upper portion of the side walls, and consists of two separate but identical installations. Each installation comprises two boilers and two pumps, each pump driven by its own separate engine, and the piping arrangements of the dock are so arranged that either pump can empty the whole of the compartments on its side of the dock. In addition to this there is a communication through the central bulkhead across the dock, so that in case of any breakdown it would still be possible to lift the dock by the engines of one side alone. The boilers are of the ordinary return tube marine type 10 feet long by 9 feet 6 inches diameter, and were built by Messrs. Cochrane & Co., Ltd., Annan. The engines are of the horizontal compound type placed on their sides, and connected directly on to the vertical spindle of the centrifugal pumps which are placed right down at the bottom of the dock, directly on top of the main drain of the pumping system, the weight of the shafts and pump impellers being taken on ball bearings at the engine deck. These and the engines have been built by Messrs. Drysdale & Co., of Glasgow.

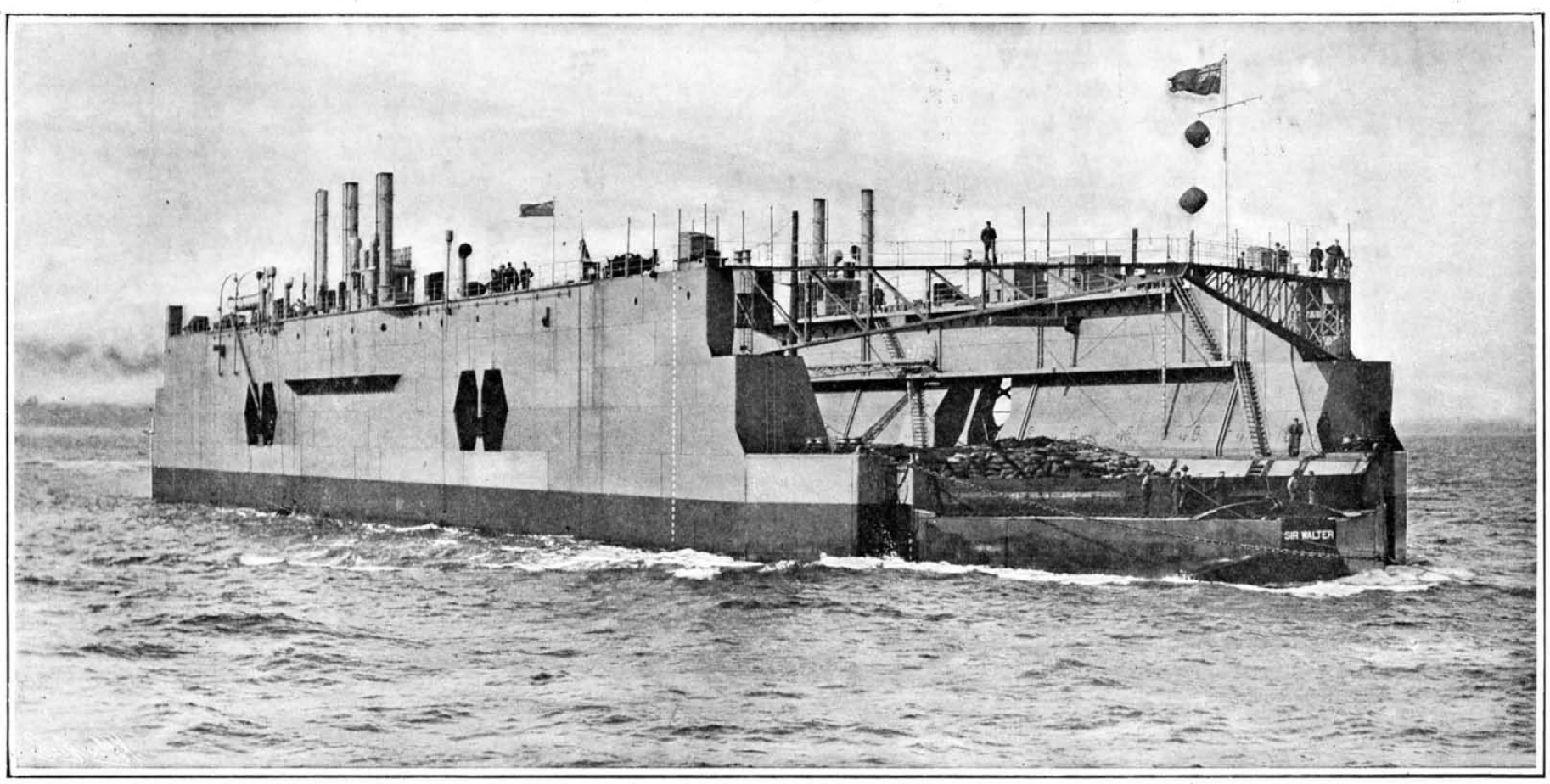
The dock is divided into forty-four watertight compartments, each of which has a separate pipe leading into it, each pipe being provided with its separate valve. All these distributing pipes are collected together into the main drain, on which the pumps are seated, and the discharge and inlets into this main drain are governed by large screw-down valves, and by automatic flap valves outside the dock. The different compartments are all worked by means of bell cranks and rods and levers from the valve house, which is placed centrally on each wall, from where direct communication can be made to the engines, and the inlet and outlet valves, so that the valveman standing in his house has complete control over the whole of his section of the dock. In addition to the main pumping service, there is a small direct-acting drainage service, which can be utilized as a washing-down service for cleaning the outside of vessels, or for filling up their tanks for testing purposes. The pumps for this service were made by Messrs. Lamont & Co., of Paisley. The valve-lifting gear, and the erection of the machinery generally, has been carried out by the Wallsend Slipway and Engineering Company, Ltd.

There are provided four mechanical side shores, worked by hand wheels from the top deck, by means of which a vessel can be centered on the dock; four steam warping winches, two on each wall, for hauling the vessel into the dock; and numerous bollards and timber heads on the walls to which the vessel can be made fast.

A very complete electric installation has been fitted, which will enable work to be carried out on ships both night and day. The installation, which is placed in one of the walls, consists of a marine type boiler by Clarke, Chapman & Co., and two steam dynamos, duplicates of each other. By means of a flexible cable the current is conveyed across the dock to the other wall, where it is connected to a switchboard from which the different services emanate. The lighting installation consists of three circuits—first, the standard 200-candlepower lamps along the top deck of the walls which light the dock generally; second, a series of clusters of lamps in reflectors with flexible leads, which can be carried to any portion of the dock or ship on the dock where light is required; and third, the ordinary incandescent lamps in the boiler, engine,



THE SMITHY OF THE FLOATING WORKSHOP.



THE NEW FLOATING DOCK ON ITS WAY TO DURBAN.

store rooms, etc. There is sufficient power to enable electric drills or other machines to be taken off from the plug boxes for carrying on work on the hulls of ships on the dock, for which purpose it is possible to utilize both the steam dynamos simultaneously, in which case steam could be taken from the main boilers, for both the main and auxiliary steam services are so connected together that either may be used to supplement the other. The whole of the electrical installation has been provided by Messrs. J. H. Holmes & Co., of Newcastle. The system used is the direct current at a tension of 110 volts, the electric cables being all contained in steel tubes to prevent injury, with the exception of the cable which crosses the dock, which is drawn into lead and suitably armored.

An account of the Durban floating workshop will shortly appear in the SCIENTIFIC AMERICAN SUPPLEMENT. It may be mentioned that the floating work shop itself has an extreme length of 129 feet 3 inches an extreme breadth inside the rubbing fenders of 40 feet, and a molded depth of 8 feet 4 inches. The ves sel is fitted with twin-screw, compound, surface-con densing engines of the following dimensions: Diameter of cylinders, 12 inches and 26 inches, stroke 15 inches The speed obtained on the measured mile was the mean of 7.12 knots, which was considerably in excess of what had been guaranteed by builders.

On the deck of the vessel, inclosed in a large house is placed the workshop machinery, which consists of a punching and shearing machine, a lathe, a steam hammer, and a drilling, shearing, and screwing machine, besides straightening blocks, a vise bench, an anvil, and the like. Electric motive power is used both for driving machinery and lighting the workshop. A cantilever crane capable of lifting 15 tons is mounted in the forecastle of the vessel. The shop will be used in conjunction with the floating dock. When the ves sel to be repaired is floated into position over the sub merged dock and then raised again, the floating work shop will steam into a favorable position, so that any repairs necessary can be executed with the greatest convenience and expedition. The combination of these two vessels constitutes a complete portable dockyard capable of dealing with all ordinary breakdowns and mishaps to ships.

Mount Rainier's Avalanche.

On December 15, the southeastern peak of Mount Rainier, sixty miles southeast of Tacoma, Wash., tum bled down the mountainside into the valley.

Mount Rainier was discovered by Vancouver in 1792 and was named for Rear Admiral Rainier, R. N. In recent years an attempt has been made to give it the name of Mount Tacoma, especially by the people of the city of that name.

Mount Rainier is nearly 15,000 feet high and is surmounted by three peaks, the highest of which has been known for twenty years as Columbia's Crest, and which stood on the southwest corner of the mountain's brow.

This peak contained a crater several hundred feet in diameter in which mountain climbers have usually spent the night on the mountain top. Sulphurous fumes and steam are always rising from this crater, keeping it free from snow the year round. Higher up, the peak was always covered with snow and ice. The mountain has a glacial system comprising fifteen distinct glaciers, several of them being on its southeast slope.

The earthquake was felt at several points through eastern Washington.

A Home-Made Spinthariscope.

Sir William Crookes invented the instrument which he calls a spinthariscope for the purpose of observing the small luminous particles which radium constantly emits. The spinthariscope is costly, which is the reason why it is used only by a few experimenters. Hugo Lieber, of New York city, has devised a similar instrument, which can be very easily made and which answers the purpose quite well.

Mr. Lieber explains how any one may make his own spinthariscope at a cost of about fifty cents.

"Cut a hole about one-quarter of an inch in diameter in a piece of cardboard," he explains in the New York Herald, "paste this cardboard on a glass plane such as is used in microscopic work. Place within the hole in the cardboard a little mixture of a non-luminous radium preparation with powdered willemite. Then put a little mucilage on the uncovered side of the cardboard and cover with another glass plane. When this is placed under a microscope the constant discharge of the radium corpuscles can be easily seen in a darkened room. A sufficient quantity of the mixture for the purpose can be obtained for $1 or less."

In regard to the characteristics of radium Mr. Lieber, who has studied it more thoroughly probably than any one else in this country, says:

"The light emitted by a tube of radium is a faint glow, simply a bright bluish white to a violet glow or fluorescence, and by no means sufficient to produce a photograph in a few seconds or minutes. To do this several hours, or even days, are necessary."

Mr. Lieber has presented two small tubes of radium to the Museum of Natural History and has supplied one of the hospitals with enough for medical experiments. It is being used in the treatment of cancer.

A Novel Wave Detector for Wireless Telegraphy.

Wave detectors so far used are based on one of the three following principles:

1. Modification of a passage resistance (coherer and anticoherer).

2. Heating effects, resulting in the employment of bolometer wires, whose resistances were altered.

3. Magnetical modifications.

Mr. Schloemilch, since the autumn of last year, has been engaged in experiments on the behavior of *polarization capacities* with regard to electric waves. In an apparatus introduced by the Gesellschaft für Drahtlose Telegraphie, the sensitiveness of polarization cells with regard to a radiation of electric waves is utilized on a practical scale for recording Morse signals. If an ordinary polarization cell with platinum or gold electrodes immersed in diluted acid, be connected to a source of current, the E.M.F. of which is little higher than the counter E.M.F. of the cell, so as to produce a slight film of gas on the electrodes, an ammeter connected to the circuit will give evidence of *an increase* of the current as soon as the cell is struck by electric waves. By decreasing the surface of the electrodes, the inventor has succeeded in strengthening this effect, obtaining excellent results as the positive electrodes were given a diameter of 0.001 millimeter and a length of not more than about 0.01 millimeter, whereas the negative electrodes, playing no important part, may assume any desired size and shape. A. G.

Preserve Your Papers.

By taking a little trouble, when a paper first comes to hand, it may be preserved to form a permanent and valuable addition to the reading matter with which all families and individuals should be supplied. We furnish a neat and attractive cloth board binder, which will be sent by mail, prepaid, for $1.50. It has good strong covers, on which the name SCIENTIFIC AMERICAN or SCIENTIFIC AMERICAN SUPPLEMENT is stamped in gold, and means by which the numbers may be securely held as in a bound book. One binder may thus be made serviceable for several years, and when the successive volumes, as they are completed, are bound in permanent form, the subscriber ultimately finds himself, for a moderate cost, in possession of a most valuable addition to any library, embracing a wide variety of scientific and general information, and timely and original illustrations. Save your papers.

The Wireless on Tugs.

So numerous have been the instances in coastwise navigation during the past year or two of the breaking away of barges from tows that one of the large towing companies has decided to equip one of its tugs with a wireless telegraph system. The first tug on which the apparatus will be installed is the "Savage," and two topmasts and the necessary rigging will be ready for the vessel when she next comes to this port.

With tugs having on board such equipment, it will be possible, in case of an accident at sea, to notify the agents of the fact and obtain assistance within a short time. In the recent gale on the coast when the steamer "Charles F. Mayer" lost barge "A," it is claimed that the barge could have been saved had the steamer been able to communicate with the shore.

Wireless stations are now so frequent along the shore that tugs will be within range of some one of them all the way from the capes of the Chesapeake to Boston.

In the museum at Copenhagen has been placed a Viking votive sun chariot discovered in a peat moor in the island of Seeland. The chariot is in the form of the sun, and is of bronze picked out with gold to give expression to the sun's rays. It rests on six wheels, or rather half-wheels, and is drawn by the horses of the sun. In its details, therefore, it preserves that form of the sun myth which is common to many nations and peoples, and which finds its eastern analogue, for example, in the legend of the fiery chariot that bore the Hebrew prophet from the sight of men. Its antiquity is fixed at about 3,000 years, dating from about 1,000 B.C., and of its nature as a sacred relic there is no doubt. It had evidently formed some part in the worship of the early Scandinavians, and it had probably had some sacrificial significance. It is thirteen and a half inches long by eight and a half inches wide, and therefore could easily have rested on even a small altar. A description of the relic will shortly be published in the SUPPLEMENT.

One firm of horse breeders at Columbus, O., will exhibit at the World's Fair a stable of 17 Percheron horses, valued at $60,000.

Correspondence.

The Earliest Modern Ship Canal.

To the Editor of the SCIENTIFIC AMERICAN:

The statement lately presented by the Department of Commerce respecting the ship canals of the world strangely ignores the earliest enterprise of this class—the Gloucester and Berkeley Ship Canal on the west coast of England.

This canal was opened for traffic in 1827. It extends from Sharpness Point, near Berkeley, the head of deep-water navigation of the Bristol Channel (estuary of the Severn River), to the city of Gloucester, a distance of seventeen miles. The canal traverses an alluvial district adjoining the east bank of the river; there are three locks, and the depth of water is 15 feet. The original cost was £500,000, but there has been large additional outlay within the last thirty years in extending the canal half a mile farther down the river, also in providing a commodious receiving basin, with extensive docks. Ocean vessels with cargo not exceeding 600 tons pass up the canal to their destination; ships of 2,500 tons are received in the outer basin for transfer of cargo to barges, etc. As the rise of tide at Sharpness Point exceeds 40 feet, the receiving basin can only be entered at or near high water.

As the Welland is included in the list of great ship canals, may not the same honor be claimed for the St. Lawrence navigation extending from a point near Ogdensburg to Montreal? Between these points there are six sections of canal, 45 miles in all, constructed by the government of Canada at a total cost of $76,000,000. The difference of level is 207 feet; this is surmounted by twenty-two locks, each 270 by 45 feet, with 14 feet depth on sill. These locks are used on the up trip only; downward-bound vessels run the rapids of the river. Lake steamers said to carry maximum cargo of 2,200 tons pass through the locks *en route* for the Welland Canal and the Upper Lakes. Ocean steamers occasionally make the through trip from European ports to Chicago, Duluth, etc.; but the great bulk of the through traffic is transshipped at Montreal and Quebec. In the past season 35,000,000 bushels of grain are said to have been sent through the St. Lawrence canals. C. BARTHOLOMEW.

Toronto, December 13, 1903.

Aurora Borealis.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of December 5 you editorially notice a paper read by C. H. Nordman before the French Academy of Sciences. The author infers that "the aurora borealis is a cathodical phenomenon occurring in the upper exhausted atmosphere."

In this connection it will be well to note the behavior of the aurora in Colorado. During the last twenty-five years it has been seen unmistakably only three times at or near Colorado Springs, at 6,000 feet above the sea. One hundred miles east of this place, at 3,000 feet altitude, it appears much more frequently. All over the higher parts of Colorado are plenty of youths fifteen years or more old who have never seen an aurora. How is this if the aurora is confined to the "upper exhausted atmosphere"? G. H. STONE.

Colorado Springs.

How Plants Climb.

It is in the twining plants, such as bryony and hop, and the tendril bearers, like the vetches, that we find the highest development of the climbing habit, says Knowledge. These plants live under unusual conditions. In order to gain the light they must seek rather than avoid overhanging foliage, and so we find the vetches, instead of turning away from the shadow toward the light, like most of their neighbors, boldly pushing up in the center of a bush, to burst into blossom amid its upper branches, far above their less daring neighbors.

But it is in the leaves of these plants that we find the most remarkable modifications adapting them to a climbing habit. The leaves of the vetches and vetchlings are pinnate—they bear a number of opposite ovate leaflets. The tip of the leafstalk and the uppermost pair of pinnæ are in the climbing species changed into tendrils—sensitive, twining, whip-like structures, which exhibit remarkable features. If the slightly curved, extended tendril of a young leaf of pea or vetch be watched carefully it will be found that it is slowly but incessantly moving round and round in a circle. If the tendril comes into contact with a twig it bends toward it and eventually takes several turns around it. Even a slight temporary irritation is sufficient to cause a bending toward any side.

Finally the tendril becomes woody and strong and forms a secure anchor cable for the plant. Not only does the young tendril rotate; the whole leaf on which it is borne is in continual motion. The shoot to which the leaf belongs is rotating also, so that the tendril is sweeping the air with a complicated motion, in the course of which it is almost sure to strike against some stem or twig of the surrounding vegetation.

THE HEAVENS IN JANUARY.

BY HENRY NORRIS RUSSELL, PH.D.

Though the bright planets which have added so much to the evening skies for the past few months are now disappearing early in the west, the winter heavens still present a spectacle of great magnificence. In identifying the constellations which we can now see, let us begin with Orion, which is nearly due south at 9 o'clock in the evening during the middle of the month. This splendid constellation is familiar to almost everyone, and need not be described here. The line of Orion's belt, continued downward and to the left, points to Sirius, which can be recognized by its great brightness, three times that of any other star that we ever see. Below it is the rest of Canis Major, with several bright second-magnitude stars that would be conspicuous if they were not so low.

Some distance to the left, and higher up, is Procyon the other dog-star, and farther on in the same direction is Gemini, with its twin stars Castor and Pollux.

A line from Betelgeuse—the bright red star in Orion—through Procyon, continued about half as far again, points out the head of Hydra, a small but fairly conspicuous group. Farther north and lower down is Regulus, at the end of the sickle of Leo. Cancer, which lies between Leo and Gemini, has nothing of interest except the star-cluster known as Praesepe, which is easily visible on a moonless night as a small patch of milky light, while separate components are disclosed by a field glass.

Directly below Orion, and level with Sirius, is the small constellation Lepus. Still lower is Columba, with one fairly bright star, which lies about as far from Sirius on one side as Procyon does on the other. The large region to the right of these groups is occupied by the inconspicuous constellation Eridanus.

Orion's belt, continued upward, points to Aldebaran, and beyond nearly to the Pleiades. Above these, and very nearly overhead, is Auriga, whose principal star, Capella, is the brightest, next to Sirius, that we can now see.

Aries is almost due west of the zenith, at an altitude of about 50 deg. south, and west of it is Cetus, which fills most of the southwestern sky.

The great square of Pegasus stands on one corner low down in the west, and the line of stars which extends from it through Andromeda and Perseus to Capella is nearly vertical. Cygnus is just setting in the northwest, but its brightest star is still visible.

Of the circumpolar constellations, Cassiopeia is high on the left of the pole, Cepheus lower down, Draco and Ursa Minor right below the pole, and Ursa Major coming up on the right.

One of the most interesting pieces of recent astronomical news comes from the Lick Observatory, and relates to the new stars that have attracted so much attention by their sudden appearance at various times in the past few years. Though these stars have all long since disappeared to the naked eye, the brighter ones are still telescopically visible, though very faint.

With the aid of the great Crossley reflector of the Lick Observatory, and a specially constructed spectrograph, a number of photographs of the spectra of these faint objects have been obtained by Mr. Perrine and others. In order to appreciate their results, let us recall some of the facts previously known concerning the spectra of new stars.

At maximum, and for some time after, these bodies show a remarkable and typical spectrum, crossed by both bright and dark lines, which are broadened and displaced in a way which, though not yet satisfactorily explained, seems to show that a large part of the star's light comes from gases in a condition of very violent disturbance. As the star fades, these lines, as well as the continuous spectrum upon which they lie, decrease in brightness, some of them vanish, and new lines appear, until finally, when the transformation is complete, the spectrum is exactly like that of a gaseous nebula.

This is as far as the changes had previously been followed, and it has been pretty generally supposed the new stars had actually turned into nebulæ. But the recent Lick photographs tell another story. As the star grows still fainter, the bright lines gradually become proportionately weaker, compared with the continuous spectrum, and at last disappear. This is well shown by comparing the spectra of new stars of different age since their outburst. Nova Geminorum, which blazed up last spring, has now fully developed the nebular type of spectrum. In Nova Persei, which appeared in 1901, the intensities of the nebular lines have much diminished, and one or two have disappeared.

Nova Aurigæ (1891) has lost many of its bright lines, a decided change having occurred since 1901. Finally, Nova Cygni (1876) has lost all its bright lines, and shows only a continuous spectrum, which is just what any ordinary star of the same brightness would do in the same instrument.

It seems therefore almost certain that these new stars have not permanently become nebulæ, but that they will finally settle down as ordinary stars, the nebular spectrum marking one stage in the process.

The most remarkable thing about this is the rapidity with which the changes take place. They seem to run their whole course, from invisibility, or extreme faintness, through great brightness to faintness again, in fifteen or twenty years at most. This is an excessively small fraction of the life of a star (which is probably many millions of years), so that the whole outburst is but a momentary episode in its history. It is quite conceivable that many stars that are now quite orderly members of the stellar system have had such affairs in their past; but we are getting into the region of speculation, and had better stop.

THE PLANETS.

Mercury is evening star until the 17th, when he passes through inferior conjunction and becomes a morning star. He is only visible during the first and last days of January, and even then with difficulty.

Venus is morning star in Scorpio and Sagittarius, and is still very bright, though she is so far south that she is less conspicuous than she was. On the 1st she rises at about 3:45 A. M., and on the 31st at about 4:30. On the 28th she is in conjunction with Uranus, being about 1¾ degrees north of him.

Mars is evening star in Capricornus and Aquarius, and can be seen shortly after sunset, as he does not set till about half-past seven.

Jupiter is evening star in Pisces. He is past quadrature, and is well down in the west by dark. He sets at about 9:30 P. M. on the 15th.

Saturn is evening star in Capricornus, and may still be seen during the first few days of the month, when he sets two hours after the sun. He is approaching conjunction with the sun, and soon disappears from view.

Uranus is morning star in Sagittarius, and is not favorably placed for observation.

Neptune, on the other hand, is well placed, being about a month past opposition. He is in Gemini, his exact place on the 14th being R. A. 6h. 17m. 30s., Dec. 22 deg. 18 min. 22 sec. north. He can be found with an equatorial telescope, but does not repay the search very well, as no detail can be seen on his disk, even with the largest telescopes.

THE MOON.

Full moon occurs at 1 A. M. on the 3d, last quarter at 4 P. M. on the 9th, new moon at 11 A. M. on the 17th, and first quarter at 3 P. M. on the 28th.

The moon is nearest us on the 4th, and farthest off on the 19th. She is in conjunction with Neptune on the 2d, Venus on the 13th, Uranus on the 15th, Mercury on the 17th, Saturn on the 18th, Mars on the 20th, Jupiter on the 22d, and Neptune again on the 29th. The conjunction with Jupiter is the closest, but even then the moon and planet are nearly two degrees apart.

Cambridge Observatory.

Radium and Its Mysteries.

BY SIR WILLIAM RAMSAY.

The story of the discovery of radium is full of interest, and my readers may pardon me even if it is again told; for it forms the first chapter in a volume of which many have still to be written.

M. Henri Becquerel, prompted by a hint from the celebrated mathematician, M. Poincaré, discovered that the compounds of uranium, a somewhat rare metal, as well as the metal itself, were capable of impressing a photographic plate wrapped up in black paper, or otherwise protected from light. It was also found that such salts, placed near a charged electroscope, discharged it, the gold leaves falling together. An electroscope, it may be explained, is a metal box with glass sides; through a hole in the lid a wire passes. The stopper which closes the hole and supports the wire is made of sulphur, or sealing wax, or some other material which does not conduct electricity. From the end of the wire are suspended two pieces of gold leaf, hanging down so as to be visible through the glass sides of the box.

If a piece of sealing wax is rubbed, so as to excite it electrically, and if the projecting end of the wire is touched with the rubbed sealing wax, a small charge of electricity is given to the wire, and through it to the gold leaves, so that they repel each other, and fly apart, making a figure like an inverted V. If the wire be touched with the finger the electric charge is conducted away through the body, and the leaves swing back into their original position.

This effect of discharging was found to be produced when a salt or mineral containing uranium was placed inside the box. Mme. Curie, a Polish lady, living in Paris, noticed that the rate at which the gold leaves fell together was more rapid with certain uranium minerals (specimens of pitchblende) than could be accounted for by the uranium oxide in the mineral; she therefore separated the mineral into its groups of constituents—uranium, iron, lead, barium, bismuth, etc. (for the mineral contains all these and many other elements), and tested each group as to its power of discharge. At first she thought that she had traced the discharging power to the bismuth group, and attributed it to an element which she named "polonium," after her native country.

This discovery has been disproved, but it appears that the amount of polonium obtainable is exceedingly small, and difficult to separate from bismuth. Subsequently Mme. Curie discovered another element of the barium group, possessing enormous powers of discharge, and to this element, which occurs in relatively greater amount, she gave the name "radium."

It is an undoubted element in the sense in which that term is generally used; its salts resemble closely those of barium, and its spectrum has been observed by M. Demarçay, Prof. Runge, and Sir William Crookes. Its atomic weight has been determined by Mme. Curie as 225; the atomic weight of uranium is the highest known—240; and there is some evidence from its spectrum that radium may have even a higher atomic weight—over 250—and that the sample analyzed by Mme. Curie may not have been quite free from barium, of which the atomic weight is only 137.

While these researches were in progress M. Curie and Dr. Schmidt discovered simultaneously that another element, thorium, of which the atomic weight is 232, also possesses the power of discharging an electroscope, and, moreover, that if air be led over salts of thorium, the air acquires and retains for a short time discharging power.

FURTHER DISCOVERIES.

The subject was taken up by Prof. Rutherford, of Montreal, and by Mr. Frederic Soddy, who then worked in his laboratory; and they found that if the "active" air were cooled by passing it through a tube cooled with liquid air it lost its "activity," the active portion remaining in the cold tube. On warming the tube the active portion was carried forward, and with it the discharging power. They also found that a similar "emanation," or gas, was evolved from salts of radium, possessing a much more permanent discharging power. While the "emanation" from thorium salts "decayed" in a few minutes, that from radium salts lasted a month. It, too, was condensible when cooled; it was luminous, and imparted temporary luminosity to objects which it touched ("excited activity").

The fact that a radium salt is always hotter than its surroundings, discovered by the Curies, implies that radium is continually losing energy; and if the radium salt be dissolved in water some of this energy is expended in decomposing a portion of the water into oxygen and hydrogen gases. Prof. Rutherford and H. T. Barnes have recently shown that "more than two-thirds of the heating effect is not due to the radium at all, but to the radio-active emanation which it produces from itself." In November, 1902, Messrs. Rutherford and Soddy concluded from their experiments on the emanations from radium and thorium that they are "inert gases, analogous in nature to the members of the argon family," and also they threw out the surmise, "whether the presence of helium in minerals and its invariable association with uranium and thorium may not be connected with the radio-activity."

Now, I had the good fortune to discover helium in 1895; it is one of the argon gases, and is contained in certain minerals, and when Mr. Soddy came to work with me in the early summer of 1903 we tested the truth of this surmise, and we were rewarded by success. The fresh emanation from radium does not show the spectrum of helium, but as it "decays," helium is produced in minute but ever-increasing quantity.

We can help ourselves by an analogy. Very complicated compounds of carbon and hydrogen can be produced; one containing 30 atoms of carbon and 62 atoms of hydrogen is known. But one of, say, 200 atoms of carbon and 402 of hydrogen would almost certainly fall to bits; it would split up and give out heat. The supposition appears reasonable that just as there is a limit to the possible number of atoms in such compounds (for the molecules or groups of atoms fall apart by their own weight), so there may be a limit to the atomic weight of an element.

Those elements with high atomic weight, such as thorium, uranium, and radium, are apparently decomposing into elements with low atomic weight; in doing so they give off heat, and also possess the curious property of radio-activity. What these elements are is unknown, except in one case; one of the products of the decomposition of the emanation from radium is helium.

Can the process be reversed? No one knows. But as gold is an element of high atomic weight, it may be confidently stated that if it is changing, it is much more likely that it is being converted into silver and copper than it is being formed from them. At this stage, however, speculation is futile. It is certain that further experiment will lead to more positive knowledge of the nature of the elements and of the transformations which at least some of them are undergoing.—London Mail.

AN ALBINO DEER.

An albino deer, with a coat as white as the drifting snows, eyes a delicate pink, and with a tread as soft and discreet as an elk fawn, was killed in the Canyon Mountains of southern Oregon recently. It was one of the very few albino deer ever seen in the mountains of the West. Old hunters tell of seeing them, usually separate from the main herds, and at various times during the early days; but they were too shy and discreet to be approached near enough for a shot.

The deer shown in the accompanying illustration, and which was killed in the Canyon Mountains, was with four other deer at the time it was found, and had not this been true, the hunters would not have taken it for a deer. Its white coat made it far more conspicuous than the remainder of the herd, and it is perhaps for this reason only albino deer are shunned by their mates.

The albino deer bears exactly the same relation to the deer family that the albino of the African race does to human kind. Aside from its white coat and pink eyes, it is like all other deer; possibly its fur is softer and more silky.

The specimen found in the pine forests of the Canyon Mountains will be made a part of the exhibit of albino mammals at the Smithsonian Institution.

METEORITES AND THEIR COLLECTORS.

BY PROF. CHARLES F. HOLDER.

The collecting meteorites is one of the most interesting fads or professions in the country. The men who are engaged in it are, in the main, expert mineralogists, who have made it a study all their lives and are devoted to it; men who can tell the location and circumstance of every fall known to science. That the business is a profitable one is well known, and large sums are often realized by the fortunate discoverers. Nearly all the meteorites are sold to the great museums of the country, while those which are too large to move are represented by sections, sawed off only after great difficulty and labor.

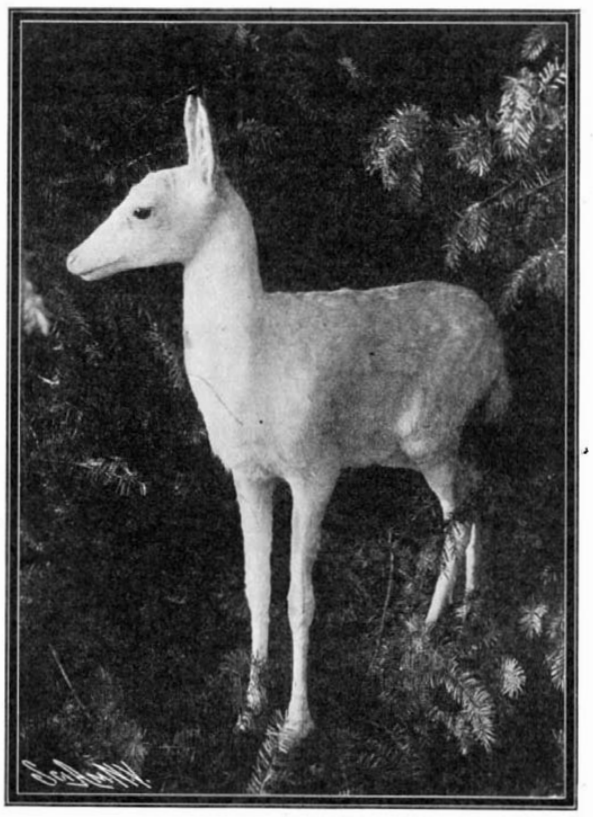
There is something fascinating about these wanderers from the sky. One may say that he has seen his specimen as a part of Biela's comet, or possibly Tempel's, millions of miles away, revolving about the sun in a sort of endless chain, and as the earth dashed through the mass of cometary matter, his specimen came plunging upon it, igniting under the enormous friction, exploding perhaps, or glancing to fall in many pieces, one of which he has secured. In the far East meteorites are still looked upon as messengers from the sky, and a volume could be written giving the theories of earnest scientists who have attempted to satisfactorily explain them and their origin.

Hardly a clear night but the observer will be repaid by a glimpse of one or more of these splendid wanderers from the unknown. Few of these meteorites reach the earth; the larger portion ignite upon entering the atmosphere, and fall as dust, which may be secured on high mountains, or in localities away from the dust of the earth. Large specimens which fail to burn, reach the earth and become buried in the soil, lying until accidentally found.

Several large meteorites have been seen to strike in Southern California during the last few years, but careful search has failed to locate them. One rancher, who lived thirty miles from the ocean, was positive that a meteor struck on his ranch "just beyond his house," but others saw it pass over the ocean fifty miles beyond. A famous meteorite was traced from Idaho far out on the Atlantic, its roar and the loud rumbling which accompanied it alarming all the inhabitants along the route.

To one who has not attempted to follow a meteorite, it might seem an easy matter to trace it. The papers generally announce the fall, and after weeks of pursuit the hunter determines the locality according to the report of the last man who witnessed the fall. He invariably states that it is on his own farm, and doubtless believes it, when in reality the spot is ten or more miles distant.

Many of the notable falls of history ave been discovered accidentally, as pse in Arizona near the Cañon Diablo the great Mexican stone found by a Mexican er in the first instance. One of the latest finds is n in the accompanying photograph by Mr. R. of Oregon City, to whom I am indebted for the garding it. The meteorite has undoubtedly g in the earth a long time, and was found t in Clackamas County, Oregon, near Oregon City, by Mr. William Dale. He observed it projecting from a mass of gravel when clearing the land of trees, and after great difficulty had it taken to his farm, about a mile distant. The stone, a huge hat-shaped object, was found in the deep forest, and was excavated only after a vast amount of labor, as its estimated weight is between ten and fifteen thousand



AN ALBINO DEER.

pounds. It was jacked up inch by inch, and finally placed upon a rude cart, as shown, and hauled with blocks and tackle down to the farm, where it has been visited by thousands.

According to Mr. Prier, it has been examined by Prof. Paul Baumel, of Portland, Oregon, an expert, who pronounces it the largest meteorite ever found in this section of the country; but as to when it fell, there is no data.

During the month of November a large meteorite flashed across the San Gabriel Valley, leaving an enormous train, and it is supposed to have dropped into the range known as the Santa Monica Mountains in Los Angeles County; but no one has been able to locate it. The writer observed a meteorite enter our atmosphere, perhaps one hundred miles up, almost directly over the city of Pasadena, Cal. It at first fell almost directly down with an enormous and brilliant train, then broke or exploded, and seemed to glance and disappeared in the west almost parallel to the earth, still with a flaming train, doubtless

A HUGE METEORITE RECENTLY FOUND IN OREGON.

disappearing in the Pacific thirty miles distant. When this meteorite broke, it created so brilliant a light that one could have told the time by it. The piece possibly flew at first in the form of a horseshoe, as a large fiery V remained plainly visible for at least ten minutes.

The theory that the heat of the sun is kept up by meteorites falling into the sun mass, was held for many years; and anyone who witnessed the recent sunspots can realize how this theory might appeal to some. In early October, 1903, the writer was on the Gulf of Mexico between New Orleans and Tortugas, and the sun dropped into a deep-red cloud at the horizon, and at once became plainly visible. It was blood-red and covered with latitudinal bands of varying tints. What was supposed to be a cloud was first noticed on the left-hand lower face, but it was disappearing or dropping with it. It resembled a great vivid black hole broken into the sun by some object that had fallen into it, or been swallowed up, being probably distorted, appearing to be an eighth the size of the sun, a distinct and formidable object. Sunspots suggested themselves to the writer's mind, though never having heard of a spot so large as this, so black and pronounced, and it was considered a singular cloud after all, yet it sank out of sight with the sun. When the papers were received from the pilot at the mouth of the Mississippi, they chronicled the wonderful sunspots that were being seen, and the writer realized that an exceptional opportunity had offered to witness this phenomenon under most favorable circumstances, with the spot enlarged in all probability by the cloud mass into which the sun sank.

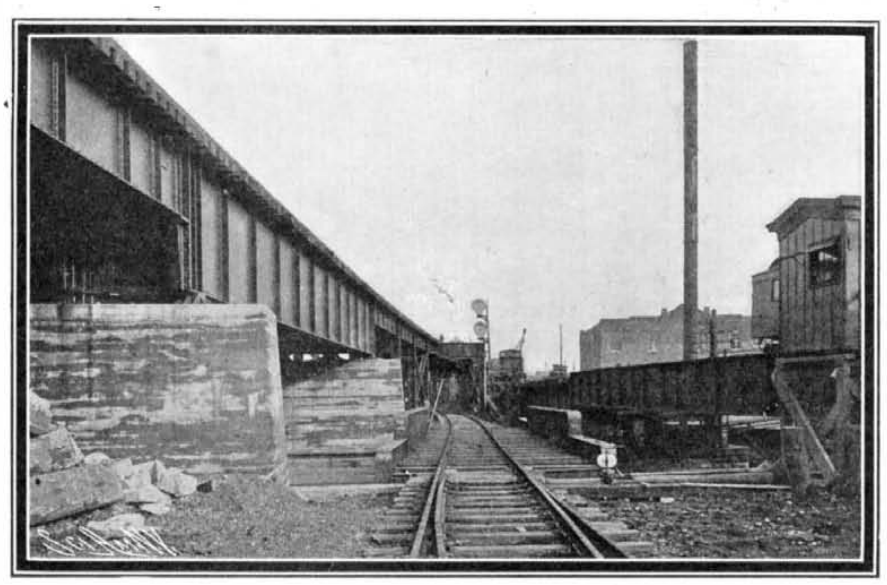
RECONSTRUCTION OF THE LACKAWANNA TRACKS THROUGH NEWARK.

By the successful transfer, on Sunday, December 20, of a massive double-deck drawbridge from its old to its new pivot pier, the engineers of the Lackawanna Railroad brought to a successful completion one of the most important links in the change of grade and general reconstruction of the line which is being carried out from Harrison through Newark to East Orange, a distance of three miles. Hitherto these tracks have remained in the same location on which the line was originally laid down. The tracks ran through the city at street grade, and after crossing the Passaic the road climbed the hill to the west of the river on the heavy grade of 138 feet per mile, or considerably over two per cent. The growing density of the street traffic of Newark, with the attendant danger to vehicles and pedestrians of the many grade crossings, to say nothing of the great cost and inconvenience of operation entailed by the heavy grade referred to, were some of the causes which led the railroad company to decide upon the present improvements, which, by the way, will have cost three and a half million dollars by the time they are completed. These improvements include the elevation or depression of the tracks so as to give unobstructed traffic through city streets; the reduction of the maximum grade from 138 feet to 60 feet per mile; the provision of an additional third track for passenger traffic; and the construction of a new passenger station and a new local freight yard, containing a freight shed nearly 500 feet in length.

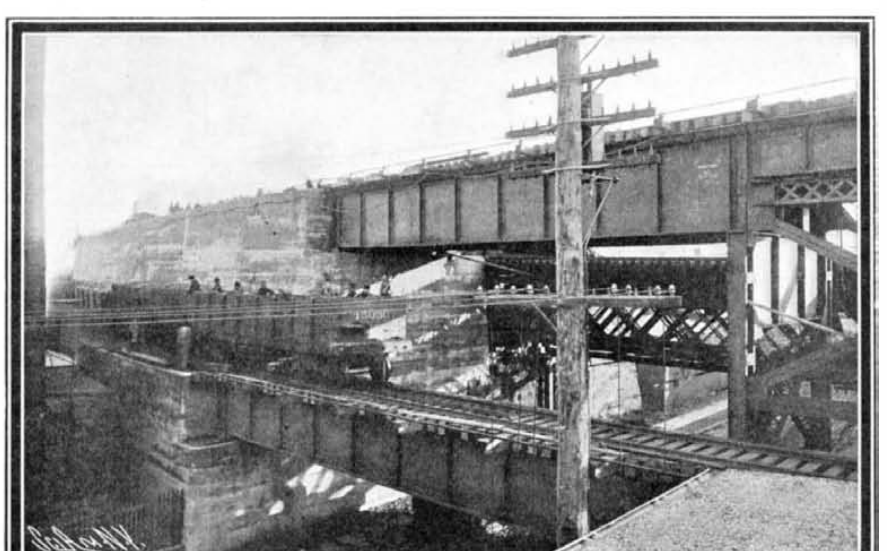
Of the whole three miles covered by the new work, one-half—or to be exact 1.6 miles—extending from Harrison to High Street, Newark, consists of the elevation of the tracks above street grade. At High Street the road strikes the hillside and here the tracks are depressed and carried below street grade, the work extending for a distance of 1.4 miles. The Montclair branch of the road is also depressed for a distance of 6-10 of a mile. The new tracks commence to rise at Harrison on a maximum grade of 1 per cent to an average elevation above street grade through Harrison of 15 feet, and through Newark of 22 feet. The average depression of the tracks beyond High Street, Newark, is 22 feet below street grade. From Harrison to Broad Street, Newark, the line contains two passenger tracks, and from Broad Street to East Orange, just over the city line, there has been added during the reconstruction a third passenger track. Adjoining the passenger tracks there is a freight track, which follows the same grade as the passenger tracks as far as Harrison Avenue and then falls on a one per cent grade to the level of the lower deck of the draw span across the Passaic River. The old location of this bridge was 35 feet to the north of its present position and 10.5 feet below its present grade. The new double-deck drawspan was built several years ago, and although only the lower deck had been used during the intervening time, it was constructed with an upper deck, to be put in service when work of reconstruction should have reached its present stage. Under the old arrangement, the passenger trains utilized the lower deck. By lowering the bridge 10½ feet at the same time that it was shifted to its new pier, the upper deck was brought to exactly the same grade as the new elevated passenger tracks and at the same time the lower deck was brought into

Old approaches and old draw pier in foreground.

Double-Decked Draw-Span, Moved from Old to New Pier on Sunday, December 20.



Looking East Along Freight Track Showing Passenger Structure at Higher Elevation on Left.



Street Crossing in Harrison, Showing Freight and Passenger Tracks at Separate Levels.

Stretch of Arched Concrete Construction at Freight Yard.

General View of New Passenger Station Showing Old Tracks in Foreground and the New Tracks Elevated.

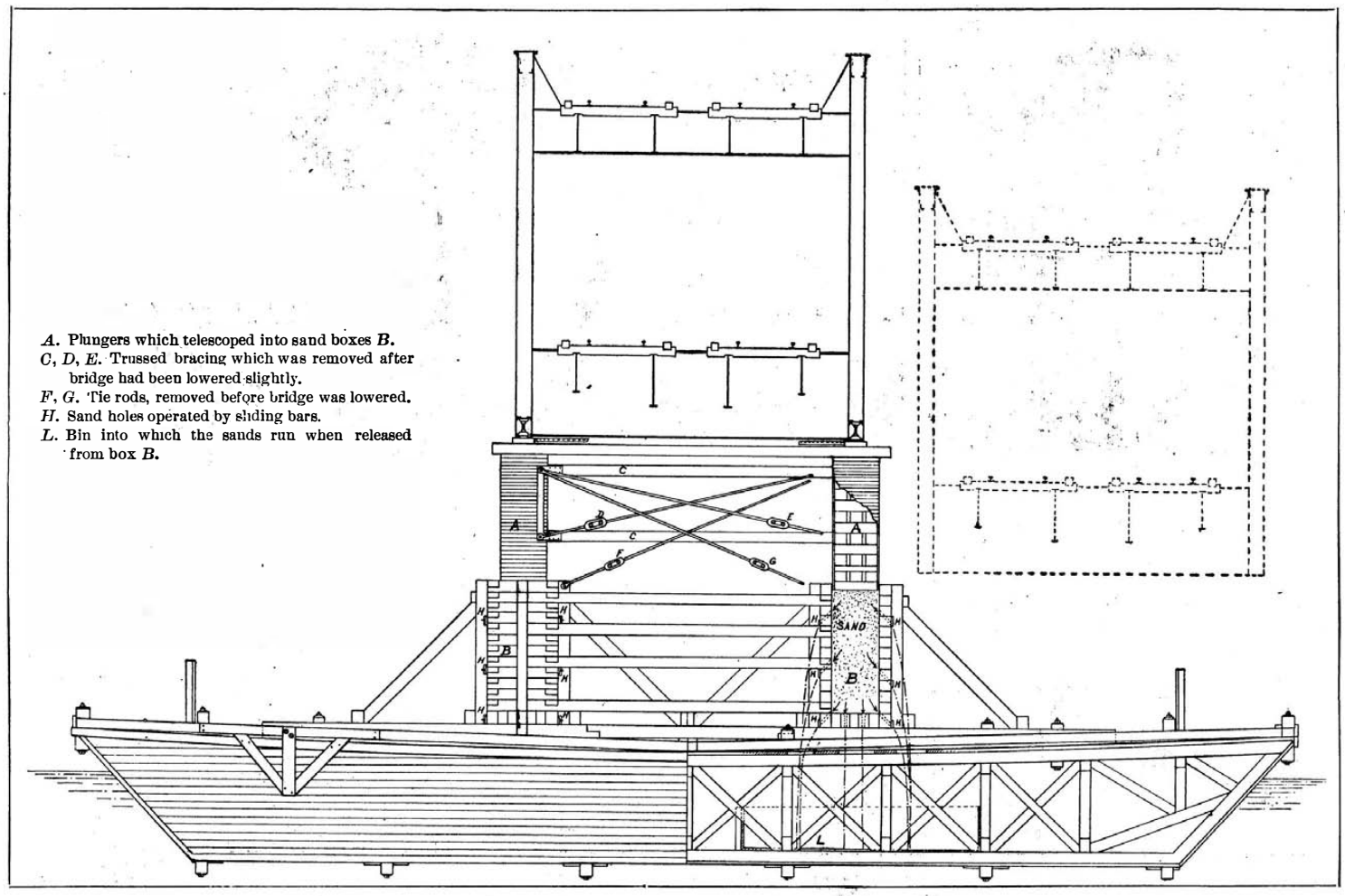
RECONSTRUCTION OF THE LACKAWANNA RAILROAD TRACKS THROUGH NEWARK.

similar relation to the new freight track. As traffic is now being carried on, the passenger trains cross the Passaic River at the higher level, while the freight trains, which, as we have seen, run parallel to the passenger tracks from Harrison to the river, now swing in underneath the passenger tracks, cross the Passaic on the lower deck, and run at street grade into the terminal freight yard.

The roadbed from Harrison to the Passaic River consists of embankment, with plate girder spans across the street, resting on concrete abutments. The fill terminates on the eastern side of Passaic Avenue, and here some interesting steel truss work is necessitated in swinging the freight track in underneath the passenger tracks for the crossing of the river, the distance of about 300 feet between the end of the fill and the easterly rest pier of the draw span being spanned by several double-deck steel trusses of special design and construction. The draw span has a total length of 221 feet, a breadth from center to center of trusses of 29 feet 3 inches, and a depth from center to center of chords of 21 feet 3 inches. Its total weight is 985 tons. After crossing the bridge the tracks are carried on a steel truss followed by a series of plate-steel girders and lattice posts, resting on a heavy concrete retaining wall. This construction extends to Ogden Street, which is crossed by a plate girder which is followed by a steel viaduct that extends to Spring Street. Here commences a long stretch of concrete arches measuring over 500 feet in length, adjoining which, with its north wall resting upon the southerly edge of the viaduct, is the new freight house.

The concrete arch viaduct terminates at Broad Street, which is crossed by a 106-foot plate girder span, and a smaller span carries the track across Plane Street. Just beyond Plane Street is the new passenger station—a handsome new building of stone and brick, whose architectural features show to good advantage in the accompanying photograph. It is a three-storied structure, containing ground floor, mezzanine, and upper floor. Entrance is on the ground floor, the ticket offices are on the mezzanine, and the third floor, which is on the level of the tracks, contains the waiting rooms and platforms. Beyond Plane Street there reaches for 685 feet a stretch of roadway, consisting of a fill supported by massive concrete retaining walls with their outer faces approximately vertical. The average height of the retaining walls is about 25 feet above the ground level. The easterly end of the retaining wall fill terminates at the slope of the hill, and here the tracks enter an open cut with concrete retaining walls, the average depth of the depression being 20 feet and the average grade 1.14 per cent.

Of the whole work as thus described, the elevated section is practically completed, while the depressed portion is well under way. The cost of the work, as we have stated, is about $3,500,000. The reconstruction of the line, however, is not concerned with the city of Newark. An important elevation and depression of the tracks is being carried on simultaneously at Summit, where twenty grade crossings will be eliminated. Furthermore, the work at Newark and Summit does not cover the whole scheme of improvements, since it is the intention of the Lackawanna company to eliminate all grade crossings between Harrison and Morristown, a distance of 30 miles; and as this scheme involves the change of grade either to elevated structure or subway through eight different towns, the magnitude of the work will be readily appreciated.



SCOW AND SAND JACKS, DESIGNED FOR TRANSFER OF DRAWSPAN AND LOWERING ON NEW PIER

Transfer of the Draw Span.—We have already pointed out that the transfer of the draw span involved moving the structure 35 feet laterally to the new pier and lowering it through a distance of 10½ feet. This was accomplished by transferring the span to four pontoons; warping the pontoons 35 feet upstream and lowering the draw span until it rested upon its bearings on the new pier. Regarded as an engineering feat, there is nothing new in such a transfer; but owing to the uncertain tidal conditions, the great depth through which the bridge had to be lowered, and the necessity for very precise centering of the span, new conditions existed which called for particular care and exactitude. The chief problem, of course, was to provide a means of lowering the draw span accurately and safely through so great a distance, and the chief engineer, Mr. Lincoln Bush, who is responsible for the work, decided that it would be difficult and risky to make use of hydraulic jacks for a vertical drop of this extent. In the first place there was the possibility of an unequal action of the jacks, and there was the disadvantage that with hydraulic jacks it would be impossible to make the fine lateral adjustments that would be necessary in placing the draw exactly to center. The whole of the weight of the draw rests upon a center bearing which is placed concentrically within a circular rack. The pinion by which the draw is rotated being attached rigidly to the structure of the draw, it will be understood that if the pinion was to mesh accurately with the rack, the draw had to be located with great precision in the center of the rack. Now, in order to cover the two points desired, namely, easy control in lowering and a certain degree of lateral adjustment in the final placing on the pier, Mr. Bush designed and used an entirely new apparatus which he defines as a sand jack. The construction and operation of this was as follows: Transversely beneath each half of the draw were a pair of scows, each 31½ feet wide, by 108 feet long, and 9 feet 6 inches deep. Transversely across the scows was built up a pair of oblong sand boxes, one beneath each truss of the bridge. These boxes, which were constructed of 12 x 12 timbers, measured 4 feet 1 inch in the clear in breadth, 54 feet in length, and 11 feet in depth. The boxes were filled with perfectly dry sand to within a few inches of the top. Resting upon the surface of the sand in each box was a plunger built up of 12 x 12 timbers, whose external dimensions were such as to allow it to descend into the sand box as the sand ran out, with a clearance all round of half an inch. These plungers were 11 feet high, and at the commencement of the operations, their bottom face rested upon the sand just 7 inches below the top edge of the boxes. The latter were provided with four horizontal lines of sand holes in the sides, each hole being 2 inches in diameter. The flow of the sand out of the holes was regulated by means of wooden slides on the outside of the boxes with holes in them to correspond with those in the box. There were also two lines of 2-inch holes bored in the bottom of the boxes. To prevent racking or swaying of the structure, the two plungers were braced together by means of timber struts and iron tie-rods. In carrying out the transfer of the span, the pontoons, partially submerged with water ballast, were floated beneath the bridge, the centrifugal pumps were started, discharging the water ballast, and the span was lifted from its bearings. It was then warped upstream and centered over the new pier; and then, by opening the sand holes and allowing the sand to flow out, the span was brought down speedily and with great accuracy until it rested upon its new bearings, the work being carried through without any hitch, and this in spite of the fact that a heavy rain storm came on and lasted throughout the whole of the operation. If the water had entered the boxes of course it would have packed the sand and prevented its flow through the sand holes; but provision for this contingency had been made by covering the sand boxes with tarpaulins. A certain amount of water, however, did get into one box, but its presence was quickly detected, and the temporary packing of the sand was easily remedied by the proper manipulation of the sand holes. The announcement that the draw span was to

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A LONG-HAIRED HORSE.

See next page.

be lowered by these very original methods attracted widespread attention in the engineering world; and it is gratifying to the railroad company, and particularly to the chief engineer, to know that in spite of predictions of trouble, the work was carried through with accuracy and dispatch.

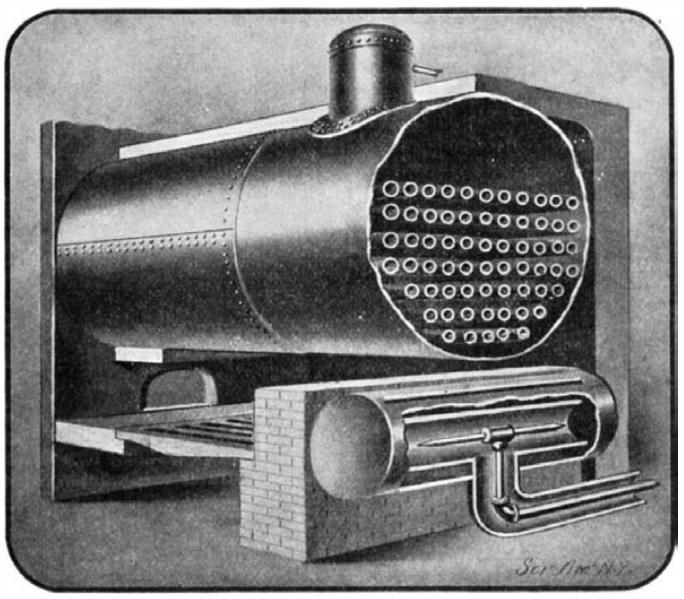
SMOKE CONSUMER.

An improved smoke consumer has recently been invented, which is especially adapted to be applied to boiler furnaces. The device is arranged to supply air and steam to the escaping products of combustion, so that the carbon in the smoke will be consumed, and a more perfect combustion of the gases will be effected. The smoke consumer is situated at the rear of the usual bridge wall of the furnace, where it is partially protected from the heat of the furnace fire. The current of air and steam is discharged from the device in the direction of the current of smoke and gases, so as to obtain an intimate commingling of the two currents, and also cause increased draft through the grate. The smoke consumer consists of a cylinder or shell provided at the top and slightly to the rear with a slot for the discharge of the air and steam. Concentrically arranged within this cylinder is a tube in which the air and steam are combined preparatory to passing into the outer cylinder. The combining tube incloses a steam injector pipe which is furnished at each end with a nozzle. These nozzles are arranged to discharge jets of steam through each end of the combining tube. A pipe entering the lower part of the furnace wall passes up through the center of the combining tube, and supplies it with fresh air. The steam supply pipe enters the smoke consumer through the air supply pipe, and conducts steam from the steam drum of the boiler. The air and steam are thoroughly commingled in the combining tube, and uniformly distributed into the end portions of the outer cylinder, where this commingled current is heated before being discharged into the escaping products of combustion.

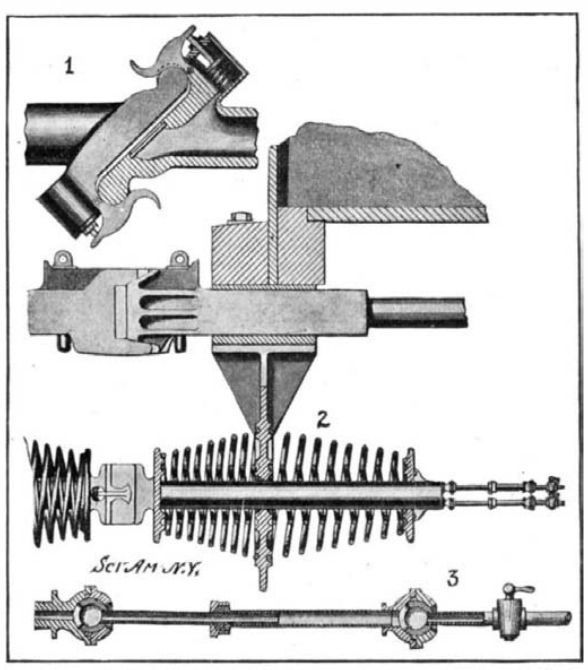
This same device may be advantageously used on steamships for ventilating the holds by drawing out the foul or impure atmosphere. A patent for this device has been granted to Annie K. Wilkins, of 520 Sheridan Avenue, Pittsburg, Pa., as administratrix of the inventor, Henry Wilkins, deceased.

METALLIC PIPE COUPLING.

The ordinary flexible hose connection for line pipes of a train often burst under the pressure of air or steam, and to obviate such dangers Mr. Harry B. Schrader, of Alliance, Neb., has invented a flexible metallic coupling of simple and inexpensive construction. The coupling embodies means for utilizing the air or steam pressure to cause a tight connection between the coupling members. As shown in Fig. 1 of our illustration, the coupling comprises two heads arranged on a transverse incline with each other. Each head is attached to a stem or drawbar having two ports opening through the head, one port being for the passage of the air through the brakes and the other for signaling purposes. Pivotally connected to each coupling head is a locking latch designed to engage with the other coupling head, as clearly shown in our illustration. The latch is provided with a curved or cam-shaped end, designed to be engaged by the approaching coupling head, thus swinging the latch to open position and permitting the heads to come together. The latch is normally held in closed position by connection with a piston, which is acted upon by a coiled spring. The cylinder in which this piston operates is connected by a small port with the main port of the coupling, so that when air pressure is admitted to the coupling, a portion will enter the cylinder, forcing the piston outward and causing the latch to tightly clamp the coupling together. The drawhead of the coupling passes through an abutment ring depending from the car. Between this and a collar on the stem are two coil springs, and similarly two springs are coiled between the abutment ring and the collar on the opposite end of the stem. A telescoping pipe section connects each port with its respective train pipe. The sections have ball-and-socket connections with the stem of the coupling, which permit perfect freedom of motion to the drawbar.



SMOKE CONSUMER FOR BOILER FURNACES.



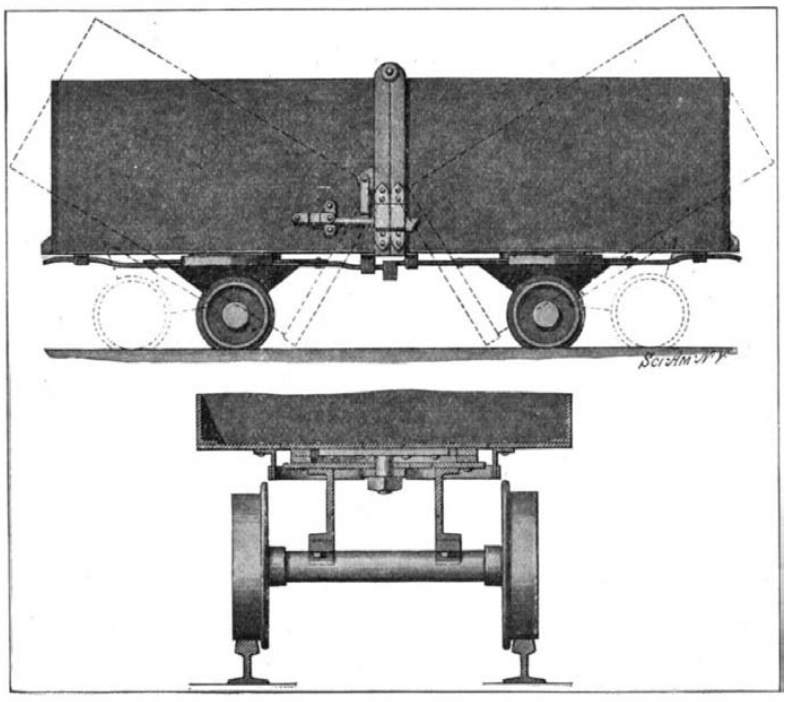
METALLIC LINE-PIPE COUPLING.

A LONG-MANED HORSE.

A marvelously-maned mare, whose wealth of silver-gray hair reaches a length of eighteen feet, and surpasses anything of the kind ever heard of in equine history, is owned by George O. Zillgitt, of Inglewood, Cal., who purchased her seven years ago, when she was three years old. At that time her mane was of ordinary length, and it was not until a year later that it began to grow with unusual rapidity. For a number of years this horse was used on the Zillgitt farm in North Dakota. During that time the mane was kept in a net, and was seldom taken down oftener than once a year. The heavy plow collar rubbed against and injured the back part of the mane, but the upper part still remains, and trails out in gorgeous waves of silver when unbound from the braids that are so necessary to keep it from getting tangled. No one has been able to account for this superfluity of hair. The animal has not been given special care. She has been treated quite like an ordinary horse, and the extraordinary growth is simply the result of some strange prank of nature. A month ago Mr. Zillgitt took the horse to California, where she is being used in the family carriage. She is the mother of a colt that seems destined to be even more famous than her parent. Though only a few months old, this colt possesses both mane and tail that reach to the ground.

IMPROVED DUMPING CAR.

A patent has recently been issued on an improved dumping car of the type used in mines for transporting ore from one point to another. The improvements relate especially to the running gear, which is so designed as to facilitate turning curves, and also to the operating devices whereby the car may be readily dumped. As indicated in our illustration the car is made in two sections, each supported by a single truck. These sections are hinged together at the top and are normally maintained in alinement and in horizontal position by a latch at each side. The trucks, which are pivoted to their respective sections, are connected by draw-bars. The connection is such as to permit a limited swiveling movement of the trucks. Normally, however, the trucks are held in alinement by flat springs bearing against the drawbars at each side. When it is desired to dump the cars the bolts or latches at the sides are released and the car section tipped downward to the dotted position shown. As the car sections are hinged at the top they must move apart when tipped, thus permitting the load to be freely discharged. The car sections are not centrally mounted upon the trucks, but their outer portions overbalance the inner portions, so that after their load has been discharged they will swing up to horizontal position, which position they will normally retain even without the aid of bolts or locks. The inventor of this dumping car is Mr. Edward I. Morey, care of G. E. Collins, 217 Boston Building, Denver, Col.



IMPROVED DUMPING CAR.

The Jungner-Edison Accumulator.

M. U. Schoop, in a recent number of the Elektrotechnische Zeitschrift, records the results of a comparative study of the familiar lead accumulator and Edison's alkali accumulator. The Swedish chemist, Dr. Jungner, simultaneously with Edison, patented a galvanic combination, based on the fact that nickel oxide fixed in a suitable way on a support constitutes an available depolarizer. Whereas for purposes of transportation, the present lead accumulator presents many drawbacks, the first of which is its heavy weight, stationary lead accumulators, in connection with which both the weight and the space play but a secondary rôle, have arrived at so high a degree of perfection that no other type of storage battery is required for stationary use.

The parallel between the lead and alkali accumulators, though not complete, goes to show that nickel sheets or steel sheets plated with nickel in alkali solution, when exposed to the effect of currents, will not be altered in the least even after weeks, corrosive effects being, as is not the case with the lead peroxide plate, never observed. The author, however, thinks it possible that the active masses present in perforated pockets in the form of compressed powders devoid, it appears, of the adhesive properties of lead salts, would drop from their supports in course of time. The author thinks a diminution in capacity would be avoided by heating the electrodes. The alkali cell would finally be inserted into an automatic charging and discharging device, allowing 200 to 300 discharges and charges being made during one month. As regards the life of lead accumulators, even in the best of accumulators the positive lead support is gradually destroyed by oxidation, the negative mass diminishing progressively in capacity; the need of durability is therefore absolutely in disaccord with the demand for a small weight. On the other hand, it is inferred from the tables recording the experiments of the author that the alkali storage battery, besides some evident advantages, presents serious drawbacks. The author, however, thinks this type of accumulator to be capable of further development.

A. G.

Building Locomotives in Germany from American Models.

The Bavarian government has decided to construct a large number of new locomotives upon the models of the American locomotives introduced by the railways of Bavaria nearly four years ago. During the next two years forty locomotives of Class B, eighteen of Class C, and twelve of Class D are to be replaced by seventy new locomotives, and 5,000,000 marks ($1,190,000) are to be expended for this purpose. The two locomotive factories in Munich, the large establishment of Maffei, as well as that of Kraus, are to be favored in the distribution of these contracts.

American locomotive builders should not lose this opportunity to secure renewed orders in Germany, since their locomotives have become the type for those about to be introduced and have proven, after due trial, the most approved models.

RECENTLY PATENTED INVENTIONS.

Apparatus for Special Purposes.

SMOKE AND FUME CONDENSER.—F. A. PASCOE, Salt Lake City, Utah. The invention is an improvement in fume arresters, being in the nature of a smoke and fume condenser especially designed for use on smelters, by which to avoid the injury to vegetation and other matter by the discharge of smoke and fumes from the smelter, as well as to effect a saving of gold, silver, sulphur, arsenic, and other elements usually carried up the smelter-flues and lost to the smelters.

Engineering Improvements.

BALANCED SLIDE-VALVE.—G. L. WACKEROW, Mellette, S. D. In this patent the invention has reference to side-valves in general. While more or less novelty resides in the minor details of this invention, its chief feature is the peculiarly improved exhausting means specially intended for balanced slide-valves, but adapted to any similar type of valve.

DUPLEX STEAM-PUMP.—F. WEISE, Halle-on-the-Salle, Germany. The objects of this improvement are, first, to place the ports in the slide-valve seat for the steam distribution of the two cylinders in one and the same center line at right angles to the axis of the cylinders; second, to lengthen the slide-valve seat in the longitudinal direction of the cylinders; and, third, to provide two long rectangular slide-valves with inclined distributing-ribs moving side by side for controlling the steam-distribution.

METHOD OF FLOWING LIQUIDS FROM WELLS.—T. F. MORAN, De Young, Pa., and F. J. MOSER, Kane, Pa. The invention relates to a method for raising liquids from wells, and more particularly to raising oil and water from exceedingly deep wells in which the liquid naturally elevates but slightly, if any, higher than the level at which it enters the well, thus affording but little submergence to the mechanism used in carrying out the method.

WATER-TUBE BOILER.—H. LAWSON, Jersey City, N. J. The main purpose in this case is to provide means for securing an improved circulation of water and the products of combustion. The water circulates through two nests of tubes and a series of drums or shells in a way to be heated in one nest of tubes by the escaping products of combustion; but the other nest of tubes form a heating-surface which arches the grate-chamber, so as to expose the nest of tubes to the intense heat, and rapidly generate steam from the previously-heated water supplied by the first-named nest of tubes.

EXPLOSIVE-ENGINE.—W. HIBBARD, C. HIBBARD and S. HIBBARD, Sandyhill, N. Y. The invention refers to two-cycle explosive-engines; and the object of the inventors is to provide improvements in explosive-engines whereby the explosive mixture drives a charge of fresh air into the working cylinder to scour or clean it of all products of combustion left by a former explosion, at the same time extinguishing any possible flame which may be contained in the working chamber.

ENGINE-VALVE MECHANISM.—R. L. DUTCHER, Stites, Idaho. In this invention a slide-valve is used in connection with a reversing-valve, so as to shift the general path of the stream and thus render the engine convertible for use as a double engine, a compound engine, etc. The slide-valve is an improvement upon the well-known Giddings valve, and allows both the fresh and exhaust steam to divide and pass through a number of concentric channels.

Heating and Lighting.

GAS-CONSUMER.—T. V. ELLIOTT, Columbia, Pa. Mr. Elliott's invention is an improvement in gas-consuming furnaces, and particularly in steam boiler furnaces, and has for an object to provide a novel construction whereby the gases escaping from the furnace may be returned directly to the fire and be consumed, thereby avoiding the loss of the gas, and economizing the heat units secured in the operation of the furnace.

GLOBE OR MANTLE PROTECTOR.—J. L. CAVANAUGH, Canton, Ohio. Mr. Cavanaugh's invention relates to improvements in protectors for lamp globes or chimneys and incandescent mantles, an object being to provide a device for this purpose which will be simple and inexpensive in construction and by means of which a chimney, globe, or mantle when the lamp is not in use will be fully protected from dust and dirt.

Household Utilities.

CONVERTIBLE CHAIR AND COUCH.—F. S. BOWN, 229 Pearl Street, New York, N. Y. In this case the invention has reference to a chair and couch in which provision is made for changing the positions of the several parts, so that the structure may be used as an easy or reclining chair or as a couch on which a person may recline, the several adjustments being secured without disconnecting either of the several components of the structure.

GUIDE AND REGULATING DEVICE FOR EGG-CUTTERS.—G. J. HASLAM, Fremont, Neb. The purpose of the inventor is to provide a device adapted to be placed by hand over an egg when in an egg-cup, the device being so constructed that it defines the extent to which the end portions shall be severed from the body of the egg and provides a guard to receive the cutting implement after the cutting is completed. The guard prevents the stroke accidentally injuring the operator, while the entire body of the device serves as a guide for the cutting implement during the operation.

WAFFLE-IRON.—Q. CRANE, San Diego, Cal. In carrying out the present invention one of Mr. Crane's main objects is to provide a baking iron or utensil which will effect a great saving of fuel and labor and one which will occupy but comparatively little space, while at the same time it will embody the essential and desirable features of cleanliness, convenience, and simplicity.

Machines and Mechanical Devices.

DRILLING-MACHINE.—W. A. KAGELMACHER, JR., Johnstown, Pa. The invention consists of a peculiar machine of that character involving novel and improved details of construction for drilling holes in shafting-rods and other places without removing the work from its fixed position. More definitely stated, the invention involves peculiar and novel means for securing the machine and drilling holes regardless of the angle of position thereof.

GAGE-BOARD ATTACHMENT FOR SAWING-MACHINES.—J. T. MARSH, Farmer City, Ill. The present invention relates to an improved attachment for the tables or tops of sawing machines for the purpose of supporting lumber at different angles to the saw. A portion of this invention is shown and described in an application previously allowed Mr. Marsh. The improvement is embodied in means whereby a gage-board is adapted to be adjusted and supported at the various angles required.

SUCTION DEVICE FOR PULP-MACHINES.—J. L. YOUNGS, Chateaugay, N. Y. An interior suction-chamber is provided in this device, entering which from one end of the device is a pipe, which may lead to a pump or the like. By mounting the suction device, so that the upper surface of an apron will come beneath the traveling felt, by which the wet pulp is carried, the superfluous wet may be rapidly withdrawn from such pulp on producing a suction in the chamber through the pipe. Felt and pulp are not drawn into the suction-chamber, no matter how powerful the suction.

ROTARY CUTTER.—C. T. HEADLEY, Brunswick, Ga. In this instance the invention is an improvement in wood-working machines of the class provided with rotary heads having cutters adapted to form grooves or slots for various purposes. It is more particularly an attachment for such rotary heads, the same comprising a bracket and a series of grooving cutters, which are applied and secured to the bracket in an improved manner.

FEED-FINGER FOR SAW-SHARPENERS.—J. E. MCCAULEY and W. C. RENIE, Hoquiam, Wash. The object of the inventors in this case is to so arrange the tooth-engaging head of the finger that it will engage a tooth at its point or swaged portion and thus feed the saw the proper distance to cause the grinding-wheel to first strike a tooth at the point, and by its downward movement remove all projections and make an even surface.

Of Interest to Farmers.

CORN HARVESTER AND HUSKER.—O. O. GILBERTSON, Kasson, Minn. This apparatus is designed to cut the stalks of corn in the field, to pull the ears of corn from the stalks, and remove the husks from the ears by its simple passage across the field. It conducts these operations in a continuous way, and presses down and rolls the stub ends of the cut stalks to a level surface with the ground to facilitate subsequent cultivation of the ground. The construction enables the machine to turn in the smallest possible space.

THRESHING-MACHINE FEEDER.—I. S. WOOD, JR., Elberfeld, Ind. In this instance the invention has for an object the provision of a feeder so arranged as to feed evenly from the top of the bundles. With an automatic feeding mechanism embodying this improvement the grain, as above mentioned, will be evenly fed in layers to the threshing-cylinder, and therefore there will be but very little, if any, jar to the machinery, as is the case when whole bundles are fed to the cylinder.

BINDER ATTACHMENT.—W. UMBECK, Cape Girardeau, Mo. It is commonly found in the operation of self-binders for grain that the thin grain falls on the platform-canvas in a tangled condition and stops at the elevator. The invention seeks to overcome this objection; and it consists in means for permitting the movement of the platform to be stopped at will, thus allowing the grain to pile up on the platform-canvas sufficiently to force it through the binder.

COMBINED CORN AND POTATO PLANTER.—D. J. SIGFRIDSON, Isanti, Minn. The purpose of the invention is to furnish an agricultural implement adapted for planting large and small seed, especially potatoes and corn, the dropping mechanism being operated either through the medium of the check-row chain or wire or from the axle of the machine, according to whether the seed is to be planted in hills or in drills.

INSECT-DESTROYING MACHINE.—M. C. KELLEY and W. P. TERRELL, Conroe, Texas. The invention is in the nature of a construction and arrangement of machine for removing insects from plants and absolutely destroying them by fire without injury to the plants. It is applicable to and intended to be used for destroying insects on all sorts and sizes of plants, but is especially designed for the destruction of the boll-weevil of the cotton-plant.

SHOCKER ATTACHMENT FOR GRAIN-BINDERS.—C. J. DOWLING, Detroit, Kan. The structure and organization of the invention are such that the attachment may be readily applied to any ordinary binder. As the sheaves are discharged from the binder-deck they are thrown into a shocking-basket arranged to turn and swing and connected with suitable mechanism for manually or automatically operating it, so that when a proper number of sheaves is accumulated the basket may be thrown into open position and the sheaves stood upright, closely nested together in the form of a shock.

Pertaining to Vehicles.

BUGGY-TOP SUPPORT.—W. H. TULLY, Wilbur, Wash. In this patent the invention has reference to attachments for vehicle-top props which are provided with a spring-support for the bows of a vehicle-top when the top is lowered and folded, whereby the top is adapted to ride in safety on rough or uneven roads.

ATTACHMENT FOR LOG-CARS OR ROAD-WAGONS.—T. D. TOY, Cherryvale, Kan. Mr. Toy's invention is embodied in improved means or devices for holding logs or other timber on railway-cars or road-wagons, which devices may be quickly released, leaving the logs free to be unloaded. When the load has been completed the means provided effectually prevent disengagement while the load is in transit.

Railways and Their Accessories.

RAILROAD-TIE AND ANTISPREADING DEVICE.—F. D. BLINE, Vanatta, Ohio. The tie is composed of an inverted channel, the open bottom of which is closed by a base-plate. The tie may be filled with concrete if desired. The antispreading device consists of a plate bent over the tie and hooked under the edges of the base plate. Flanges on this plate are bent back over the flanges of the rail. Wedge plates are slipped in between the rail and the antispreading device.

NOISELESS CROSSING.—P. J. LASSEN, New York, N. Y. The crossing invented by Mr. Lassen will allow cars to pass the same without noise or shock. The inventor claims in a railway-crossing the combination of a plurality of rails intersecting each other, each rail being provided with a thread-surface and with a groove parallel with the thread-surface, the groove having a bottom integral with the rail and raised at points where the rails intersect.

DEVICE FOR DELIVERING ARTICLES TO MOVING TRAINS.—A. L. IRVIN, Meadville, Pa. The device is designed to be employed for holding and delivering articles, messages, documents, parcels, and packages, and any small articles in general to moving vehicles or trains. The inventor provides a holder which shall securely retain such parcels and which may be extended in a manner to be received or taken by the engineer, conductor, or other official while the train is in motion.

Miscellaneous.

BAKE-OVEN.—H. J. WADE, Pocatello, Idaho. It is the object of this invention to improve the construction of bake-ovens whereby heat is applied more directly and effectively and fuel thereby economized, also whereby the cost of construction is materially reduced. The improvement includes apparatus for the economical heating of water for the production of steam in the baking-chamber.

ADJUSTABLE SOLDERING-BLOCK.—A. R. WEBSTER, Milford, N. H. The purpose in this case is to provide details of construction for a device which afford a soldering-block that embodies readily adjustable clamping means for the support of separated portions of eyeglass or spectacle frames to be soldered for their connection, the improvement being also available for reliably supporting separated portions of articles of jewelry that are to be united with solder.

COMBINED CALENDAR AND PEN-RACK.—T. VON DER LÜHE and W. H. BARTHOLOMEW, New York, N. Y. One of the principal objects of the invention is to provide a calendar-stand which may be folded or collapsed for distributing or mailing the same; but when in its operative position the parts will be so correlated and combined that the stand will be provided with a relatively wide base portion, so that the possibility of the stand containing the pen-rack being upset will be reduced to a minimum.

COMBINATION MUFFLER AND CHEST-PROTECTOR.—L. E. SCHOCH and E. J. SCHAFER, Chicago, Ill. In this instance the object is to provide a muffler and chest-protector which is neat and attractive, easily applied or removed, and arranged to afford considerable warmth and special protection to the neck, throat, and chest of the wearer from the inclemency of the weather. The garment being knitted it is sufficiently elastic to readily conform to the body.

COMBINED REIN HOLDER AND GUIDE.—J. I. STAMPER, Meade, Kan. The main feature of novelty residing in Mr. Stamper's guide is the two spaced rollers. They should be spaced apart, adapted to permit [illegible]y of a rein and at the same time support it in flat condition with both sides removed from rubbing contact with the guide. The elongated eyes at the free ends of the frame members simply adapt the guide for use with spread straps. The free ends of the frame members may be bent and perforated, adapting the guide for direct connection to the hames by a suitable securing-bolt.

QUILL-TIP FINISH.—J. J. ROBINSON, New York, N. Y. In this patent the invention relates to improvements in finishing devices for the quills of feathers or plumes employed in the trimming of women's headware, and the object being to provide a device for this purpose that will not only hide the quill from sight, but will have a neat, attractive appearance.

CURTAIN-EXHIBITOR.—D. J. HAVILAND and C. S. SICKLESTEEL, Boulder, Col. One object of the invention the inventors have in view is the provision of a construction by which a series of two or more curtains may be suspended in a way to overcome strain thereon and tearing thereof and to allow the curtains to be adjusted individually, to the end that a portion of each of a series of curtains may be displayed to view and comparison of different patterns of curtains may be made to good advantage by a customer.

GARMENT-FASTENER.—M. F. EISNER, New York, N. Y. This invention has reference to improvements in garment-fasteners, particularly fasteners for the fronts of corsets, and the object is to provide a fastener by means of which the fronts of a garment may be quickly drawn together and secured with very little exertion on the part of the wearer.

SUSPENSORY BANDAGE.—E. R. DRAKE, De Land, Fla. The inventor's claim in this instance is: The combination, with the body-band and the scrotal bag having a ring attached, of the leg-band composed of a central part formed of two elastic tapes sewed together and sliding in the ring, and two inelastic end portions which are connected with the body-band.

SHOE-LACING ATTACHMENT.—A. A. DE LOACH, Atlanta, Ga. Mr. De Loach in this invention makes an improvement in that class of shoe-lacings in which the buttons secured to the shoe along the edge of the slit therein are provided with rollers to relieve friction of the lacing-cord in drawing and tightening the string. The upper portions of the lacing are provided with an elastic core, to permit the top portions of the shoe to be widely distended for putting on the shoe with freedom.

FISH-SPEAR.—A. J. CAMPBELL, Luray, Va. The staff or pole has supporting means at one end for two pivoted hooks, which are held closed under tension, and peculiar trigger means whereby the pivoted hooks are held open adapted for use and which operates to release them. The invention relates to spears specially intended for catching fish, but equally adapted for catching animals by impaling them therewith.

CORE FOR USE IN WALL-MOLDS.—A. T. BOISE, Boyne, Mich.—The invention resides particularly in an improved collapsible core around which the plastic material is molded, so as to form cavities in the walls when the cores are removed. These cores comprise, briefly stated, a relatively rigid frame and a contractible shell formed of an integral sheet of flexible material curved around the frame and having its ends overlapped or otherwise engaged, the frame having means for holding it in proper connection with the frame.

JEWEL-SETTER.—W. F. BOAST, Colby, Kan. In this patent the invention refers to watchmakers' tools; and its object is to provide a jewel-setter very effective in operation, and arranged to permit a jeweler to accurately and quickly set the roller-jewel in correct position in the roller-table of the watch-balance.

ISOCHROMATIC PHOTOGRAPHIC PLATE AND FILM.—L. SMITH, 14 West Hill, Highgate, London, England. The advantages obtained by this invention as compared with the ordinary single layer of isochromatic emulsion is the absence of all halation and false tone-rendering due to imperfect interception of light rays and as compared with a double or triple layer of ordinary emulsion the wider and more perfect tone-rendering due to the color sensitiveness of each layer of emulsion of which the film of this invention is composed.

WINDOW-FASTENER.—E. A. KLAGES, Crafton, Pa. One of the primary objects of this invention is the provision of a fastener which shall be composed of two main members, a locking member and a keeper therefor, such members being adapted to be fastened on adjacent meeting-rails and securely hold the two rails in alinement, so that one of the sashes can be moved relatively to the other only when the locking member is detached or released from its keeper.

NECKTIE-FASTENER.—C. WOOD, Victoria, Canada. The object in this improvement is to provide a device having details of construction that adapt it for a clasping attachment upon the center and rear side of a necktie, and also for a secure but readily detachable engagement with the front stud or button on the neckband of the shirt, so as to hold the tie in correct position thereon with regard to a permanent or attached shirt-collar.

BREAST AND POLE STRAP FASTENER.

—E. Z. SMITHPETER, Bogard, Mo. The usual means for connecting harness with the neck-yoke of a [illegible] wagon is a breast-strap which passes through a ring on the yoke, its ends being attached to the collar hames, the strap being thus bent at an acute angle where it passes through the yoke ring, so that it is subject to great strain and rapid wear at that point. Advantages are obtained in respect to wear and ease and rapidity of hitching and unhitching the team.

POLISHING COMPOUND.—G. SHAMBECK, Salt Lake City, Utah. The object of this invention is to provide a polish for use on any article of furniture, vehicles, and woodwork in general, whether previously varnished or not, the polish imparting a bright and fresh appearance, so that the article treated will look as though it had recently been renovated or was entirely a new article. The compound acts the same either on a wet or dry surface.

HOSE-COUPLING.—H. E. SMITH, Roslyn, Wash. The purpose of this improvement is to provide details of construction for hose-couplings which are simple and practical, affording means for connecting two sections of the hose-coupling in a reliable manner and permitting the sections to be manually disconnected with ease, and which may be employed to couple onto a fire-hydrant as well as an ordinary hose.

TRUSS-PAD.—I. B. SEELEY, New York, N. Y. In this case the invention refers to improvements in support and retention hernial pads, the object being to provide a pad adapted to the various constructions of hernia-trusses for the requisite mechanical support, and designed more especially for use in the mechanical treatment of inguinal hernia as located at the lower abdominal body-section.

COMBINED ASH-RECEIVER AND PAPER-WEIGHT.—P. A. ROBSON, Westminster, S. W., London, England. This article serves both as an ash-receiver and as a paper-weight, and is so constructed that it may be used as a pipe-cleaner. It has extending centrally upward from the ash-receiving well a tapered spike, which may be used as a means for cleaning or removing burned particles of tobacco or ashes which cling to the interior wall of the bowl of the pipe.

GAME-BOARD.—H. A. ROAT, JR., Harrisburg, Pa. The principal object in this instance is to provide a board which may be readily manipulated by one person, acting as a scorer, to present certain apertures or orifices therein to one of the players, so that should such player shoot or send a marble through one of the apertures he will receive credit for a certain number of points, indicated by numerals placed over or adjacent to the apertures.

GARMENT-SUPPORTER.—FRANCES C. MCDONALD, P. O. Box 399, Chicago, Ill. The present invention is in the nature of an improvement upon the device forming the subject matter of a former patent granted to this inventor. The purpose of the present improvement is to devise a supporter particularly designed for use in retaining and securing hosiery and the like, which will embody the features of durability, simplicity, and convenience. Means are so adjusted that a stud or similar article may be locked by the supporter, the button being adapted to engage with articles of clothing.

HORSESHOEING-STOCK.—M. M. MAY, Rulo, Neb. Among other things this invention has for its object the provision of a stock which may be readily opened for the introduction of the animal and easily and securely closed, to provide means for securing either foot in a raised position convenient for the operator, and to provide means for sustaining a part of the animal's weight when standing on three of its feet during the shoeing operation.

PROTECTING HEAD-GEAR OR HAT.—ANNA MIEROSLAWSKI, New York, N. Y. The object of the invention is to provide a head-gear protector, more especially designed for protecting ladies' hats and other head-gear against rain, dust, and the like, to prevent the hat from being injured, the protector being very simple in construction, and easily applied to properly fit the hat without danger of injuring the trimmings thereof.

CARD GAME.—H. E. GAVITT, Topeka, Kan. The cards used in this game bear indicia of different money values. The cards of a pack are divided into groups of eight, all of one group being alike in name of stock and its assumed money value per share, also in the amount of the capital stock. A telegram-card is used on occasions. Cards are dealt equally, and players attempt to fill their broken groups by trading with neighbors a number of cards exchanged for a like number. The cards and manner of playing illustrate the transactions of the world's great stock-exchanges.

CESSPOOL.—H. D. GARDNER, New York, N. Y. This cesspool is constructed of cement, or the like, and is adapted for draining surface water. Its shape is the frustum of a cone. The sides are provided with a series of slots wider at the outer than inner end portions, so that solid dirt packed against the cesspool's exterior will enter the outer portions of the openings, so as to prevent mud being driven into openings from the interior, while means are provided to prevent the earth around the cesspool falling into it, yet permitting drainage of water from the earth into the cesspool's interior.

CONDUIT FOR HOSE, CABLES, ELECTRIC WIRES, OR THE LIKE.—J. BURNSEN, West Superior, Wis. The invention pertains to improvements to be placed across a street below the surface, so that fire-hose may be passed through it and not interfere with traffic and not be damaged by vehicles. The conduit may also be placed on the bed of a body of water, through which electric wires or other devices may be carried across the water.

FISH-HOOK.—W. E. KOCH, Whitehall, N. Y. In this patent the invention has reference to improvements in fish-hooks, an object being to provide a hook with a sliding weight whereby the weight will not only serve as a sinker, but will serve to hold live bait in natural position—that is, with back up.

BOTTLE-CLOSURE.—J. F. PERRY, Dec'd, Chicago, Ill. In this patent the invention is an improvement in that class of bottle-closures in which a seal of some form engages a fillet or shoulder of a bottle-neck, so that its dislodgement is prevented, save by the use of a tool suitable for the purpose.

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Minerals sent for examination should be distinctly marked or labeled.

(9259) A. S. says: Kindly inform me of the best place to take a mechanical engineering course in the city of New York; and also where the State University is situated, and whether they have a course like the above. A. The course in mechanical engineering at Columbia University, New York city, is one of the best in the country. The requirements for admission to this course are high. The Pratt Institute, of Brooklyn, N. Y., has a two years' course in steam and machine design, which is an excellent mechanical course, with lower requirements for admission than the one referred to above. The State University of New York is Cornell University, situated at Ithaca, N. Y., in the central part of the State. This is one of the best engineering schools in the country.

(9260) G. E. P. says: Is Manhattan Island sinking? A and B both claim that it is. I claim that it is not. A says it is sinking from the great weight of buildings, etc. B says it is because it is being undermined by the sea, East River and North River. A. Geologists think the seashore in the vicinity of New York city and along the New Jersey coast is sinking slowly. The rate is believed to be a few feet in a century. The weight of buildings in the city has no influence in the matter, as that is as nothing in comparison with the weight of the earth on which the buildings stand. These buildings have their foundations upon the solid rock below, and are as firm as the earth itself. The sinking is due to motions in the crust of the earth itself. Such motions are known to exist in many parts of the earth. 2. I have a sal-ammoniac battery, the carbon of which became covered with crystals of sal-ammoniac. I burnt the carbon, and then paraffined the top and put it back. In a little while the crystals came on top, but did not collect on the carbon below the paraffine. How can I fix it? I also noticed a thick layer of carbon in the bottom of the jar. A. When the liquid in a sal-ammoniac cell becomes too strong, a crystal forms. It is not sal-ammoniac, but a more complicated substance, which can be dissolved with difficulty in water, and this has made the trouble for you. The burning which you gave the carbon caused some of the carbon to become powdery and fall off in the water. It should not have been done. The carbons are not as good for it. 3. Please send directions for making blue vitriol battery. A. You require for a gravity battery a star-shaped arrangement of thin sheet copper to be placed in the bottom of the glass jar. In the top of the jar is hung a star, or crowfoot-shaped piece of zinc, weighing 3 to 4 pounds. These you should buy from some dealer. Put in copper sulphate enough nearly to cover the copper. Then fill the jar with water to cover the zinc. Connect the wire from the copper to the zinc, and let the cell stand for several hours till the liquid at the top becomes clear like water. The cell is then ready for use.

(9261) M. & M. say: We are in need of a paper, white preferably, which will after being dampened with water or some other fluid, turn color when an electric current is passed through it. Any information that you can give us on this subject will be gladly paid for and appreciated. A. There are several ways to prepare a paper which changes color when an electric current is passed through it. The simplest is to make a solution of potassium iodide in water and boil some starch in this solution. With the liquid wet some paper. When the wet paper comes into an electric circuit the paper turns dark blue around the positive pole. Another mode of preparing paper is to make two solutions, one of sodium sulphate in water and of phenolphthalein in alcohol. The latter solution may be very weak. Mix them together and wet paper with the liquid. In this case the negative pole turns the paper pink.

(9262) T. C. R. says: This town (Russell) of 1,200 inhabitants is situated high and dry on the watershed between two rivers (Smoky Hill and Saline), each of which is about 200 to 250 feet lower than the town. The Smoky is 7 miles distant, and the Saline 4 miles, at nearest point. Water is not accessible in wells in towns nearer than about 250 to 400 feet in depth, except surface wells in some parts at 20 to 30 feet, which will not furnish large enough supply for any but limited domestic use. The deep wells are practically useless, because of the great amount of salt and other minerals in the water. No one here seems to be informed on the subject, and least of all the workmen who make cisterns. Are there back numbers of the SCIENTIFIC AMERICAN or SUPPLEMENT on this? Can you give any suggestions that would be useful in establishing public municipal water supply for this town? Any literature to help, or any makers of machinery who would make useful suggestions, or any engineers who can be appealed to for preliminary ideas. Can you make any suggestions along the lines first indicated above? Some persons have made guesses that $35,000 to $50,000 would be necessary to install a plant with sufficient capacity for this town. A. In reply to your recent inquiry about the water supply of the town of Russell, we would say that good quality sand, of a sufficient depth, makes a most satisfactory filter. We cannot recommend any literature which would be useful in this matter to one not technically versed in the subject. The question of water supply is a most vital and important one. At the same time, it is an extremely difficult one, and without having thorough investigations made by a competent water-supply engineer, we are unwilling to make any suggestions. If your town has not a satisfactory supply, it would probably be the best investment it could make to get expert advice as to the best method of improving its supply, and then to follow this advice. If you wish us to recommend an expert for this purpose, we should be glad to do so.

(9263) W. H. says: I want to make a square glass fish aquarium. Will you please tell me how to make a cement to be watertight and stick to the glass? A. 1. Dissolve 1 part finely shredded India rubber in 64 parts of chloroform; then add 14 to 24 parts of powdered mastic and digest with frequent shaking until dissolved. 2. Melt together 2 parts of shellac and 1 part of Venice turpentine. Use warm.

(9264) J. E. D. says: To what height will a siphon pull water? Please answer this and put several hundred people at ease in our town. A. A siphon would lift water to a height equal to the height of a water column exerting the same pressure as the atmospheric pressure (which would be for the standard pressure of the atmosphere 33.9 feet), if it were not for the fact that water contains some air in solution, and at ordinary temperatures gives off enough vapor to make a perfect vacuum above a water column impossible. The amount that this action will decrease the height to which a siphon can lift water will depend upon the temperature of the water. If the water is at 212 deg. F., the siphon will not lift it at all; if it is at 700 deg. F., it will lift it 33 feet.

(9265) W. G. asks: Would you kindly inform me how many cubic feet of air one cubic foot of kerosene oil requires for complete combustion? A. One pound of kerosene oil requires for its combustion about 17 pounds of air, or approximately 225 cubic feet of air. The specific gravity of kerosene is about 0.75; therefore one cubic foot of kerosene would require approximately 10,500 cubic feet for its perfect combustion. From 30 per cent to 50 per cent excess air is usually allowed, however.

(9266) C. K. T. says: I desire to learn how carmine is manufactured. A. The preparation of carmine is little understood, but success in its manufacture depends less on any mystery connected with the process than on the employment of the purest water and the best materials, and the exercise of moderate care, dexterity, and patience. The following formula will produce carmine of the richest hues down to ordinary and common, according to the skill possessed by the manipulator: Madame Cenette's process. Cochineal (in powder), 2 pounds, is boiled in pure river water, 15 gallons, for 2 hours, when refined saltpeter (bruised), 3 ounces, is added to the decoction, and the whole boiled for 3 or 4 minutes longer; oxalic acid, 4 ounces, is next added, and the boiling again renewed for 10 or 12 minutes; the heat is now removed, and the liquid allowed to settle for about 4 hours, after which time it is decanted with a siphon into shallow plate-like vessels, and set aside for three weeks. At the end of this time the film of mold which has formed on the surface is dexterously and carefully removed, without breaking it or disturbing the liquid beneath it. The remaining fluid is next very carefully removed with a siphon, and the adhering moisture, as far as possible, drained off, or sucked up with a pipette. The residuum, which is the carmine, is dried in the shade, and possesses extraordinary luster and beauty.

(9267) A. H. F. says: 1. I would like to know the height of a locomotive from rails to top of cab roof. Of course I know that there is a great deal of difference in the different locomotives, but what I would like to know is of the average locomotive built at present. A. The height of locomotive cab roofs varies with the size of wheels, between 10 and 12 feet. 2. I would also like to know the side motion of the cab top from one side to the other while at its full working capacity

at about 40 to 50 mile rate over an average good track, and up-and-down motion if there is any. A. We have no data in regard to the amount of rocking of the cab top. 3. What is the specified side clearance of tracks of our present steam railroads, and also top clearance? A. The clearance between rail and wheel flange is from ¼ to ⅜ of an inch, increased by wear to a ½ inch or more. 4. I would like to know the name of the best railroad block signal system in existence in the United States at present, and about the cost of construction per mile and maintenance. A. We cannot designate the best block signal system in use. Both pneumatic and electric systems are in use by different railroads.

(9268) E. F. S. asks: Kindly inform me how to figure wave lengths of different tones, and where I can find a list of lengths of sound waves, and number of vibrators necessary to produce different tones. A. The wave length of a tone is found by dividing the velocity of sound by the number of vibrations required to procure that tone. The number of vibrations for an octave is usually given in any textbook of physics. They are relatively, taking the fundamental as 1, or unity, 1, 9-8, 5-4, 4-3, 3-2, 5-3, 15-8, 2. Each octave requires double the number of vibrations of the next above it. The standard for "international pitch" has 435 vibrations for A, the sixth of the middle octave of the piano. Taking 3-5 of this number of vibrations, we have for C, as fundamental, 258.6 vibrations. From this the series of tones in the untempered scale can be calculated by the ratios given above. For the scale of equal temperament, which is used in pianos, organs, etc., use 258.6 for C as fundamental, and use as a multiplier 1.05946, to obtain the number of vibrations in the tones of the chromatic scale, with sharps and flats. The results are for the middle octave with A in second space treble clef:

C	258.6	G	387.5	
C♯	274.0	G♯	410.6	
D	290.3	A	435.	Standard
D♯	307.5	A♯	460.9	
E	325.8	B	488.3	
F	345.2	C	517.3	
F♯	365.8			

If now 1120 be taken as the velocity of sound in a warm room, you can by dividing find the wave length for all tones. These are not of practical consequence, since we tune pipes and strings to tones, and not to wave lengths. The diameter of a pipe affects the length required to produce a tone, and wave length alone is not enough for tuning a pipe. The whole matter is exhaustively treated in Helmholtz's "Sensations of Tone," which we can supply for $9.50.

NEW BOOKS, ETC.

INDUSTRIAL USES OF WATER. By H. De la Coux. Translated from the French and revised by Arthur Morris. London: Scott, Greenwood & Co. New York: D. Van Nostrand Company. 1903. 8vo. Pp. 354. Price $4.50 net.

The chemical action of water in nature and the phenomena of hydrochemical activity observed in a large number of industrial operations are so closely related that their study will help to determine the cause of difficulties with water, and assist at the same time in discovering the necessary remedies. If water were actually what its chemical formula represents it to be, simply a compound of hydrogen and oxygen, the difficulties and troubles which arise when it is put to industrial uses would not be possible. The present volume is an exhaustive treatise on water and its uses in the arts. The question of the solubility of salts, feed water for boilers, water in dye works, print works, and bleach works, water in soap works, laundries, canning, paper making, photography, artificial ice, beverages, distilling, are all adequately considered. Special attention is also given to the filtration, distillation, and sterilization of water. It is an admirable treatise, which will be warmly welcomed by the chemist and technologist.

TUBE, TRAIN, TRAM AND CAR; OR, UP-TO-DATE LOCOMOTION. By Arthur H. Beavens. With an Introduction by Llewellyn Preece, M.I.E.E. London: George Routledge & Sons, Ltd. 1903. 12mo. Pp. 291. Price $2.50.

Mr. Beavens has presented a popular account of electric locomotion, in which he has discussed not only subways and tunnels, and their relation to urban transportation, but also the tram car and the motor car. This is not a book which the mechanical engineer is likely to read with any profit; but which the man in the street, who wishes to know something of the great civil engineering feats by which it is possible to transport masses of people safely from place to place, will read with profit. The work commends itself to those who want an untechnical book.

THE MOTH BOOK. A Popular Guide to a Knowledge of the Moth of North America. By W. J. Holland, D.D., Ph.D., Sc.D., LL.D. New York: Doubleday, Page & Co. 1903. 8vo. Pp. 479. Price $4.

There are 48 plates in color photography containing 1,500 figures, and there are 300 text cuts illustrating a majority of the large species of the moths of North America.

The author will be best remembered when his butterfly book is cited. This work practically revolutionized the study of insects, and added greatly to the popularity of the science. The moths of North America are remarkably beautiful, and far exceed butterflies in interest, from the standpoint of form and color. Such subjects as the method of collecting specimens, the history of silk culture, the economic importance of insect life, are fully treated.

LIQUID FUEL AND ITS COMBUSTION. By William H. Booth. New York: E. P. Dutton & Co. 1903. Quarto. Pp. 411. Price $8 net.

The subject of liquid fuel has been agitated by engineers for the last twenty-five years. The author has endeavored to put together what has been done in the burning of liquid fuel since its first introduction. The discovery of Texas oil has put an entirely new aspect upon the whole question of liquid fuel. The work is one which will greatly interest all mechanical engineers and those who are concerned with steam raising.

KNOWLEDGE DIARY AND SCIENTIFIC HAND BOOK FOR 1904. London: Knowledge Office, 326 High Holborn. 1903. 8vo. Price $1.

The Diary comes to us this year with the usual number of good descriptive articles. Among these may be mentioned those on the "Camera Applied to Science in Natural History," "Practical Meteorology," "Physics," "Practical Work with a Small Telescope," "Full and Complete Astronomical Summary and Account of Terrestrial Phenomena for the Year," "Some Uses of the Microscope and Variable Stars."

HARPER'S COOKBOOK ENCYCLOPEDIA. Arranged like a dictionary and compiled under the direction of the Editor of Harper's Bazar. With Contributions by Famous Authorities on Cooking. New York: Harper & Bros. 1903. 12mo. Pp. 443. Price $1.50.

For the purpose of enabling the housekeeper to find at once exactly what she wants, the recipes of this book have been alphabetically arranged. An elaborate system of cross references facilitates the looking up of any recipe. The arrangement not only gives direct reference to particular subjects, but by grouping together recipes on the same subject, suggests new possibilities. A few practical hints regarding some of the simple principles of cooking, recipes for the chafing dish, cooking for invalids, kitchen time tables, tables of weights and measures, proportions, cooking utensils, etc., will be found of help.

THE ENGINEER IN SOUTH AFRICA. By Stafford Ransome, M.I.C.E. New York: E. P. Dutton & Co. 1903. 12mo. Pp. 319. Price $2.50.

Mr. Ransome has written a review of the industry of South Africa, and has given some idea of the region's present engineering position, and has endeavored to present a proper conception of its future possibilities. The study here presented is the result of a ten months' visit to the British possessions south of the Zambesi River, a visit made at the request of the London Engineer for the purpose of giving to British readers a frank and full account of the various problems that have been evolved by recent events. In Mr. Ransome's opinion the war has had the effect of clearing the political atmosphere of South Africa, except in Cape Colony. But here the growing strength of the industrial centers is slowly but surely effecting a change for the better. The industrial prospects of South Africa, he believes, are brilliant, but they must be developed slowly, because the country must have time to recover from the effects of a long and devastating war. On the whole, it must be confessed that Mr. Ransome has done his work with thoroughness and impartiality.

PRINCIPLES AND PROBLEMS OF IMPERIAL DEFENCE. By Lieut.-Col. Edward S. May, C.M.G., R.A. London: Swan Sonnenschein & Co., Ltd. New York: E. P. Dutton & Co. 1903. 12mo. Pp. 332. Price $3.

This book has been written from a standpoint that is only too often lost sight of, the standpoint of the business man. Poets and generals, artists and admirals, have pretty well succeeded in diverting the popular attention from the prosaic side of war, and have done all they could to heighten what may be termed the chivalrous side. Lieut.-Col. May points out that the conduct of a war is essentially a business transaction. The health and lives of his men represent the capital of the general. Apathy in peace and panic in war are dangers that have to be avoided. To legislate in order to make the most of what we have, to employ it so that it may be productive and remunerative in the future, should be our aim, so that war can be conducted without a panic. Politics and strategy should go hand in hand. Co-operation of the services, too, is a most important feature in imperial defense—co-operation above all in the council chamber. For the earnestness of its tone and the fairness with which its information is presented, Lieut.-Col. May's book deserves to be commended.

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Furnace, H. H. Huff 747,718
Furnace construction, J. M. Scanlan 747,648
Furnace fronts, protective apparatus for boiler, O. N. Morin 747,464
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Furniture fastening, knockdown, V. E. Clark 747,683
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Fuse and fuse magazine, Woodruff & McCarthy 747,528
Fuse, electric, H. Geisenhoner 747,697
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Game apparatus, W. S. How 747,716
Garbage destructor, Rooke & Thrush 747,488
Garment fastener, F. Hussey 747,721
Garment hook, M. G. Roeder 747,486
Garment supporter, O. Kraus 747,555
Gas burner, incandescent, L. R. Hopton 747,550
Gas burning furnace, E. Bumford 747,533
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Gas generator, acetylene, H. Symonds 747,502
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Gear for presses or other machinery, driving, O. Spahr 747,792
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Glass, making sheet, Harrison & Wharton 747,913
Glass plates or sheets, manufacture of, W. L. Kann 747,437
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Governor, reversible shaft, C. R. Minor 747,626
Grain hulling and scouring machine, W. E. Larmon 747,556
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Grinding mill, P. R. Janney 747,610
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Guns, automatic or semi-automatic attachment for quick firing, Benet & Mercie 747,848
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Hame fastener, G. B. Hoch 747,708
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Harvester, cotton, J. M. Philbrick 747,760
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Harvester reel, T. H. Berg 747,362
Harvesting potatoes or similar root crops, machine for, R. Richter 747,771
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Hoisting apparatus, O. F. Lidke 747,737
Hoisting machine, S. M. Foltz 747,401
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Hose coupling, A. H. Getz 747,412
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Isodiametric bodies, holder for use in making, S. S. Eveland 747,541

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DESIGNS.

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Ceiling sheet metal border plate, D. H. Wagner	36,702
Ceilings and molding therefor, sheet metal field plate for, D. H. Wagner	36,703
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Comb, E. B. Kingman	36,682, 36,683
Comb, pompadour puff, J. E. Lowe	36,693
Doily or similar article, J. W. Catty	36,686
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Stove, W. W. Woods	36,697
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Medicine, pain allaying, OiliO Chemical Co.	41,699
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Tonic cordials, Nelson, Baker & Co.	41,708
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Typewriter ribbons, American Ribbon & Carbon Co.	41,729
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"Bailey's Standard Gloves, Assorted Sizes," for gloves, Bailey Knitting Mills	10,612
"C. N. R. Plaster Preventive of Car and Sea Sickness," for plasters, C. N. Reed	10,629
"Graham Biscuits," for biscuits, Ontario Biscuit Co.	10,619
"Greenough's Quick Cure," for veterinary medicines, C. J. Greenough	10,628
"Hollister's Rocky Mountain Tea Nuggets," for medicine, Hollister Drug Co.	10,625
"J. H. Small," for cigars, L. Roses, Sons & Co.	10,620
"Mountain Sage Bitters," for medicine, Mountain Sage Malt Tonic Co.	10,624
"Ontario Biscuit Co," for biscuits, Ontario Biscuit Co.	10,618
"Ontario Malt Biscuits," for biscuits," Ontario Biscuit Co.	10,617
"Queen Louise Face Massage Cream," for complexion cream, N. Lopard & Co.	10,622
"Red Raven," for shoes, Fleishman, Morris & Co.	10,614
"Shepard's Lung Food," for medicine, J. C. Shepard	10,626
"Smith's Wonder Worker," for a medicine, W. K. Smith	10,627
"Sunnybrook Creamery Butter," for butter, Helmet Creamery Co.	10,616
"Sunshine Condensed Milk," for condensed milk, United States Condensed Milk Co.	10,615
"Tamazula," for hair tonic, L. E. Warner	10,623
"White Rose," for lime, Saginaw Lime & Lumber Co.	10,630

PRINTS.

"Dr. Pierce's Golden Medical Discovery," for medicine, World's Dispensary Medical Association	870
"Dr. Pierce's Golden Medical Discovery and Dr. Pierce's Favorite Prescription," for medicine, World's Dispensary Medical Association	871

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

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