SCIENTIFIC AMERICAN

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WEEKLY.

THE NEW STEAMSHIP FÜRST BISMARCK.

At 11:28 P. M., May 15, the new Hamburg-American steamship Fürst Bismarck arrived at New York on her first trip across the Atlantic, making the passage from Southampton, England, in 6 days, 14 hours, and 7 minutes. This is not only the fastest time ever made by any vessel sailing from Southampton and the Continent, but, counting the sailing distance from Southampton as sixteen hours farther than from Queenstown, which is usually allowed, it is the fastest maiden trip ever made across the ocean. The distance sailed was 3,086 miles, and the average speed 19½ knots per hour. The following were the runs for the successive days: May 9, 426 miles; May 10, 473 miles; May 11, 475 miles; May 12, 494 miles; May 13, 481 miles; May 14, 498 miles; May 15, 239 miles. Prince Bismarck and his family inspected the ship at Hamburg before she sailed, and requested the captain to cable him the result of the first trip, the success of which probably exceeded the anticipations of the veteran statesman.

The Fürst Bismarck was built by the Vulcan Shipbuilding Company, of Stettin, Germany, and was launched November 29. On her trial trip she made the speed of 20·7 knots per hour with 91 revolutions of her screws, and her engines indicating 16,400 horse power. She is 502½ feet long, 57½ feet wide, and 34½ feet deep from the upper deck to keel plate, being of 8,716 tons register, while all closed rooms of the ship have a capacity of 11,938 tons. The upper deck houses are 9 feet high, the promenade deck rooms 8 feet, and the bridge is 12 feet higher still. The tops of the masts are 133 feet above the promenade deck, and the three funnels, each 12 feet in diameter, extend 56 feet above this deck.

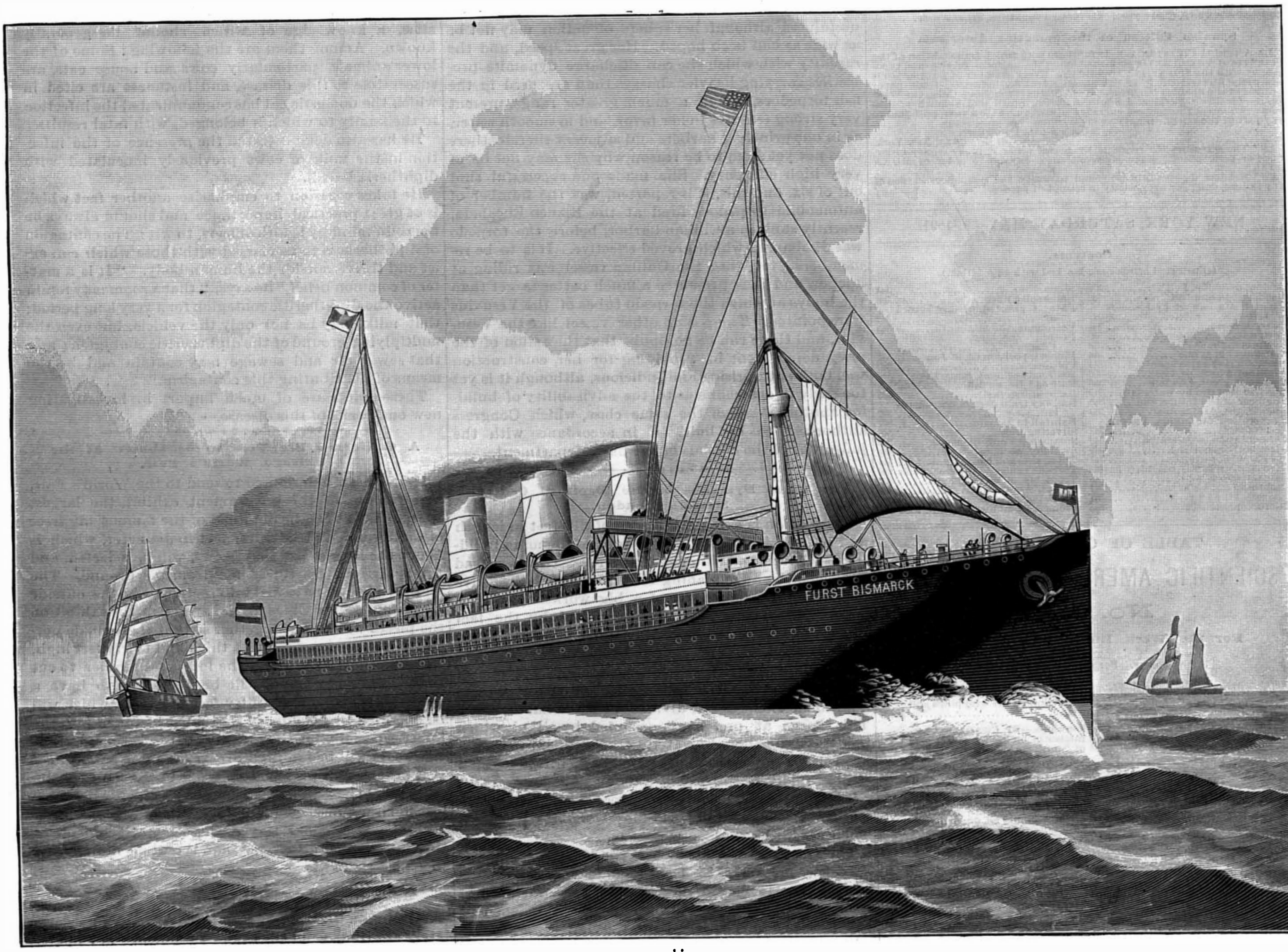
The vessel has a solid longitudinal bulkhead from upper deck to keel, completely dividing the ship lengthwise into two halves, which are non-communicating, and each of which is fully equipped with duplicate machinery, each side being also divided into numerous watertight compartments. The two engines, each of a nominal horse power of 7,000, are triple expansion, the cylinders being 40, 67, and 106 inches in diameter, and the piston stroke 5½ feet. There are nine double-ended boilers, in three separate compartments, each set of boilers having independent connections with each set of the engines. There is also one boiler on the upper deck above the water line adapted for connection with the pumps in case of accident disabling the boilers below. The coal bunkers have a capacity of 2,700 tons. The main steam pipes are of copper, each pipe being covered with crucible steel 7-18 wire, adding enormously to the strength of the pipes. The shafting, made by Krupp, is of steel, and is hollow.

The hull of the ship has a double bottom, the space between the outer and inner shell being divided into chambers to hold water ballast, which can be pumped in or out by automatic pumps. The vessel has two keels, one on each side, whereby the draught is lessened, and rolling somewhat diminished, while the immersion of the screws is better secured. The rudder is of great size, and the independent action of the screws also affords means for readily steering the ship under any circumstances. The screws are of manganese bronze, 18 feet in diameter each, with three blades and 32 feet pitch. The bosses are of steel, 4 feet 6 inches in diameter. The crew numbers 329.

The vessel is supplied with a very complete system of deck and engine room as well as helm and bridge telegraphs, and on the bridge is Alison's motograph, promptly indicating to the officer of the bridge whether his orders have been understood and carried out. It shows the number of revolutions the engines are making at all times, and in what direction, whether ahead or astern. The electric light installation includes four sets of combined engines and dynamos, the latter being compound wound and of Siemens latest type. A thousand Edison 25 candle power incandescent lamps brilliantly illuminate all parts of the ship.

The furnishing of this splendid ship is, as might be expected, of the most luxurious description, the comfort and elegance provided being designed to satisfy the most exacting taste. The main saloon on the upper deck is 72 feet long and 40 feet wide, well forward of the machinery, and there is another saloon, 50 by 22 feet, on the main deck. The decorations are of the most sumptuous style, a profusion of rare wood carvings and panel pictures by well known artists being employed to secure the highest effects.

On the voyage over the coal consumption is said to have been 262 tons per twenty-four hours, and it is claimed that the engines of the new steamer develop a materially higher degree of efficiency than those of the City of Paris or the City of New York, on which the daily coal consumption is about 330 tons. However this may be, it is certain that the performance of the Fürst Bismarck, and everything in her appearance, so far as can be judged at present, are well calculated to afford some surprise to English shipbuilders, as she seems to be in every way abundantly capable of taking her place by the side of the finest vessels yet built in English shipyards.



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NEW YORK, SATURDAY, MAY 30, 1891.

Contents.

(Illustrated articles are marked with an asterisk.)

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For the Week Ending May 30, 1891.

Price 10 cents. For sale by all newsdealers

TESTS OF THE TORPEDO CRUISER VESUVIUS.

On May 19 and 20 some carefully planned tests of the torpedo cruiser Vesuvius were made, at Hampton Roads, Va., in the presence of army and navy officers and a number of interested foreign officials. Dummy shells, made of cast iron and steel, were used, of the same weight as the dynamite shells for which the guns were made. The first three shots were fired at fixed buoys, at one mile, three-quarters of a mile, and half mile distances, the vessel being in motion. The first projectile went directly over the buoy which served as a target, dropping a few yards off, within a space deemed to be destructive. The second and third shots both went wide of the mark. Three shots were next tried at a moving target, the Vesuvius herself moving at a speed of 17 knots. In this test a cutter with a mast was used as a target, the target being towed by the Cushing. The first shot, mile range, went 200 yards beyond the target; the second shot, three quarters of a mile range, went a quarter of a mile beyond the target; and the third shot, half mile range, struck the water a quarter of a mile short of the target.

These trials fall short of what it had been thought might be attained in the way of accuracy of firing, and while it is possible that better results may be reached with further experience, the opinion seems to be growing that pneumatic torpedo guns are perhaps better suited for forts and other fixed defenses than for ships of war. It does not follow, however, but that the Vesuvius still has a most important field of possible usefulness, although her sphere of action may not be as wide as had been hoped. Her great speed, and the rapidity with which she can discharge dynamite projectiles carrying heavier charges than are used in the fish torpedoes, and at a much greater range, present very strong features in her favor, and in smooth water, as in our principal harbors and adjacent thereto, there does not yet seem to be reason why she may not be of very high efficiency. She made one successful shot out of six, and this, it is reported, was the number of automobile torpedoes fired at the Blanco Encalada, recently sunk in a Chilian harbor, before the torpedo was discharged which proved effective. It is to be remembered, too, that the Chilian vessel was riding at anchor, and thus presented a much better target than the buoys at which the torpedo tubes of the Vesuvius were pointed. There is no other vessel like the Vesuvius, and there can be no doubt that the action of the navy department in providing for her construction was both enterprising and judicious, although it is yet too early to determine as to the advisability of building another vessel of the same class, which Congress authorized to be built, if in accordance with the judgment of the officials of the navy department.

The Great Dynamos of the Deptford Central Station, London.

The station is a large building of 210 feet in length and 195 feet in breadth, the height of the main building is 100 feet, and chimney shafts 150. The overhead travelers, the huge planing machines and lathes, give one more the impression of a big workshop than a generating station. This is occasioned by the fact that the whole of the plant is made on the premises.

The boiler house contains twenty-four 500 horse power tubular boilers divided into four batteries of six boilers each. It is intended to place on top an additional twenty-four, divided in a similar manner. This space at present is occupied by a tank which holds 800,000 gallons of water. Underneath the boilers is placed a forced draught engine to facilitate making steam rapidly in the case of a foggy day.

The great dynamos now in process of construction will be by far the largest and most wonderful electrical machines in the world.

The armature ring for each of the 10,000 horse power dynamos measures 35 feet in diameter, it is made of cast iron in eleven pieces, and is to be fastened to the dynamo shaft by cast iron arms or spokes, each of which will be in turn secured to the shaft by a double milled steel ring shrunk on, while as an additional security 22 solid steel bolts, 6 inches in diameter, each weighing when finished 12 cwt., passing through the outside of the armature ring, screw direct into a steel ring mounted round the center of the dynamo shaft.

The armature and shaft when completed will weigh 225 tons, and the field magnets 350 tons more. This is exclusive of the massive bed plate on which both the engines and field magnets will stand. One 5,000 H. P. engine is to be fixed at each end of the dynamo shaft, the armature thus being in the center, and taking the place of the ordinary flywheel, which is dispensed with; the bobbin holders are fixed in the same way as on the 1,250 horse power machines, 132 coils being used. It may be mentioned here that five dynamos of this type, each supplying 200,000 lights, are to be built.

To give a slight idea of the extraordinary size of the engines to be employed for driving, the measurement from the ground to the top of the high pressure cylinder is to be 48 feet. The over-all dimension of the dynamo is 45 feet, and of this 16 feet is below the floor level. Yet, in spite of the colossal proportions, it is said the dynamos will be so easy of manipulation that they can be drawn apart for cleaning in less than five minutes. The Deptford central station differs from almost all other generating stations from the fact that, with the exception of the bare castings and engines, every part of the work is done on the premises. The turning of the shafts and crank pins, the fitting together of the dynamos, the making of the conductors, all are carried out under one active supervision.

In order to cope with the gigantic nature of the work, some of the largest planing machines and lathes in England are used. One planing machine gives a vertical cut of 20 feet and a 22 foot horizontal cut. A lathe taking four cuts has a capacity of 11 feet in diameter and 25 feet in length. Everything is carried out on the same large scale.

The Diphtheria Bacillus.

The ardor with which the study of the causation of diphtheria has been pursued among those who are engaged in that branch of medical science has been at last rewarded by the discovery of the true diphtheria bacillus.

The most eminent bacteriologists in the world with great unanimity announce the fact.

Dr. Klein, the eminent English bacteriologist, has published an elaborate report in the Nineteenth Annual Report of the Local Government, in which he enters into the details of his methods of investigation and his tests.

His paper contains several facts of prime importance, a knowledge of which should be generally known. Among them are the following: Some of the lower animals, particularly cows and house cats, are susceptible to this disease, and instances are cited in which the domestic cat has communicated the infection to the family to which it belonged, with fatal results.

He has also demonstrated the presence of the infection in the milk of cows previously inoculated with diphtheria bacilli.

He takes occasion to emphasize another fact which is of great practical importance and should always be borne in mind by health officers, to wit: The contagion of diphtheria is to be classed with those which can exist and thrive outside the human body. "It is a matter of common belief," he says, "that a room may retain active the diphtheritic contagion for a very long period; that milk may be not only the vehicle, but even the multiplying ground of the diphtheritic contagion; and that sewer air and sewage may contain and be the means of distributing this contagism."

These points are of much import in investigating new outbreaks of this disease.

A California Big Tree to be Shown at the Chicago World's Fair.

It has been determined to send to the World's Fair, as a feature of the government exhibit, the largest specimen that can be obtained of the famous big trees of California. A tree thirty feet in diameter, which is about the largest size that grows, will be selected, and the limbs cut off thirty feet from the ground. The trunk will then be sawed into sections and the outside piece only sent to Chicago. On arrival at the exhibition the pieces will be put together so that the outside portion of the tree, several feet thick and thirty feet high, will stand just as it did in the forest. In order to cut the tree into sections it will be necessary to have a special saw made, about fifty feet in length, which will be operated by machinery that must be taken into the forest especially for the purpose. It is estimated that eight cars will be required to carry the tree to Chicago. It is proposed at present to place it in the center of the rotunda of the government building, which will be 120 feet in circumference. The interior of the tree will be decorated with cones, leaves, and other attachments of the tree, divided into rooms, and the whole illuminated with electric lights.

Fast Railroading.

A train on the Chicago and N. W. road, of 3 cars, lately ran from Council Bluffs to Chicago in 9 hours, exclusive of stops, or at the rate of 53·92 miles per hour.

On the Canadian Pacific a train recently ran from Vancouver to Montreal in 92½ hours, including 3 hours' detention from a mud slide. From Smith's Falls to Montreal, 128·3 miles, the running time was 2 h. 5 m., or at the rate of 61·6 miles per hour.

THE "gliding" railway, or chemin de fer glissant, exhibited at Paris in 1889, has been established as a short length at the Crystal Palace, London. In this construction the coaches are without wheels, but "glide" on a film of water between the "skates" of the carriage and the broad flat rail which supports the weight. The motion is effected by a pressure of water from hydrants which are brought into play as the train proceeds.

A CORRESPONDENT in Babitz, Bohemia, writes to the Viennese *Deutsche Zeitung:* "In the neighborhood of Eule lives a woman who is 113 years old. She has been a pensioner for more than 40 years, but still threads her needle without glasses, and takes an hour's walk to church."

POSITION OF THE PLANETS IN JUNE.

JUPITER

is morning star. He wins the place of honor on the June annals for his brilliancy, more convenient position for observation, and lessening distance from the earth. He will rise about 11 o'clock in the evening when the month closes, and will lead the heavenly host through the summer and autumn, being more attractive than he was last season, on account of his greater northern declination. Jupiter passes one of the most interesting epochs in his course on the 7th at noon. He is in quadrature, being 90° west of the sun, and half way between conjunction and opposition. His period of visibility, or the time when he is most conveniently observed, extends from June to December, or from three months before his opposition on September 5 to three months after that time. Telescopes will soon be turned toward this king of the planets, his famous red spot will be investigated anew, the changes in his bands and their beautiful coloring will be noted, and the configurations of his satellites will afford an unending source of enjoyment. Telescopic observers are never discouraged, always hoping that patient research will be rewarded by some astronomical titbit to make them famous or for the good of science. The process of world-making is slow on this gigantic planet, equal in volume to 1,300 planets the size of the earth.

The moon is in conjunction with Jupiter the day before her last quarter, on the 27th, at 7 h. 24 m. A. M., being 4° 15′ south.

The right ascension of Jupiter on the 1st is 23 h. 10 m., his declination is 6° 29′ south, his diameter is 37″.6, and he is in the constellation Aquarius.

Jupiter rises on the 1st at 0 h. 47 m. A. M. On the 30th he rises at 10 h. 58 m. P. M.

SATURN

is evening star. He is in quadrature on the 1st at 6 h. 11 m. A. M., being 90° east of the sun. There are but six days' difference in the time of the quadratures of the two giant planets. Saturn is in quadrature on the 1st on the eastern side of the sun, and is on the meridian about sunset. Jupiter is in quadrature six days later on the western side of the sun, and is on the meridian about sunrise. One planet rises nearly at the time the other sets.

The moon is in conjunction with Saturn on the 13th, at 4 h. 44 m. A. M., being 3° 30′ north.

The right ascension of Saturn on the 1st is 10 h. 52 m., his declination is 9° 27′ north, his diameter is 16″.8, and he is in the constellation Leo.

Saturn sets on the 1st at 0 h. 42 m. A. M. On the 30th he sets at 10 h. 51 m. P. M.

VENUS

is morning star. She rises about an hour before the sun during the month, and is hard to find, as her luster fades in the blaze of light that precedes the near approach of the sun. Her light number is 58.2 on the 1st against 218.3 at the time of her greatest brilliancy, and 0.869 of her illuminated disk are turned toward the earth. Observers will note her rapid movement northward, as well as her decreasing size, lessening brightness, and nearer approach to the sun.

The moon makes a close conjunction with Venus two days before her change, on the 4th, at 6 h. 14 m. A. M., being 12′ south. The waning crescent and the planet rise on that morning about three hours before the conjunction takes place, the moon being southwest of the star and near it.

The right ascension of Venus on the 1st is 2 h. 45 m., her declination is 14° 13′ north, her diameter is 12″.0, and she is in the constellation Aries.

Venus rises on the 1st at 3 h. 7 m. A. M. On the 30th she rises at 3 h. 4 m. A. M.

MERCURY

is morning star. He reaches his greatest western elongation on the 5th, when he is 24° 2′ west of the sun. He is visible at and near that time to the naked eye, and his high northern declination is a favorable condition for success in finding him. He must be looked for at elongation, about 4° southeast of Venus, in the northeastern sky.

The moon is in conjunction with Mercury on the 4th, at 3 h. 39 m. P. M., being 2° 23′ south.

The right ascension of Mercury on the 1st is 3 h. 8 m., his declination is 13° 41′ north, his diameter is 8″.8, and he is in the constellation Aries.

Mercury rises on the 1st at 3 h. 31 m. A. M. On the 30th he rises at 3 h. 59 m. A. M.

NEPTUNE

is morning star. Traveling westward from the sun, he meets Mercury traveling eastward toward the sun, the conjunction occurring on the 18th, at 3 h. A. M., when the planets are but 19′ apart, Neptune being north. He next encounters Venus on the 22d, at 3 h. P. M., being 29′ south.

The right ascension of Neptune on the 1st is 4 h. 20 m., his declination is 19° 54′ north, his diameter is 2″.5, and he is in the constellation Taurus.

Neptune rises on the 1st at 4 h. 19 m. A. M. On the 30th he rises at 2 h. 30 m. A. M.

MARS

is evening star, but is of little account on the celestial calendar, setting at the close of the month about three-quarters of an hour after the sun.

The right ascension of Mars on the 1st is 5 h. 54 m., his declination is 24° 21′ north, his diameter is 4″.0, and he is in the constellation Taurus.

Mars sets on the 1st at 8 h. 43 m. P. M. On the 30th he sets at 8 h. 7 m. P. M.

URANUS

is evening star. His right ascension on the 1st at noon is 13 h. 44 m., his declination is 10° 10′ south, his diameter is 3″.8, and he is in the constellation Virgo.

Uranus sets on the 1st at 2 h. 23 m. A. M. On the 30th he sets at 0 h. 28 m. A. M.

Mercury, Venus, Neptune, and Jupiter are morning stars at the close of the month. Mars, Saturn, and Uranus are evening stars.

The Rainfall in Jamaica.

BY EUGENE MURRAY AARON, PH.D.

The historian Froude, after a tour of all the English possessions in the West Indies, as described in his delightful narrative, gives it as his opinion that nowhere are such rainstorms to be encountered as are known in the island of Jamaica. During my residence there, in 1890 and 1891, I had, as United States Signal Service observer, exceptional opportunities to note and gauge these wonderful down-pours, and to collect a few facts which may be of interest to the readers of the SCIENTIFIC AMERICAN.

May and October, respectively, are still called the central months of the rainy seasons, although the periods of excessive precipitation have, of late years, become very variable and uncertain. In 1889 and 1890, there were no well-defined rainy seasons, and yet the average rainfall throughout the island was near the normal standard. In 1886, on the other hand, while the total rainfall for the year was normal, the greatest damage was caused by water within a few days.

The distribution of the rains in Jamaica affords to the student of meteorology a highly interesting problem, and one that as yet remains unsolved. As an example: The Castleton Garden region and the Drax Hall estate, lying only thirty-five miles apart, in the parish of St. Ann, on the north coast, are separated by a range of hills averaging less than two thousand feet in height. Yet observations of the mean annual rainfall, taken for a period of fifteen years, show 108·55 inches for the one, and 67·15 inches for the other. Such discrepancies are to be found in many parts of the island, although its entire length is only 140 miles, and its average breadth 34 miles.

As a matter of course, great differences are observable between places of widely differing elevation. Thus, an average of only 43·18 inches in Kingston, at the sea level, is balanced by the excessive fall of 121·62 inches at the government cinchona plantation, at an altitude of 5,000 feet, although the two places are separated by only ten miles. But how shall we account for such a variation as exists between the two lighthouses of Plumb Point and Morant Point, both on the south side of the island, and only forty miles apart, both at the same level and in like wind and current systems, where the fall is 39·52 inches at the former, and 75·28 inches (almost double) at the latter?

The sudden and overwhelming down-pours, often amounting to what, in our southern Alleghanies, are called cloud-bursts, or "waterspouts," lead to some very peculiar and often distressing incidents. The mountain streams in most cases have to flow through several miles of arid plains, fully exposed to the burning rays of a tropical sun, before they reach the sea. They rarely arrive there except at times of excessive floods. The sun-baked earth and bowlders, and the evaporating force of a temperature of 125° in the sunlight, are too much for these shallow water courses. A single mile of such radiation is usually sufficient to cause a mountain torrent of considerable size to dissipate in vapor and to lose itself among the burning sands. The visitor sees a dry gully many yards in width, and is told that it is the bed of a mountain torrent which, in time of flood, becomes a river with a resistless current and a depth of many feet.

The "Dry River," which drains a large territory on the south side of the island, sinks entirely from sight into the sands of the valley of Vere, about fifteen miles from the sea. Yet so formidable did this stream become in June, 1886, after a few hours of rainfall in the hills, that it rose to a height of eighteen feet above its usually dry bed near the sea, and a torrent between 300 and 400 feet wide carried away in a single night government and private property to the value of $300,000.

In 1889, the Yallahs River, a stream which had not before been "down" (flooded) for many months, descended with such violence as to carry away a family of coolies living in a bamboo hut near its course, and to wash out to sea a mail carrier and his horse who had essayed to cross where a few moments before were only heated sand and rocks.

A cool mountain stream, after dashing over a rocky escarpment and falling into a vine-embowered pool, tempted me one day to a bath. When I made my first plunge a mere thread of water was trickling over from above. But while I was reveling in the change from air of 95° in the shade to water of refreshing coolness, without a thought of rain, or even a sign of cloud, suddenly a sheet of water, perhaps six inches in depth, leaped over the cliff above me. Every second saw its volume increase, and I had barely time to save my clothing, which I had placed a foot above the usual level of the pool. A storm in the upper hills had lent to the tiny streamlet above me the force and fury of a torrent.

So sudden and so heavy are these downpours that no amount of precaution is sufficient to save from a thorough drenching the wayfarer who is thus overtaken on the higher levels. One in which I was caught in Hardware Gap, at about 4,000 feet elevation, will serve to illustrate their nature. A perfectly clear sky was in five minutes overcast with fleecy clouds, and in five minutes more was sending forth ominous mutterings from inky heavens. With only this brief warning the scene was transformed from smiling sunshine to pouring rain. As I was more than a mile from the nearest hut, and as the storm was already causing landslides across my steep and rocky trail, there was nothing for it but to urge my horse to the partial shelter of some overspreading tree. Before such refuge could be found the atmosphere had come to be charged, as it seemed, with more water than air. The burdened lungs gasped and shuddered in the ordeal, and the temperature fell from about 115° in the sun to less than 65°. Those who have ventured into the Cave of the Winds under Niagara will realize the sort of breathing that fell to my lot for over forty minutes. Mackintosh, umbrella, overshoes, were as useless for protection as the gauze of my insect net.

During most of the three hours of the storm's duration the play of lightning was almost incessant, and the roll of thunder as it waked the echoes lurking in the gorges, or the crashing report when some near-by tree was struck, defied description. My horse was so terrified as to be quite unmanageable, if any attempt was made to hold him. Yet he would not stir a yard from me after I alighted, but stood trembling in every fiber. In my own excitement and breathlessness I almost forgot the risk I ran in standing under a large tree during the storm attended by such electric disturbance.

The abundant rainfalls in the favored parishes of Jamaica are among the chief agencies which have made the island famous for yielding a greater variety of fruits than any other spot of equal area on the globe. They are also one cause of the enormous tree-growths there. Readers of the SCIENTIFIC AMERICAN may be interested to learn that the immense silk-cotton and banyan trees growing in the Bahamas, as illustrated and described in a recent number, are far surpassed by trees of the same species now growing in Jamaica.

A Singular Railway Train Derailment.

Near Roslyn, L. I., on the evening of May 17, a locomotive with its tender and one car, running at a high speed, were wrecked in a most singular manner. A horse had broken loose from his pasture and wandered upon the track. In attempting to run, as the train approached, one foot caught between the rails of the main line and a switch, and the horse was hurled from the track against the switch target, snapping the bolts and bars connected with it. The switch was thus unlocked, and, after the engine had passed the points, they slid sufficiently to catch the flanges of the wheels on the tender, which, with the car, was thrown from the track and totally wrecked. The rear wheels of the engine were also derailed, and then the pin holding it to the tender broke, the engine going a few rods farther on the ties and turning over on its side. The engineer, who had stuck to his post, was killed, as was also a friend who had been riding with him in the cab.

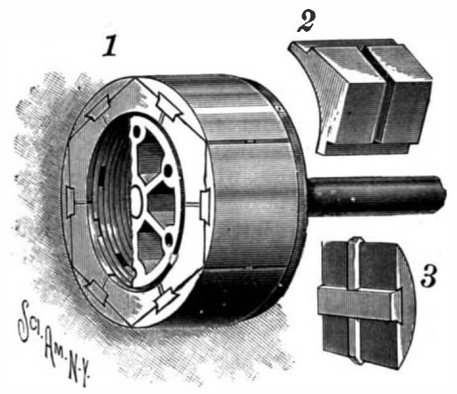
Women's Building for the Columbian Exposition.

We notice with much pleasure that an award of $1,000 has been made to Miss Sophia C. Hayden, of Boston, for her design for the Women's Building at the Chicago World's Fair. A second prize of $500 was given Miss Lois L. Howe, also of Boston, and Miss Laura Hayes, of Chicago, received the third prize of $250. The awards were made by Mrs. Potter Palmer, president of the board of lady managers. The designs had previously been discussed and criticised by the chief of construction, Mr. Burnham, and by other members of the board of architects.

The event is of interest as indicating the hold that women are taking of the profession of architecture. In many respects they would seem pre-eminently suited for it. Their innate tact and taste and their appreciation of the domestic wants are elements which should tell in their favor, at least as designers of houses to be lived in. The field of women's work is rapidly broadening, and this competition emphasizes their entrance into the higher professions.

AN IMPROVED METALLIC PISTON PACKING.

This is a segmental piston packing in which the parts are so arranged that displacement of the segments in any direction is impossible as long as the packing is in position on the piston. It has been patented by Mr. Nicholas Pflaum, of Port Jervis, N. Y. It consists of a series of interior blocks having angular exterior surfaces on which fit the angular surfaces of exterior segments, longitudinal keys fitting between the blocks and segments. Fig. 1 represents the arrangement of the packing in use, and Fig. 2 shows one of the interior blocks. On the inner face of each of these blocks is



PFLAUM'S METALLIC PISTON PACKING.

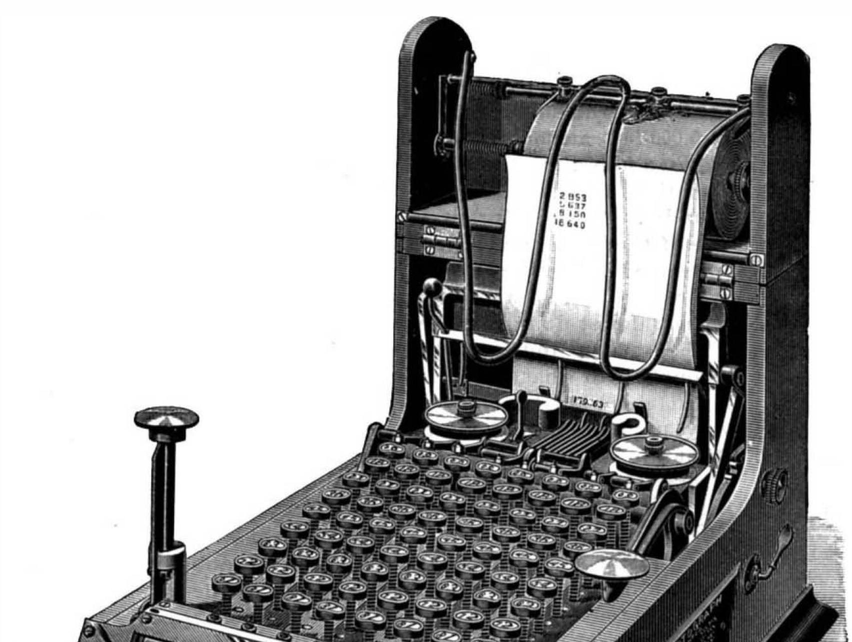
formed a segmental offset, fitting on the exterior surface of the spider of the piston, the inner faces of the blocks, to one side of the offset, being also segmental, and forming with the spider an annular recess in which are placed springs to press the blocks outward. On two adjoining outer angular surfaces of two succeeding blocks is fitted an exterior segment, shown in Fig. 3. Each segment has tongues on its inner surface to fit into corresponding grooves on the outer surface of the blocks, and in each of the segments is a transverse dovetail in which fits a projecting key, engaging a transverse groove in two adjacent blocks. This form of packing is recommended for use in the cylinders of air-pumps, to prevent leakage, and is adapted to afford efficient service in a wide variety of uses.

AN AUTOMATIC ADDING AND RECORDING MACHINE.

A machine by means of which figures may be placed in tabular order with the rapidity of ordinary type-writing, and which at the same time automatically adds the amount as the figures are listed, with no possibility of a disagreement between the listed figures and their indicated total, is represented in the accompanying illustration. The machine is adapted to record and foot up eight columns of figures, while a similar machine is also made having a capacity reaching to ten columns. As will be seen, there are eight columns of keys, the first two columns to the right, in listing amounts of money, being used for the units and tens of cents, the next three columns for the units, tens, and hundreds of dollars, and the remaining three for units, tens and hundreds of thousands, the machine being thus adapted to all amounts under a million dollars.

To record the amount 179.63, shown at the bottom of the paper just back of the keys, the operator struck key 1 in the fifth column, key 7 in the fourth column, key 9 in the third column, key 6 in the second column, and key 3 in the first column, and then pressed the up-feeding spacer lever seen to the right of the key board. The amount recorded is thus presented in plain sight before the next figures are listed, the operation of which is proceeded with after the same manner, each separate amount being exposed to view, by pressing on the spacer lever, before commencing upon the following amount The total of any number of amounts printed can at any time be seen upon the type wheels behind the glass just in front of the keys; but to print the answer on the slip at the bottom of the column, the operator presses the knob standing at the left of the keyboard. The little thumb screw on the right of the machine is to clear the register, or reduce the machine to naught, another thumb screw farther back regulating the feeding of the paper, while the lever device near it is for feeding the paper backward. The machine will take paper of any width up to six inches.

The comptograph is an outgrowth of the comptometer, a universal figuring machine operated by keys, but which does no printing. The comptograph simply prints lists or columns of items and adds and automatically prints the answer beneath them at the same time. For listing checks in a bank, for the use of insurance companies, for the preparation of such extended tables as are furnished by various statistical authorities, and for other purposes where clearness and rapidity of work, no less than accuracy, are difficult to obtain, this machine has already proved itself a great success. Besides its advantages in clearness and accuracy, it is said that an operator can, with very little practice, do as much work as can be done by two men in the old way. The machine is the invention of Mr. Dorr E. Felt, being covered by several patents, and is manufactured by the Felt & Tarrant Manufacturing Company, of Chicago, Ill.



THE COMPTOGRAPH.

An Ingenious Swindler.

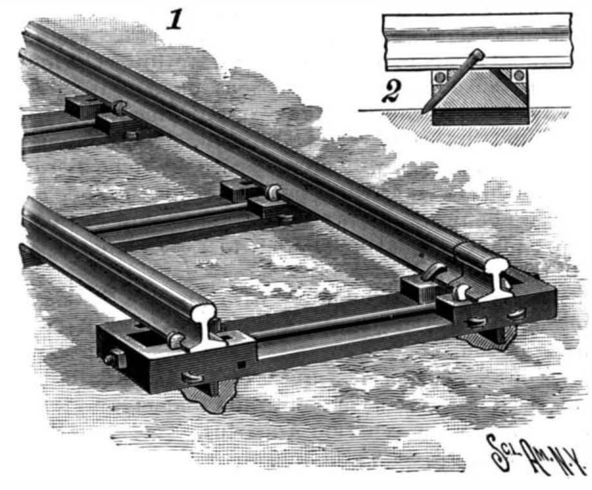
The incident of the arrest of a man in London for the attempt to swindle a jeweler in that city, by means of the "philosopher's stone," through which he pretended to increase the bulk of gold, brings to mind the attempt and success to the amount of $100,000, which some Baltimore gentlemen were done out of about three years ago.

The *N. Y. Tribune*, which published the account of the arrest a few days ago, concludes that the culprit in limbo is the same individual who swindled the Baltimorean merchants in a similar ingenious manner, as follows: About three years ago a man came to Baltimore and introduced himself to a real estate agent as Mr. Gephart. He unfolded his scheme of increasing the bulk of gold, and invited the agent to call at his rooms. The agent gave Gephart a gold dollar, which was placed in a small crucible and a white powder was added by Gephart. The two men took turns at a blowpipe in increasing the heat of the crucible until the gold was melted and mixed with the chemical. It was then allowed to cool, after which Gephart took it out, gave it to the agent and told him to send it to the United States Mint to be assayed and recoined. The mint officials returned a report showing three times the amount of gold that was put into the crucible. The real estate agent became convinced of the value of Gephart's secret, and introduced Gephart to several wealthy citizens, and they too became convinced of Gephart's ability to increase the bulk of gold.

A stock company was formed, and the basement of the house of one of the men interested was selected as the place of operations. One of the gold increasing company furnished about $50,000 in gold and the other four about $10,000 each. In the presence of the whole party Gephart apparently put all this gold into one of the vats and placed it on the fire. He then put in a quantity of the powder and other chemicals. In doing this, however, he declined to permit any of the party to approach the vat, saying that the fumes of the chemicals would overpower any one not prepared to risist them. A top was put on the vat, and at the suggestion of Gephart extra strong locks were procured, and the vat was securely fastened with them. The same precautions were taken with the door of the basement. The keys were given to the man in whose house the experiment was being tried. Gephart said that the vat must not be opened for three weeks. After remaining about the city for several days, Gephart said he was called to a distant city on business, but would return on the day appointed for taking out the gold. He did not come as promised. The real estate agent became suspicious, and persuaded the party to make an investigation. They went to the cellar, and upon opening the vat found that the gold had all disappeared, while in its place was a lot of rocks and scrap iron. The men were dumfounded. The cellar had been entered surreptitiously and the gold stolen.

AN IMPROVED METALLIC RAILROAD TIE.

A metallic railroad tie of very simple form, designed to be durable in use, and which permits of the use of



SAUNDERS' METALLIC RAILROAD TIE.

ordinary spikes for securely fastening the rails in position, is shown in the accompanying illustration, and has been patented by Mr. Ellison Saunders, of Austin, Texas. Integral with the base plate of the tie, and at each end thereof, are recessed blocks, flat on top, to form a solid rest for the base of the rails without adding unnecessarily to the total weight of the tie. To strengthen the base plate, and to serve as braces, the recessed blocks at the end of each tie are connected by a rod, on one end of which is a head, while the other end is provided with a tightening nut. Each of the blocks has four diagonal apertures for the passage of ordinary spikes, the heads of which engage the base of the rail, while their points are clinched on the outside of the blocks as shown in Fig. 1. Ordinarily two spikes only will be sufficient for each block, one at each side of the rail, but when two rails are joined together over the block, four spikes will be employed to hold the ends of both rails firmly in place. The blocks at the ends of the base plate may, if desired, be connected by two brace rods, in which case the rods are placed over the base plate at the sides, as shown in the sectional view, Fig. 2, the fastening spikes then passing through the blocks under the rods. On the under side of the base plate, near each end, are transverse lugs, in line with the rails, to prevent lateral movement of the tie and assist in anchoring it in place.

Pancreatic Juice.

In the person of a patient recently operated on in Warsaw for tumor of the pancreas, an opportunity has occurred of ascertaining the composition of human pancreatic juice. After the removal of the tumor by the thermocautery a drainage tube was inserted, and when the discharge ceased to be purulent and assumed the character of pancreatic juice alone, it was examined. It formed a tenacious yellowish turbid liquid, with a distinctly alkaline reaction. At a temperature of 100° F. the juice actively converted starch into maltose, egg albumen into peptone, and olive oil into an emulsion. On analysis it gave water 86·405 per cent, organic compounds 13·251 per cent, including albuminoid bodies 9·205 per cent, and extractive matters soluble in alcohol. Salts—consisting of carbonates, chlorides, phosphates, and sulphates of sodium, potassium, calcium, and iron—0·344 per cent. On comparing the human pancreatic juice with that of other animals, it was found to resemble most nearly that of the dog, according to Schmidt's analysis.—*Lancet.*

WITH one or two trifling exceptions, the submarine cables of the world, which stretch over 120,000 nautical miles, and have cost 200,000,000 dollars, are of British construction.

AN IMPROVED DUMPING CART.

A simple and convenient cart, that is easily constructed and operated, and which combines lightness with strength, is shown in the accompanying illustration, and has been patented by Mr. Mark A. Libbey, of South Berwick, Me. It has a cylindrical body pivoted between the wheels, and a sliding cover, the body being operated by a gear mechanism. The body is preferably of sheet metal, with its ends slightly cone-shaped, each end having a thickened central portion, from which project trunnions into the wheel hubs. On these trunnions is pivoted a U-shaped frame, to the front part of which the shafts are attached. On one or both of the body ends is an annular flange or pulley, to which are secured the ends of a chain which passes over a sprocket wheel on a shaft held to turn in lugs on the under side of the U-shaped frame, just in advance of the body. On this shaft is a gear wheel meshing with a gear on the lower end of a vertical shaft, supported to extend up near the driver's seat, and provided at its upper end with a crank, so that by turning the crank the cylindrical body may be turned on its axis. On the transverse shaft are also ratchet or cog wheels, adapted to be engaged by teeth of spring-held arms projecting upward through the foot platform, whereby the body is held in the desired position. The sliding cover has lugs on its ends to overlap the edges of the cylinder and hold the cover in position thereon, and is provided with a spring latch to be engaged by a catch on the cylinder to hold the cover in closed position. In loading the cart the body is turned to bring its opening at the top, the cover being closed after loading. When the load is to be dumped, the driver opens the cover, and, by means of the crank on the vertical shaft, turns the body bottom up. A modified form of this invention is also provided, by means of which the horse may be brought closer to the load. In this case the chain and sprocket wheel are dispensed with, and the end of the body itself is provided with a gear meshing with another gear on the lower end of the vertical shaft extending up by the driver's seat, the body then being turned directly by means of the gears.

LIBBEY'S DUMPING CART.

ATKINSON'S CYCLE GAS ENGINE.

At the present time our attention is attracted by any device that promises to reduce the cost of producing power, or, to state it with greater accuracy, utilizes a larger percentage of the energy stored in coal. At the present time the gas engine leads, developing an indicated horse power from less than 1½ pounds of coal, results of one test showing 1·11 pounds per indicated horse power per hour, and that, too, in a 12 horse engine developing but 7 or 8 horse power. If such results as these can be obtained in every day practice, the gas engine is the coming motor. In this country its development has not progressed so rapidly as in Europe, and we are but beginning to realize that it is a more economical motor than the steam engine and will eventually supersede it. It has been and still is generally regarded as a motor suitable only for small powers, but that the contrary is the case, and that large, powerful gas engines can be built, the mechanical world is just beginning to see. This being the case, those engaged or interested in the production of power should familiarize themselves with the history of the gas engine, with the principles controlling its operation, and with the mechanical devices adopted in the various engines that have, from time to time, been placed on the market; they would then be in position to judge intelligently of the relative merits of the surviving engines.

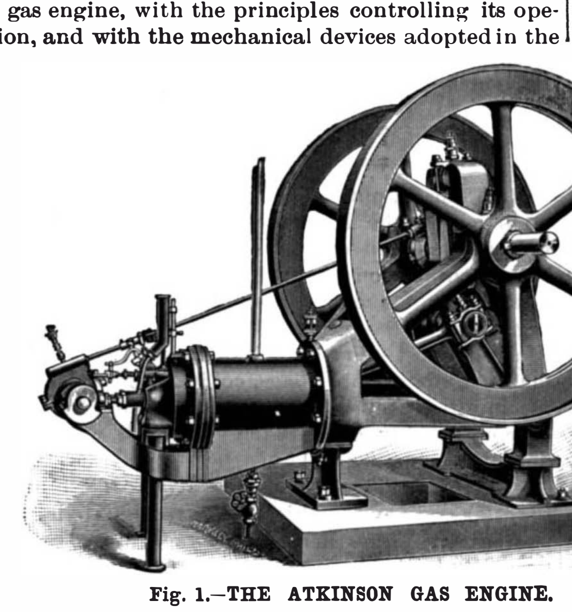


Fig. 1.—THE ATKINSON GAS ENGINE.

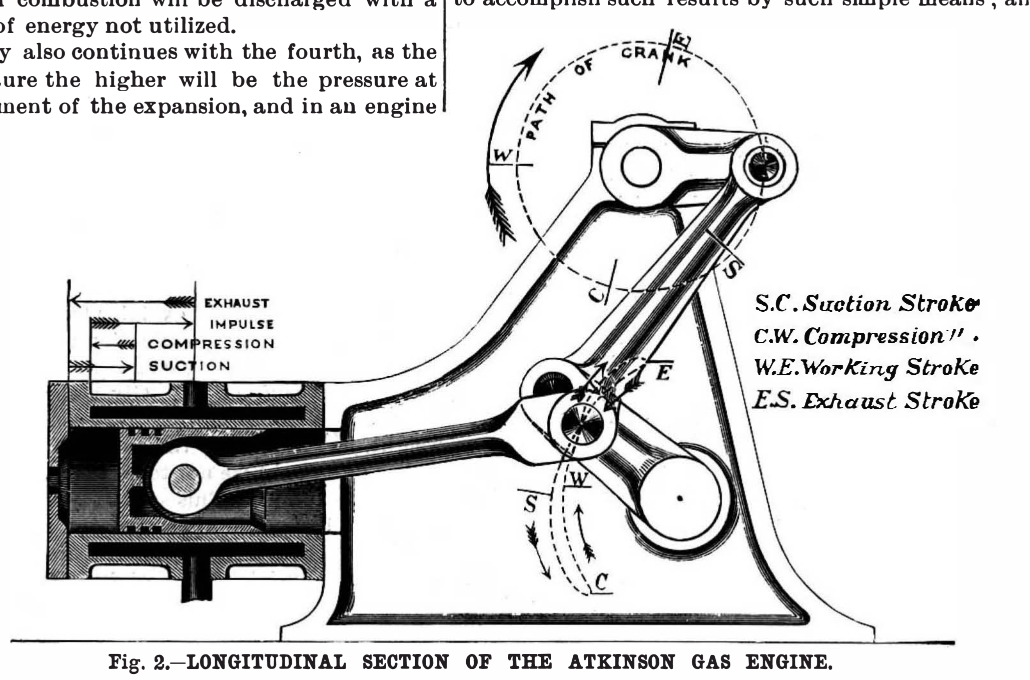


Fig. 2.—LONGITUDINAL SECTION OF THE ATKINSON GAS ENGINE.

It is not our intention to give the history of the gas engine, but merely to call attention to the conditions necessary to obtain the greatest economy. Clerk, in his work, "The Gas Engine," refers to a pamphlet published by Beau de Roches, in Paris, in 1862, and we quote: He states that to obtain economy with an explosion engine, four conditions are requisite:

1. The greatest possible cylinder volume with the least possible cooling surface. 2. The greatest possible rapidity of expansion. 3. The greatest possible expansion. And 4. The greatest possible pressure at the commencement of the expansion.

In using boiler tubes, he states the efficiency of the heat transmitted increases with the reduction in the diameter of the tubes. In the case of engine cylinders, therefore, the loss of heat of explosion would be in inverse ratio to the diameter of the cylinders.

Therefore, he reasons, an arrangement which, for a given consumption of gas, gives cylinders of the greatest diameters will give the best economy, or least loss of heat to the cylinder. One cylinder only must be employed in such an engine; but loss of heat depends also upon time. Cooling, therefore, will be proportionately greater as the working speed is slower.

The sole arrangement capable of combining these conditions, he states, consists in using the largest possible cylinder, and reducing the resistance of the gases to a minimum. This leads, he states, to the following series of operations:

1. Suction during an entire outstroke of the piston. 2. Compression during the following instroke. 3. Ignition at the dead point and expansion during the third stroke. 4. Forcing out of the burned gases from the cylinder on the fourth and last return stroke.

The ignition he proposes to accomplish by the increase of temperature due to compression. This he expects to do by compressing to one-fourth of the original volume.

The only successful engines that have been placed on the market are those embodying the above cycle. All others have had but a short life and have disappeared. Some of these have been resurrected under different names, only to repeat the same history.

In designing an engine to meet the conditions laid down above, the first may be provided for by careful designing, and the second by high piston speed; this being limited by the time necessary for complete combustion. But the difficulty begins with the third, as the greatest possible expansion can only be obtained by expanding the charge to a volume greater than the original volume; for when expanded to the original volume only, the charge will have a high terminal pressure, and if expansion is only carried to this point, the products of combustion will be discharged with a large amount of energy not utilized.

The difficulty also continues with the fourth, as the purer the mixture the higher will be the pressure at the commencement of the expansion, and in an engine in which the four strokes are of equal length, it is impossible to obtain a pure mixture, owing to the fact that the necessary compression space is, after the exhaust stroke, left full of the products of combustion, and these, of course, adulterate the charge and reduce the pressure. There is also another disadvantage attending the use of such a compression space, and that is, that it places a limit upon the size of the engine; for if an engine of large power is built, the cooling surface of the cylinder will bear such a small ratio to the volume of the cylinder that the percentage of heat lost to the surfaces by the products of combustion during the exhaust, suction, and compression strokes will be very small, and the temperature of the charge will be so high that when the heat due to compression is added a premature explosion will take place, and the motion of the engine be retarded or reversed. Consequently, to increase the power of engines after certain power has been reached, one or more cylinders have been added, forming, in reality, separate and distinct engines connected to one crank shaft.

A new engine has, however, appeared which not only overcomes the difficulties presented by the third and fourth conditions, but also the latter trouble; and, in order to emphasize the statement that it approaches more nearly than any other to the ideal engine, we would call attention to De Roches' cycle as followed in engines of the Otto type.

During the suction stroke the charge is drawn in and mixes with the products of combustion. The next stroke compresses it, ignition then takes place, and it is expanded to the original volume only, and the terminal pressure is high. The products of combustion are then expelled by the fourth stroke.

The new engine referred to—Atkinson's Cycle Gas Engine—performs all these operations in one revolution of the crank shaft. Fig. 1 is a perspective view of the engine and Fig. 2 a sectional elevation, showing only the mechanism by which the above operations are effected. It will be noticed that the different operations are obtained by the addition of but two parts—a link, which vibrates through the arc of a circle, and a connecting rod, and by changing the position of the crank shaft in relation to the cylinder. The outer end of the piston connecting rod is attached to a pin passing through the crank connecting rod, and the latter is connected to the link. The different centers are so placed in relation to each other and to the center line of the cylinder that the center of the pin to which the piston connecting rod is attached travels in a curve resembling the figure eight, passing over the portion, S E, during the suction stroke, over C W during the compression stroke, over W E during the working stroke, and over E S during the exhaust stroke. The figure shows that the compression stroke is shorter than the suction stroke, that the working stroke is almost double the suction stroke, that the exhaust stroke ends with the piston as close to the cylinder cover as it is possible mechanically to have it, and that the working stroke takes place in one-quarter of a revolution. It is apparent that, with a given rotative speed, greater rapidity of expansion can be obtained with this engine than with engines of other types, and that it is possible to expand the charge to such a volume that the terminal pressure will be reduced to the lowest practical point, and that, owing to the purity of the charge, the greatest possible pressure will be attained at the commencement of the expansion. Owing to the fact that practically all the products of combustion are expelled, the incoming charge will attain no higher temperature in a large engine than in a small one, and, consequently, large sizes can be built.

This, certainly, is a remarkable piece of mechanism to accomplish such results by such simple means; and the results of tests made by disinterested parties show that the friction cannot be any greater than in an ordinary engine. If this engine should prove a commercial success, operated in conjunction with a producer for making cheap fuel gas, there can be no question as to its superseding all other prime motors. We understand it has proved successful in England, and is now being manufactured in this country.

BRICKS are enameled by being dipped into a slip composed of finely ground enamel suspended in water. They are then dried and fired a second time.

On Poisons.

Dr. Meymott Tidy's emphatic oratorical style is familiar to and popular with London lecture audiences. The announcement that he would explain to the members of the London Institution "What is a poison?" brought together an unusually large audience on Monday, March 16. The lectures delivered at the institution are marked by several excellent features. There is a chairman, we believe, but he never speaks; there are no votes of thanks. The lectures begin punctually at one hour and finish punctually on the stroke of the next, and, unless you take a very prominent seat, you can glide out at any time you like without disturbing the rest of the company. Nobody glided during Dr. Tidy's lecture. He knows poisons very intimately, and he can tell what he knows in the most attractive style. We do not know how Dr. Tidy says "Good morning," but can hardly imagine that he would say it without introducing some dramatic effect.

Toxicology, he said, is the science of poisons. How comes it to be called toxicology? The Greek word from which it was derived meant a bow, and was used to signify not only the bow but also the arrows used with it. Dioscorides, in the first century, first used the term in connection with poison, which was at that time associated with the art of smearing the arrow heads used in warfare. Thus the meaning of the word tended to enlarge itself, trying, as words do, to keep pace with scientific progress. In that Greek word *toxon* was to be found not only the derivation but the early history of poisoning.

A grim interest gathers round the history of poisoning. No doubt the first poison employed was that obtained from the snake. The subtle serpent first taught the art to man, but in those early days it was used in open warfare. But man grows wiser, and perhaps wickeder, and it was reserved for later times to taint the cup of friendship with the deadly venom. Was the suggestion too wild that if it had not been for the invention of more effective means of slaughter, the chemist would still have been called in to aid in the art of poisoning weapons? But if he had missed his chance in that respect, he could still look back to the early days of toxicology as the cradle of science.

This art of poisoning arrows went back to quite prehistoric times. Mythological legends tell how Hercules dipped his arrows in poison to slay the Hydra, and how his jealous wife clothed him with the coat of Nessus, wherewith she vainly hoped to regain his affection, but only occasioned the sufferings which destroyed him. Strange it is to note how old is the knowledge of the poisonous nature of putrid blood, and of putrid animal fluids generally. This was recognized in very early times. The blood of a red-haired woman was regarded as especially poisonous. And up to almost recent times blood itself was thought to be poisonous. A king of Egypt was said to have been killed by drinking bullock's blood, and not more than a century and a half ago Blumenbach induced one of his students to drink the same, while he and his class stood by to watch the symptoms.

The stories of Circe and Medea, of Drusilla and Locusta, of Tiberius and Nero, of Toffana and the Medicis, were tempting, but were not the subject of the lecture. He had to deal with the question, "What is a poison?" The law has not defined it, but the law frequently demands a definition from scientific witnesses. The popular definitions of a poison are none of them sound, much less scientific. He had searched every dictionary he could put his hands on and believed that the definition in every case amounted to this: That a poison is a drug which kills rapidly when administered in small quantities. But many poisons do neither the one nor the other. The terms "small quantity" and "rapidly" were about as definite as the classical piece of chalk. "Here," said the lecturer, holding up bottles containing nearly an ounce of each, "are oxalic acid and sugar of lead, in about the quantities necessary to be taken to make sure of a fatal result. But we should hardly call these small quantities. And yet these are certainly poisons. Moreover, many of the most certain poisons are very slow in their action."

Dr. Tidy defined a poison as "any substance which, otherwise than by the aid of heat or electricity, is capable of destroying life by chemical action on the tissues or by physiological action on the organs of the body. There's a good lot of it," he added, "but I can't get it into fewer words." Of course, he explained, mechanical means were excluded. You might kill yourself by swallowing pins, but pins were not poison. Nor is a substance a poison which destroys life by merely blocking out that which maintains life. Then he took two glass jars, one containing carbonic acid gas and the other nitrogen, and dipping a taper in each, showed that it was easily extinguished. "So would you go out," he said, "if you were introduced into either atmosphere. But the nitrogen is not a poison. With 20 per cent of oxygen in it you can live quite easily; but neither 20, nor 40, nor 60 per cent of oxygen would enable you to live in an atmosphere of carbonic acid gas, which is a poison." He proceeded to say that nature hates classification, but he must give illustrations of three classes of poison. First, he alluded to sulphuric acid, and showed a part of a stomach charred by the action of this poison. A caseful of stomach and other tissues was shown, illustrating the effects of various poisons, but time did not allow of these being explained. The charring effect of sulphuric acid was explained by the familiar experiment of pouring sulphuric acid on a thick solution of sugar, showing that the effect of the oil of vitriol was to abstract the water, and thus to cause the "charring." The stomach dies. That is molecular death, and this death soon extends to the rest of the body.

Carbonic oxide furnished an illustration of a second class of poisoning. A bottle of this gas was lighted at the neck, and burned with a blue flame, "the same as that which you see just over your fire stoves. This gas is always present in coal gas to the amount of 5 or 6 or 7 per cent, and gives it its poisonous character. I don't think carbureted hydrogen burning in the gas jet is at all poisonous. I think all the poison is in the 5 or 6 per cent of carbonic oxide. How does it destroy life? In this way: The active agent of our blood is the red coloring matter called hæmoglobin. This substance abounds in wonder. I think it is the most marvelous compound, chemically, with which we are acquainted. To live and thrive and flourish we must get albumen and albumenoids. We cannot form these ourselves, but the plant can. The power of building up albumenoid substances is limited to the plant laboratory. Man has the power to change one albumen into another. He can convert albumen into peptone, for example; he can break them up into albumen lower in the scale; but he cannot go higher—*with one exception*. That exception is hæmoglobin, the red coloring matter of the blood. This hæmoglobin, which comes on the scene through a stage opening of which we know not the whereabouts, has a strange property. As a rule, substances which combine with oxygen with the greatest difficulty can be separated from it with the greatest ease; and, conversely, substances which combine with it with great ease can be separated from it only with the greatest difficulty. Gold is one of the most difficultly oxidizable of bodies, and its oxide is most easily reducible. Potassium and sodium, on the other hand, combine with oxygen with the greatest ease, but it required the genius of a Humphry Davy to separate them. Hæmoglobin is an exception in this respect also. It combines with and separates from oxygen with equal facility. The life of man depends on the perfection with which hæmoglobin performs its function as oxygen receiver, oxygen carrier, and oxygen deliverer. But when a man takes carbonic oxide, hæmoglobin combines with this almost as easily as it does with oxygen, and, having taken it, the carriage is full; it cannot take up any oxygen. But, worse than that, it cannot get rid of the carbonic oxide; the carrier cannot unload. In scientific phraseology, the combination of hæmoglobin and carbonic oxide is a comparatively stable compound. The man dies because the sequence of oxidation is interrupted."

Strychnine was the third illustrative poison introduced. This poison was said to destroy life by physiological action. "And what do I mean," said the lecturer, "by physiological action? I mean just simply that I don't know what I mean. Not knowing how it acts, I use the phrase physiological action to conceal my ignorance. It would never do to say we did not know how drugs act, so we say it is a physiological action. But we know one thing about the action of strychnine. We can tell by means of the spectroscope that the fits resulting from the administration of strychnine coincide exactly with the abstraction of oxygen from its compound with hæmoglobin. Why it kills we do not know, and let me remark that it is one of the highest forms of knowledge to know exactly the limits of our knowledge. In fact, the term physiological action no more explains death by poisoning than the term catalysis explains fermentation."

But can chemical investigation throw no light on the reason for the poisonous character of certain elements and certain compounds? Given that we know many facts about phosphorus, for example—its atomic weight, its relations to the periodic law, its spectrum, and so on—ought we not to be able to foretell, in some degree, its action? This subject was studied first by Blake in 1841, and afterward by Rabuteau in 1867, and by other investigators. At first it was thought that the physiological activity of the elements increased the ratio of their atomic weights, but it was afterward noted that the reverse was the case in certain groups, and the end of the researches was the conclusion that neither in regard to elements nor compounds could any reliable rule be formulated. In inquiring into this subject further difficulties occur in the strange allotropic forms of certain elements and the isomerism of the organic compounds. Illustrations of these conditions were adduced in yellow and red phosphorus, the first of which, the lecturer said, would be fatal in 2 grain doses, while of the other an ounce might be taken without injury, as far as he knew. Ozone was another mysterious body. Every one knows that oxygen is the great life-preserver and life-sustainer. Ozone is oxygen in which three atoms are condensed into each molecule instead of two. But if you put a frog into ozone, into this condensed oxygen, it will soon close its eyes, its respiration will fall rapidly, and it will die simply for want of oxygen. As an illustration of isomeric bodies take these two substances, morphia and piperine, send them to a chemist for analysis, and his report will be that they are identical in composition; and yet the one is of all things in the world that which is most calculated to send one to sleep, and the other is of all things in the world the compound to keep you awake.

In ancient times the arts of witchcraft, medicine and poisoning were bound up together. The Greek word pharmakist was used to signify dispenser of medicines, a witch, and a poisoner. One of the great services that science has rendered to mankind has been to separate these notions. The modern pharmacist no longer requires the stuffed crocodile to watch over his incantations, to aid in the composition of his medicines. And science has done more than this. It has rendered impossible the secret villainies of the old poisoners. It follows the traces of secret treachery with a blood-hound scent, and will ultimately tend to repress entirely the crime of poisoning.—*Chem. and Drug.*

Accelerated Fermentation.

The invention by F. Hofmeister, Munich, Germany, consists in spreading the ferment used over a large surface immersed in the liquid to be fermented. For this purpose the fermenting vessel is provided with a large number of diaphragms, bars, bands, or strips, preferably consisting of some pure tasteless fabric. In order to take up as little vat space as possible the supports are made very thin, and the surfaces are placed in an inclined position, and in some cases perforated to allow of the ready escape of the carbonic acid.

The fermentation of wine, beer, etc., is started as follows: The ferment-supporting surfaces are sprinkled with old must, beer, etc., and the tun is closed and a current of air aspirated through the apparatus for thirty-six hours. The must, wort, or other liquid is then run into the tun, when fermentation soon commences. Or, the arrangement of surfaces may be at once placed in a fermenting liquid, with the result that fermentation will be considerably accelerated. In order to produce sparkling drinks the tun and its ferment carriers are placed in a strong vessel provided with a lid, which is fitted with a pressure gauge, tap, and manhole. After fermentation the liquid may be drawn off through a tap at the bottom, which communicates with the fermenting vat. Two forms of the above apparatus are described. According to temperature and other factors, a pressure of four to five atmospheres is developed in a period of one to six days. If fermentation has been carried on slowly (three to six days), the wine may be drawn off quite bright, provided the apparatus has been kept at rest.

The use of ferment-bearing surfaces is of great importance to breweries. Fermentation can be carried on at a lower temperature than usual, and since fermentation goes on rapidly, a smaller number of vessels will suffice. The invention will also be of great value to distilleries, leading to a considerable economy in time. The losses which usually occur owing to the passage of unfermented matter into the wash, and to acid fermentations produced at the expense of alcohol, will be entirely prevented by the rapid fermentations at comparatively low temperatures obtainable by the use of this system. The working efficiency of the apparatus increases with its age; only the deposits on the surfaces should be withdrawn about every two months.

An Englishman's Views of American Trusts.

Mr. Plimsoll, a member of the English Parliament, in an article in the *Nineteenth Century*, has discovered that in the United States no less than seventy-one large combinations were organized in 1888–89. Some of these include many others, in all 490 "trusts" were organized in two years. They have been formed to control almost every branch of industry, including the manufacture of paper bags, coffins, and pickles, and it is computed they include no less than $2,000,000,000, or considerably more than two-thirds of the entire manufacturing capital of the United States. Mr. Plimsoll is afraid that further attempts will be made to foster and develop this odious trust system in England, and he urges her legislators to rouse themselves promptly to the danger of this fearful menacing calamity. He suggests that a select committee or a royal commission should be constituted without loss of time, "to inquire into the whole of the subject."

LORD SALISBURY is quite a distinguished savant as well as a renowned statesman. In a recent lecture before the Chemical Society of London, he said: "Astronomy is, in a great measure, the science of things as they probably are, geology is the science of things as they probably were, chemistry is the science of things as they are at present." To these adds the *Electrical Engineer*, "electricity is the science of things as they probably will be."

Correspondence.

A Pretty Experiment with a Diamond Ring.

To the Editor of the Scientific American:

A diamond, however small, will reflect an object or a landscape, and show to the eye a brilliant and perfect picture.

To illustrate this the operator must place himself with his back to the object to be reflected, and raise the hand containing a diamond ring so that the stone is close to the eye, and opposite the object. Close the eye not in use, and move the diamond closer to or further away from the eye, to bring the picture to a sharp focus.

By this means it is possible for a person to sit in a room with his back to the company and see all that is going on. ARTHUR S. GREEN, photographer.

Frankford, Pa.

To the Editor of the Scientific American:

So many persons have given their way of cutting off glass bottles, and as I have a way I think far ahead of any I have seen mentioned in your paper, I will explain, as it may be of some interest to your readers.

I take a piece of large wire and bend it in a circle to fit around the bottle, leaving the two ends of wire projecting an inch or two. This wire I clamp around the bottle by tying a cord around the ends of the wire. Then with an ordinary glass cutter I follow the clamp all around. Then remove the clamp and tie a soft cord around the bottle at the cut; saturate it with coal oil. When the oil has about burned off plunge the bottle in water. I have never failed to cut the thickest bottle perfectly smooth. CHARLES HUGHES.

Red Bluff, Cal., May 13, 1891.

To the Editor of the Scientific American:

It seems to me that the *Electrical Engineer* doesn't draw the right moral in what it has to say of "Telephoning in French," page 291. It is this: When telephoning in French, use plain English. It is the world language.

In your article on "A Hanging Garden and a Model Office Building," a slight error occurs. The architects were not Townsend & Mix, but Townsend Mix & Co., of Milwaukee and Minneapolis. Mr. Mix died lately. The "Co." is Mr. W. A. Holbrook, who lives in Milwaukee. I have often admired that Minneapolis pile and regret that none of the magnificent buildings contemplated in Milwaukee seem to include the peculiar features which make the Guarantee Loan Building justly celebrated. W. K. FRICK.

381 21st Street, Milwaukee, May 9, 1891.

To the Editor of the Scientific American:

I send you a few pieces of cracking coal, with reference to Mr. Geo. M. Turner's article on cutting glass in your issue of April 18, page 245.

At the first glance you see that its use (which I described in your issue of October 4, 1890, page 213) is quite the same as the use of a red hot poker or a small gas flame, with the only difference that it is not so awkward by far as a poker, and requires no preliminary arrangements, as the gas flame.

I am astonished that the sprengkohle seems to be quite unknown in your country. Therefore I give you the address of our first rate store, whence it may be got. It is Lenoir & Forster, Vienna V. Waaggasse 5. I do not remember what I paid for the case I send you. At all events it was a trifle, perhaps 15 or 20 cents.

FRED. MULLER.

Vienna, May 1, 1891.

[A trial of the cracking coal shows it to be very satisfactory for the purpose named.—ED.]

Jet Propulsion.

To the Editor of the Scientific American:

I have been a constant reader of your valuable paper, the SCIENTIFIC AMERICAN, for the last fifteen years, and I, as well as all the members of my household, look forward to its appearance in the house every week as a source of pleasure and profit to us all. During the above period I have read with interest the different articles appearing in its pages on the system of propelling vessels by a jet of water under pressure. In your last week's issue, May 9, there is an article on this subject from the pen of Mr. Alex. Vogelsang. His ideas as stated therein are, I believe, valuable, but they do not embrace enough to solve the difficulty or give the best results. I have devoted a good deal of thought and study to this subject, and the conclusion I arrived at two years ago, in order to get the highest rate of speed, was to have the vessel propelled by a combination of the screw propeller (smaller than the usual size) and one or more jets of water under heavy pressure, in the following manner: Have the propeller shaft hollow except the extreme outer end, and the wings of the propeller also hollow, and these hollows to connect with the hollow in the propeller shaft by suitable openings, and have an opening or nozzle in each wing of the propeller, not on the outer ends of the wings, but in their sides or edges well out to their outer end, opening in the opposite direction of the vessel's way or course. Have the force pumps in the vessel connected with the hollow propeller shaft, which needs to be no longer than to give the necessary bearings by means of a gland and packing. It will follow by forcing water at a high pressure through the hollow shaft, thence through the openings into the hollow wings and out at the openings or nozzles in the edges of the wings, that the same results claimed by Mr. Vogelsang will be attained, and the propeller will be forced to revolve by the force of the water leaving the openings in the wings, and thus the power of the improved jet and the propeller will combine to give motion to the vessel. This in my opinion is the true way or principle to get the most power out of one or more jets of water for propelling a vessel. The further details which I have worked out would be too lengthy to give at present writing, but would do so if necessary at some other time. JAMES S. PARMENTER.

Woodstock, Ontario, May 13, 1891.

Jet Propulsion.

To the Editor of the Scientific American:

In your edition of May 9, 1891, Mr. Vogelsang gives his experience in jet propulsion. The subject is one of entrancing interest, and the more discussion there is on it, the sooner we shall get sifted down to facts and possible success, and view the subject from a practical standpoint.

All the proposed plans I have read of deal in small jets with high velocity. These bore a hole in the water, but do not propel. It would seem possible to get the best results by offering volume of resistance to volume of power. If the power is so great as to annihilate the resistance, the power is wasted and little or nothing gained in propulsion. If a lower velocity of power was applied against an increased surface of resistance, would it not produce more satisfactory results? We do not want a sledge hammer to strike at a fly.

Power is ordinarily most effective at its point of application, which in jet propulsion would be just beyond that point where it issues from the pipe and begins to press upon the water. If the resistance is slight, the movement of the boat is slow, but if the power applied is met with a commensurate area of resistance, the speed of the boat will be increased. If the outlet is confined to one jet, it must be large, or it might be better to have several outlets at different points. The possible merits of centrifugal jets must be determined by trial.

The same article states that "a great velocity is imparted to the adjacent water, in the same direction as the moving vessel, by which the jet would meet with little resistance and create a greater slip" (?)

That parallel movement of the water would be an advantage as far as resistance and slip is concerned. If the water was stationary, the movement of the boat would necessitate greater velocity of the jet to offset the difference. This fact is well known in regard to stern wheel boats, in which the slip of the wheel is much below that of side wheels. The square stern carries with it a mass of water by the suction of the boat's movement, and thus offers a better resistance to the paddles than if it flowed away from the boat at the same speed as the boat progressed.

It may be well to consider the area of resistance to the paddle wheel, which it is proposed to supplant with a jet.

Say three paddles immersed, each 15 ft. long and 2 ft. wide, would give 90 ft. area to each wheel or 180 ft. to two wheels. That represents an ordinary area of steamboat paddle, driven with great force against 180 square feet of water, and such a power as therein exists we can hardly hope to equal with a syringe.

The wheel is solid and the water gives away before it. With water driven against water there is a double loss by such contraction. There is a dreamy future to jet propulsion like there is to electricity. We do not know how very little we know about it.

J. B. BROLASKI.

St. Louis, May 9, 1891.

A Lightning Stroke.

To the Editor of the Scientific American:

Having been a constant reader of the SCIENTIFIC AMERICAN for the last ten years, and having seen occasionally accounts of the freaks of lightning in its columns, I would like to write you of the work of a stroke near this place.

On the evening of April 25 last, during a violent thunder storm, the lightning struck the lightning rod on a dwelling house, followed the rod until it came to a defective insulator, then entered the house, striking Mr. Roode about half inch back of the ear and burning its way the entire length of his body, then through a wool mattress, splitting a hard maple bedstead, afterward passing through various parts of the house until it reached the water pipe.

After four hours of skillful work Mr. Roode regained consciousness and is on the road to recovery. His body is now so heavily charged with electricity that he can impart to any one taking him by the hand an electric shock equal to that received from a powerful battery.

Jewett City, Ct., May 13, 1891. L. D. HOWE.

Coast Defense.

At a recent meeting of the Institute of Naval Architects, London, Lord Brassey expressed his views as follows:

We have now to deal with coast defense. The flotilla for this purpose should include rams, monitors, and armed torpedo vessels of the Polyphemus type improved. For coast and harbor defense a torpedo flotilla has been proved to be in a high degree effective. Seven ironclads and eleven other vessels were sunk by defensive torpedoes during the American war of secession. In the war with Paraguay, the Brazilian ironclad Rio de Janeiro was destroyed by similar means. During the Russo-Turkish war the Turks lost a gunboat and a monitor in the Danube, and a steamer of 1,200 tons at Batoum. It will probably be well to have torpedo boats of two classes. The first class, of not less than 150 tons, should be able to cruise with the fleet within a certain distance from the coast. The second class boats, for harbor defense, may be of small size and cheap construction. In the conditions which favor the attack by the torpedo boat upon heavy ironclads blockading a port, a small and cheap type will be almost as effective as one more costly. Of fifteen attacks with the spar torpedo, enumerated by Ledieu and Caudiat, seven were more or less successful. The same authors mention it as a notable fact that, while in all cases of frail construction, no boat armed with the spar torpedo has yet been destroyed by the enemy's fire.

In proposing the defense of harbors by a torpedo flotilla, he offered no new suggestion. In inviting more attention to the monitor type, he entered on more debatable ground. The Monitor was designed by Ericsson with the view to reduce as much as possible the surface exposed to the enemy's fire. It was capable of floating at a light draught. In the bombardment of Charleston 2,330 projectiles were fired by the forts. The monitors were struck 256 times. They sustained no serious injury, and must be pronounced to have been thoroughly efficient for coast service and harbor defense. With their deck openings properly closed, they withstood the fury of raging seas. In the United States the qualities of the monitor type have always been highly appreciated, and a heavy expenditure has been incurred in rebuilding many of the original vessels. The American board of naval policy recommended a ram with a displacement of 3,500 tons. The navy department has produced a design, now in course of construction, of 2,950 tons displacement, heavily armored, no armament, speed 18 knots. Our Polyphemus, simplified and cheapened, offers a type which we have unaccountably neglected. The French are building two torpedo rams considerably smaller than the Polyphemus. We should build rams of a type which should not only be adapted for coast and harbor defense, but efficient for service with a sea-going fleet. In concluding these observations on cruisers, he would press most strongly the necessity of a large re-enforcement to the navy of first-class cruisers of the Blake and Blenheim and Edgar types. The necessity for the smaller class is obvious, but our requirements have for the present been largely provided for under the Hamilton programme.

As a five years' programme, he would propose ten battleships, six armored coast defense vessels, monitors, six armored rams, Polyphemus type improved, forty cruisers of the first class, thirty look-out ships, and fifty torpedo gun vessels.

In conclusion, he regretted that he appeared as the advocate of a heavy expenditure on naval defense. Our necessities have been created chiefly by the policy of other powers, who are making preparations to take the offensive if the occasion should arise. The splendid enterprise of our seamen and our merchants involves expenditure on the navy. Year by year our shipping bears an increasing proportion to the aggregate tonnage of the world. Property of a value exceeding £150,000,000 is always afloat under the British flag. To create a trade of enormous magnitude, and to make no adequate preparation to defend it, would be to invite attack and to expose ourselves to humiliation.

Killed by Locusts.

A recent telegram from Algiers, Africa, says the French savant, M. Kunckel Herculais, the president of the Ethnological Society, who was employed on the government mission of investigating the locust plague in this province, has met a horrible death. While examining a deposit of locusts' eggs at the village of Sidieral, he was overcome with fatigue and the heat and fell asleep on the ground. While sleeping he was attacked by a swarm of locusts. On awaking he struggled desperately to escape from the living flood. He set fire to the insect-laden bushes near him, but all his efforts proved ineffectual, and when finally the locusts left the spot his corpse was found. His hair, beard, and necktie had been entirely devoured.

M. Herculais was a member of the French Academy and the author of several valuable works on insects.

THE YARYAN PROCESS AND APPARATUS FOR EVAPORATION OF LIQUIDS.

BY H. H. D. PEIRCE, M.E.

We present to our readers the following description of the Yaryan process and apparatus for evaporation of liquids, not only as of interest from a scientific point of view, but because the "Yaryan" has become so essential a part of many manufactories that a thorough knowledge of its construction and working is necessary to every engineer. We give illustrations showing a quadruple effect in plan elevation and section and a perspective view of a vertical triple effect.

The process of M. Rillieux, invented in 1830 for evaporation by triple effect, had, up to the time that Mr. Yaryan gave his attention to it in 1885, never been improved upon. This device, though defective in many ways, was still so great an advance that for more than fifty years no further steps were taken. As recently as 1882 M. Paul Horsin Deon, in his treatise on sugar making and evaporation, remarks that "the working principle of Rillieux apparatus must never be changed, as it has never been improved upon."

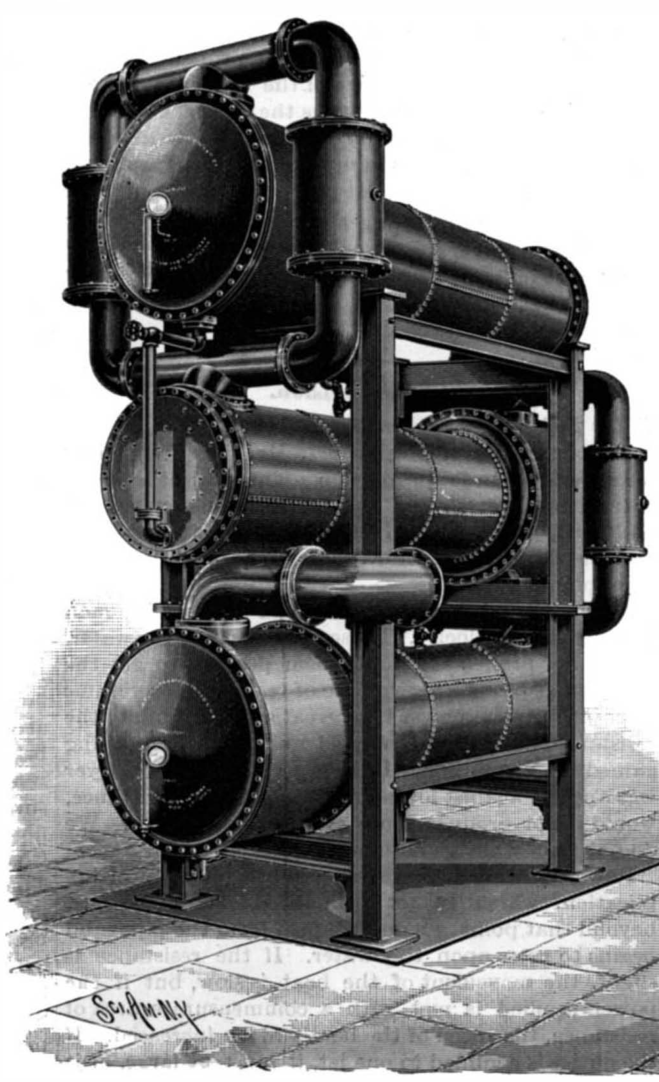
The distinguishing features of the Yaryan system are film evaporation and the rapid motion of the liquid through the tubes during the process. With regard to the latter point, the experiments of Herr Hugo Jelinek, of Prague, show the following results:

Velocity of the liquid per second in meters.	Calories absorbed per square meter.
0·312	22·7
0·640	33·6
1·020	46·9
1·640	69·9

It is claimed that in practice the Yaryan apparatus shows an efficiency per square foot of heating surface of more than double that of any previously known. At the exhibition of novelties at the Franklin Institute in Philadelphia in 1885, two successive tests before the judges showed an evaporation of 31·5 pounds of water per square foot of heating surface; the temperature of feed water being 125° Fah. A second test was demanded by the judges, such efficiency seeming impossible. A medal was finally awarded the Yaryan Company upon these tests. This high efficiency is gained partly by film evaporation and partly by the rapid motion of the liquid. Other advantages of the rapid motion are that no particle of the liquid to be evaporated remains long in contact with the heating surface and that scale forms with less rapidity. In the treatment of many solutions this is of the greatest value, as continued subjection to high temperature would injure the product. For example, in the boiling of sugar great care has to be taken not to produce caramel, thus injuring the color by overheating.

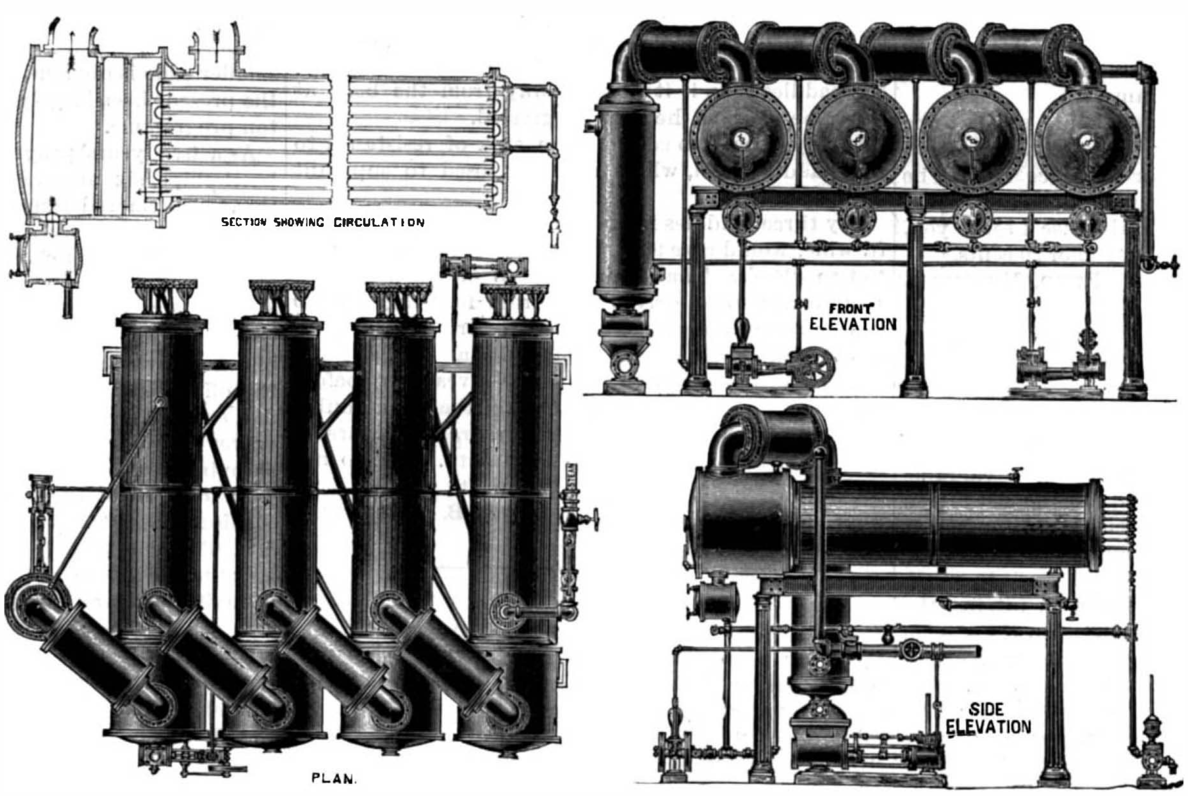
The operation of the Yaryan apparatus is as follows:

The steam, which may either be exhaust from the engine or live steam direct from the boiler, is led into the cylindrical chamber surrounding the coils in the first effect. The liquid to be concentrated is fed into the first tube of the return bend coils of the first effect in a small but continuous stream and immediately begins to boil violently, becoming a mass of spray, containing as it rushes along the heated tube a constantly increasing proportion of steam. The inlet end of the coil being closed to the atmosphere, and steam being continually formed, the contents are propelled through the tubes at a high velocity, finally escaping from the last tube of the coil into the separator. Here the now reduced volume of liquid falls to the bottom, while the vapor passes away at the top, coming in contact in its passage with a series of baffle plates in the separator which remove any entrained liquid. From the separator the steam passes through an ingeniously constructed catch-all which effectually removes any liquid which may still remain to the chamber surrounding the coils of the second effect, where its heat produces the further evaporation of the reduced liquid. In the second effect, the liquid is led from the bottom of the separator of the first effect into the coils, and the same operation takes place as in the first effect, and so on through the entire system, whether triple, quadruple or more effects are used. The steam from the final effect goes to the condenser and



YARYAN'S TRIPLE EFFECT APPARATUS.

vacuum pump, a vacuum of twenty-eight inches being thereby maintained in the separating chamber and consequently in the coils. Hence, the boiling point of the liquid is at a lower temperature than that of the surrounding steam, and by the condensation of the steam from the previous effect upon the cooler pipes in this effect, a vacuum of a less degree is maintained in the next preceding effect. This relative reduction in pressure, and consequently boiling temperature, automatically adjusts itself, however many effects are



YARYAN'S EVAPORATING APPARATUS—QUADRUPLE EFFECT.

used, thus effecting the boiling of the liquid by the steam produced by its own evaporation in the previous effect.

The advantages claimed by the Yaryan system over other systems of evaporation, whether in vacuo or open air, are as follows: 1. It is more economical in steam, using the latent heat at different temperatures with a greater number of effects than any other system. Many are in operation having four effects, and the system may be carried to six effects without difficulty. 2. It is automatic in its action, taking its own supplies required and delivering the product concentrated to the exact density desired continuously. 3. The liquor is not subjected to high and injurious temperatures for more than two minutes, while in all other systems large quantities are retained for a long time under those conditions. 4. The pumping and mechanical arrangement is much simpler and less liable to get out of order. 5. The priming and consequent boiling over of frothy liquids is absolutely prevented. 6. The entire apparatus is easily cleaned. 7. The apparatus is lighter in itself, and inasmuch as but a small quantity of liquid is contained in it for a given time, it requires a less expensive foundation. It also occupies less space than any other machine for the purpose. 8. There is absolutely no coloring of the liquid during the process of concentration. 9. An evaporative efficiency more than double per square foot of heating surface over any known system of evaporation.

To the manufacturer of sugar, whether from cane or beet juice, or in the refinery to reduce sweet water, the Yaryan evaporator is of especial interest, owing to the large quantities of liquor which must be handled daily and the liability to inversion which all sugar solutions possess. With the ordinary triple effect, the heat of the first effect—which reaches nearly 200° F.—and the length of time it is subjected to this heat are fruitful sources of inversion. With the Yaryan system frequent tests with the polariscope demonstrate that there is no inversion whatever, and consequently no loss of sugar. As previously explained, this is one of the advantages of the rapid motion of the liquid through the machine.

The "Yaryan" has been adopted by over 100 of the leading sugar refineries throughout the world, including La Refinerie C. Say, of Paris; Messrs. Henry Tate & Sons, of London; Messrs. Hogg, Curtis & Campbell, of London and Demerara; Stewart Gardner, Esq., of London and Demerara; Messrs. Gardenin Brothers, of Lipetsk, Russia; The Havemeyer Refining Company, of New York; Messrs. Harrison, Fraser & Co., of Philadelphia.

Previously to the introduction of the Yaryan system, every attempt to evaporate the spent alkali liquor of soda pulp mills had proved a total failure. This liquor, which is the waste product resulting from boiling the wood in a solution of caustic soda, is a liquid resin soap and quickly becomes a mass of froth under the action of heat. In the Yaryan apparatus this froth, which formerly baffled all efforts looking to the recovery of the soda, is beaten down by the rapid motion of the liquid and more rapid motion of its vapor over it, with the result that no priming over of the liquid takes place. To-day the "Yaryan" is an indispensable adjunct in every soda pulp mill of any consequence in the United States. No soda pulp mill could to-day compete with its rivals without it.

While in the manufacture of fish glue the Yaryan is a recognized necessity, in the manufacture of hide glue the manufacturers are only beginning to wake up to its advantages, and to such we would suggest a careful investigation. In the manufacture of hide glue it is generally supposed that the liquors do not require evaporation, as they will set firmly enough as run from the digestors.

Although this is true with the firsts and seconds, the practice of using thirds to boil fresh stocks with is objectionable. Certain enterprising manufacturers, recognizing this point, and the adaptability of the Yaryan to their needs, have adopted the practice of evaporating their thirds by means of this apparatus and making it into a grade of glue by itself. Experimenting further, they have found great advantage in evaporating the first and second liquors in the Yaryan, with great gain in economy of time, in drying, and of space.

For bone and pigs' feet glues, which must be reduced to at least 18° Baume in warm weather, the Yaryan apparatus is especially adapted. The difference in product obtained by firms using it, as compared with that made by the crude and barbarous methods of open evaporation, is most marked, to say nothing of the economy of production.

In the production of glycerine, the leading manufacturers thoughout the world have adopted the Yaryan system. By its use, an article much nearer anhydrous, viz., 1,264 specific gravity, is produced without loss, than can be obtained by use of the vacuum pan, and at one-half the cost of evaporation.

Among the manufacturers of glycerine using the Yaryan apparatus are Price's Patent Candle Company, of Birkenhead, England; Messrs. Proctor & Gamble, M. Werk & Co., and the American Glycerine Co., of Cincinnati, Ohio.

Other users of the Yaryan evaporator are: Manufacturers of glucose, gelatine, extract of beef, bark and wood extract and caustic soda; as well as slaughtering and rendering establishments, where it is used to concentrate tank water.

The use of fresh water for marine boilers has become a matter of necessity with the progress of engineering and the universal adoption of high pressure. On long voyages the carrying of a supply of fresh water to replenish waste is, of course, not to be thought of. The attention of engineers has, therefore, been urgently directed to processes of distillation of sea water. Nothing that has been found can compare with the Yaryan apparatus for this purpose. Its high evaporative power, its small size and weight, the fact that but a small amount of water is carried in the machine at any one time, its freedom from scaling, its automatic and continuous action, and the ease with which all its parts can be reached for examination and repair, recommend it above all other machines.

For distilled water for domestic purposes, nothing has hitherto been devised which offered a satisfactory solution to the crying need in many of our cities for pure water for drinking purposes. Germs of typhoid and other insidious diseases held in the water, the native element and best of all breeding places for bacteria, cause hundreds upon hundreds of deaths each month. Freezing does not affect them except to make them torpid, so that ice formed on ponds holding the germs of typhoid or typhus may become a deadly poison. For this reason artificial ice made from distilled water is rapidly growing in favor and displacing —even at an increased cost—natural ice, which may bring disease or death into the household.

To the manufacturer of artificial ice the Yaryan evaporator, which enables him to obtain distilled water at four times the economy of the old process of distillation, is a *sine qua non.*

In several cities the distribution of distilled water by pipes is seriously contemplated, using the Yaryan process of distillation. At present a large business is done by several companies who furnish distilled water, either in bulk or in bottles, at a cost of from 10 cents a gallon upward. Already a plant for production of distilled water on a large scale is under construction, by means of which it is confidently claimed that absolutely pure water will be produced at a cost of less than fifty cents a thousand gallons.

It may well be considered whether the Yaryan system of evaporation does not offer the much needed solution of the problem of the disposition of the sewerage of cities. By means of this process, a fertilizer could be produced from sewage water which could be sold as a commercial fertilizer.

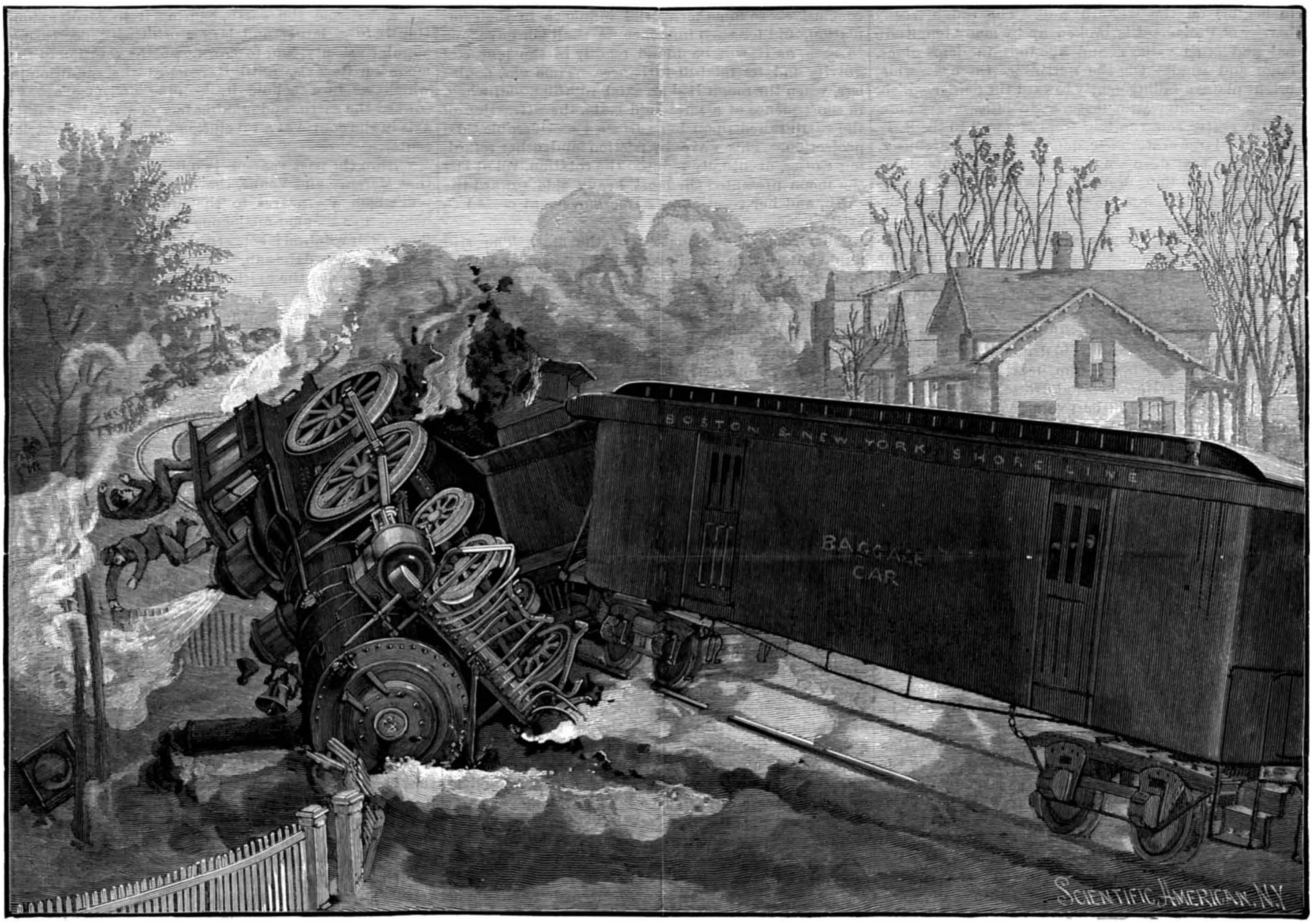
A REMARKABLE RAILROAD ACCIDENT.

A noteworthy instance of the very singular manner in which railway accidents sometimes take place, and where the escape from great loss of life seems little less than miraculous, was afforded by the wreck on the Shore Line Railroad, a little east of New Haven, on April 18, which forms the subject of the accompanying illustration.

The east bound Boston and New York Express left New Haven at 3:05 P. M. The train consisted of the locomotive, one baggage car, and four passenger cars. It had just passed over the long Quinnipiac River bridge, and was rounding a curve, when the flange of the left hand forward truck wheel of the locomotive broke, and a portion of the wheel nearly eighteen inches long flew off. The train had been going at the rate of only about twelve or fifteen miles an hour over the bridge, and the engineer had just opened the throttle for full speed when the accident happened. With the breaking of the flange, the wheel left the track on the curve, the other truck wheels and the driving wheels also being derailed and bumping along on the ties for some distance, as the locomotive was pushed ahead by the impetus of the train, the locomotive being finally turned completely around and thrown to one side of the track, landing in a partially crosswise position over a shallow ditch or gully. The engineer had been leaning from his cab window, and he was pitched forward into the ditch, the locomotive falling over him, but not upon him, so that he was enabled with a little assistance to crawl out, not having received any serious injuries. The fireman likewise went over in the cab and was thrown out into the mud and water of the ditch. The engineer saw the truck wheel strike the ties, and instantly put on the air brakes and blew the whistle.

Just beside the track, at the place where the accident happened, is a private residence, from which the manner of its occurrence was noted by eyewitnesses. It is said that the momentum of the train appeared to lift the rear end of the locomotive, so that the frame of the cow catcher caught in some heavy planking at the side of the track, when the locomotive was made to turn almost a complete somersault before it landed in the ditch. The tender, which had been drawn from the rails by the engine, was finally swung around and landed in the ditch to the rear of the locomotive, its forward end also pointing in a direction opposite to that in which it had been going. The connecting link between the tender and baggage car was broken, and the latter was pushed into an embankment on the opposite side of the track, when all further progress of the train was stopped, the first passenger coach, which had not left the track, being brought to a standstill immediately opposite the derailed and overturned locomotive, which but a moment before was pulling the train.

The damage to the locomotive was by no means as great as might have been expected, although the cab was broken to pieces, the cow catcher broken and its rods twisted out of shape, and the iron sheathing punctured and ripped in many places. The locomotive was built in 1873, and was to have been taken to the repair shops the next week. The engineer testifies to having tried the wheel with a hammer before the train left New Haven, but a few minutes previous to the accident, and that he found it good and sound. It would have been a little remarkable for the truck wheel to have left the track in such a manner had it not been that the engine was on a curve, and the comparatively slow rate at which the train was moving tended to minimize the danger. As it was, there were not a few of the passengers who felt profoundly thankful that the accident had not happened some four hundred feet further back, when the entire train might have been precipitated from the high bridge into the Quinnipiac River.



A RAILWAY ACCIDENT—N. Y., N. H. & H. R.R.

To get a good polish on mahogany easily: Mix one part of boiled linseed oil with two parts of alcoholic shellac varnish. Shake well before using. Apply in small quantities, with a cloth, and rub the work vigorously until the desired polish is secured.

The Moon.

At a recent meeting of the British Astronomical Association, London, Mr. T. Gwyn Elger read a paper on "The Lunar Walled-Plain Ptolemaus," which was illustrated by lantern slides prepared by Mr. A. Wheeler and exhibited by Mr. Maw. After describing the telescopic aspect of this magnificent circumvallation under a low sun, and the more prominent details which may be seen under these conditions, even in a small achromatic of 2¾ in. or 3 in. aperture, he said that it is an hexagonal shaped inclosure some 115 miles in diameter, the area of the floor being about 9,000 square miles, or approximately equal to the combined areas of the counties of York, Lancashire, and Westmoreland. Its dimensions are so great that, were it possible for any one to be stationed on the floor near the center of the ring, he might easily imagine that he was standing on a boundless plain, so long as he looked only to the north, east, or south, as not a peak or any indications of the existence of the complex and massive border would be visible.

Even on turning westward, one object only would break the monotony of the horizon, and this the upper one thousand feet of the great peak η (nearly 8,700 ft. in height) on the western wall. The rough, rocky barrier of Ptolemaus is broken up by many longitudinal and cross valleys, and abounds in depressions, large and small. On the northwest there is a wide, bright plateau falling gently toward the border, which, among other interesting features, includes a very noteworthy crater row running from the wall to the S. E. side of a large crateriform depression, Hipparchus r, which has two deep contiguous craters on its S. W. side. The late Rev. Prebendary Webb found that the direction of this crater row was continued down the eastern slope of r, by a delicate cleft, now called "Webb's Furrow." Hipparchus r has a central mountain, easily visible under a moderately high sun. The shadow of the mountain η is very conspicuous and beautiful at sunrise, when the three peaks which surmount it may be well observed in very "common telescopes," and the crater near its highest point is very clearly visible on the wall in instruments of moderate aperture. The north and northeast border, and the neighborhood of Herschel and Herschel d, include a vast amount of detail hitherto unrecorded, but which will be mapped and catalogued in the monograph of the formation which is being prepared under the auspices of the association.

The floor, in addition to the many craterlets and saucer-shaped depressions and low ridges visible thereon, is traversed by a system of light markings and associated light spots, even more remarkable than those discovered in Plato, Fracastorius, and Archimedes. Between January, 1881, and August, 1883, Mr. A. Williams recorded at least 85 of these faint, light streaks, which objects will, of course, receive the close attention of the section, with a view to confirm his observations. The hexagonal shape of the border of Ptolemaus is far from being a solitary instance of the tendency to a six-sided figure among the larger class of walled and ring plains. The same peculiarity may be noted in the case of Copernicus, and in many other of the so-called rings, large and small. The explanation of this, and also of the fact that arrangement of the mountains and highlands of which it is made up have in many places no apparent relation whatever to the contour of the floor (a structural condition also not confined by any means to Ptolemaus), may be left to the ingenuity of the framers of hypotheses. In describing the eastern wall, Mr. Elger referred to a remarkable gap in it, where for a distance of three or four miles there is no barrier at all between the floor and the outside country. In conclusion, he contended for the importance of the observer acquiring a correct appreciation of the actual size of the formation he studies so as not to underrate the true significance of details. He also urged the members of the section not to attempt to draw more of Ptolemaus, or any other formation, than they can reasonably hope to finish during the course of three or four hours' observation, and to devote themselves to a limited area, or their work would not possess any great selenographical value.

Mr. Green then gave a paper on "The Lunar Seas," which was also illustrated by means of the lantern. He said: On examining a map or photograph of the moon, it will be evident that these seas follow a definite order of arrangement, the smaller being near the limb and the larger nearer the center of the disk. There is not a single instance of these dark areas extending to the limb, and although large craters may be found there, and larger still are revealed by libration, they are not filled with dark matter like the seas. It should also be observed that even when the dark formations come very near the limb, as on the northeast, there is still an unbroken line of bright surface beyond them, so that we have no reason to expect that similar blotches exist on the side turned from the earth. The brighter portions of the lunar surface are separated most definitely from the seas, by being higher, more detailed, and to a great extent covered with crater-like forms. The seas, on the contrary, are lower, comparatively smooth, and craters few and far between. The question then arises, which of these two so widely diversified surfaces is the older? It has been supposed by some that the seas represent the more ancient state of our satellite and that the crater-covered surface has encroached on them; yet this cannot be the case, for the shapes of the seas would then have been that of the spaces left between invading circular forms; but this is not the case; the seas tend greatly to circles, and press forward into the crater-covered surface with a fairly even line, broken occasionally by the remains of partly destroyed craters. Mr. Green illustrated this point by drawings of Fracastorius, the ruins of the north wall of which he pointed out could be seen under favorable circumstances, and of Doppelmeyer, Gassendi, and the Sinus Iridium.

He also showed how the base of the Apennines appeared to be fringed by great masses of debris which seemed to have fallen from their summits. He then resumed: Thus far we have found that the lunar seas are comparatively a recent formation, that they increase in size from the limb toward the center, and that in all probability they exist only on the side which is turned toward the earth: These circumstances point conclusively to some terrestrial influence in their formation, and for such influence we shall not have long to seek, as it will be found readily in the power of gravity and its tidal disturbances. Time was, doubtless, when the moon had an axial rotation, and when, in consequence of a semi-fluid state, the attraction of the earth raised upon her surface a considerable tidal projection. This wave, by friction and other retarding causes, eventually reduced the rotation, till at last the moon presented the most heavy side toward the earth, and her rotation as a free movement ceased to exist.

Then came the formation of the seas. The still liquid interior, in obedience to the powerful attraction of the earth, welled up through every crack and opening, choosing, of course, the weakest places, and, spreading on the surface, reduced it again to the semi-fluid condition, where now it is to be seen in the various forms of these lunar seas. It need not be supposed that these irruptions rose to a higher level than the older crater-covered surface; but that the heated mass cut its way into the general surface which it undermined, and gradually reduced the fallen portions. An example of this may be seen on the eastern edge of the Apennines, near Archimedes. The possibility of this remelting process is evident from the frequent cutting of one crater form into another, portions of the older crater being thoroughly destroyed by the contact.

Mr. Alex. J. G. Adams said: The idea that, owing to tidal action by the earth, lunar seas exist upon the side facing us only, was not quite clear to him. Were we to assume a single tide alone? The effect of gravitation was the production of two tides in a line with the disturbing body, and he thought this state would apply to the moon. Moreover, while in no way detracting from the general hypothesis, and while fully allowing for cleanness at the disk edge, the probability of double tide carried with it the idea of seas upon either side the moon. The point of tidal lag had been touched upon and deserved further remark. Our tidal effects were always in rear of causation, and in some cases there appeared to be a harmonic give and take, as exampled by the fact that whereas the spring tides lagged more and more each spring lunation, the neaps gained, insomuch as to produce occasional overlapping. In the case of the moon, however, it was probable, owing to coincidence in her periods of orbital and rotative motions, that her tidal lag would be comparatively fixed, and seemingly just such as to produce decrease of sea upon her western limb.

Consumption Germs.

Speaking at the Sanitary Convention in Vicksburg, Miss., of December, 1889, Dr. A. Arnold Clark, of Lansing, Mich., as reported in *Popular Science Monthly*, accepted the germ as the chief source of the disease, and referred to experiments in which the germs had been found on the walls of rooms where consumptives had been. They are derived from the dried sputa of the patients. Animals, according to Dr. Cagny, feeding on the sputa die of consumption, and the disease has been produced by inoculating with the sputa, by swallowing it, and by breathing it. "When we think of the ten thousand consumptives in Michigan who every hour in the day are expectorating along our streets, and even on the floors of public buildings, post offices, churches, hotels, railroad cars, and street cars, when we think how these germs are being dried and carried into the air by every passing breeze, by every sweeping, and how they are capable of producing the disease six months after drying, when we think of the miscellaneous crowd sleeping in hotel bedrooms, when we think of the close, unventilated sleeping car with hangings and curtains so well calculated to catch the germs, and where, as some one has said, the air is as dangerous as in those boxes filled with pulverized sputa where dogs are placed for experiment, then when we remember that man's lungs are a regular hot house for the multiplication and growth of these seeds of consumption—is it any wonder that one citizen in every seven dies of this disease?" As the lesson from these facts, the author advises that no consumptive should be allowed to expectorate on the floor or street, and all sputa (from consumptives) should be disinfected and burned.

The Tides and the Stars.

One of the most interesting steps in the wonderful advance of astronomy during the last forty years is that taken a few years ago by Prof. George H. Darwin in his investigation of the effects of tidal action in the evolution of the solar system. According to Prof. Darwin's conclusions, the moon was born directly from the earth in the molten stage of our planet's history, and at the beginning of its career revolved rapidly around the earth at very close quarters. At that time tremendous tides were raised upon each of these plastic masses through the attraction of the other. By means of reactions, which can be demonstrated readily with simple geometrical figures, although their full analytical investigation is an intense mathematical process, the effect of the tides is both to drive the moon gradually away from the earth, causing it to revolve constantly in a larger and larger orbit with decreasing angular velocity, and to slow down the rotation of the moon on its axis, until it reached the condition in which we now behold it, keeping one face always toward the earth, and making but one rotation on its axis in the course of a revolution around its terrestrial center.

Within the past year or two it has been discovered that Mercury and Venus, the only planets of our system which are nearer to the sun than the earth is, behave in a manner analogous to that of the moon, so far as their rotation is concerned. They always keep the same side toward the sun, ust as the moon always keeps one face toward the earth. It is not improbable that these planets may have been brought into their peculiar condition by the effects of tidal friction, although the problem presents great difficulties.

Quite recently an attempt has been made to apply the principle of tidal evolution to those wonderful solar systems known as the double or binary stars. Mr. T. J. J. See, of Berlin, has made a mathematical investigation along this line which leads him to some exceedingly interesting conclusions concerning the constitution of the universe. In a binary system there are two suns, often far exceeding our sun in magnitude, which, held in comradeship by their mutual attraction, revolve around their common center of gravity, carrying their families of planets, if such they have, round and round in ceaseless gyrations. One remarkable feature of such systems is that the orbits of the revolving suns are exceedingly elongated ellipses, differing in this respect very widely from the nearly circular orbits of the planets in our system. Another feature is that, while one of the members of the combination is almost always noticeably smaller than the other, yet in no case is the disproportion of magnitude anything like so great as that which exists between even the largest of our planets and the sun.

Both of these peculiar features of the binary stars are explained by Mr. See's hypothesis. He concludes that the fact that the two stars are always comparable in size indicates that they owe their origin to the splitting up, through the effects of rapid rotation, of a condensing nebulous mass which was nearly homogeneous throughout its volume. He shows, mathematically, that the greater the departure from absolute homogeneity in the parent nebula, the wider the difference in magnitude of the two masses after the separation would be. His investigations lead also to an explanation of the highly eccentric orbits of the binary systems, by showing that the effect of tidal reaction between the two masses after separation had taken place would be not only to drive them gradually apart, but to increase the eccentricity of their orbits.

Perhaps the most interesting thing that Mr. See points out as a deduction from his investigations is that we cannot take our solar system as a type of solar systems in general. The smallness of our planets in proportion to the sun, and the near approach to circularity of their orbits, indicate that our system resulted from exceptional conditions, which, perhaps, have not been precisely duplicated. This conclusion will undoubtedly be welcomed by those who hold with Dr. Whewell that ours is the only inhabited world, and yet, surely, proof of the infinite diversity and variety of the universe cannot militate against the belief that nature is as perfect in binary systems and in sun clusters as in our little corner of space.—*N. Y. Sun.*

PROF. ELIHU THOMSON finds in his experiments on the physiological effects of alternate currents that the danger of the current diminishes as the number of alternations per second is increased. Thus it took twenty times as strong a current to kill a dog when the alternations were 4,500 per second than when they were 120 per second. When the alternations were 300 per second, the current was only half as dangerous to life as when the alternations were 120.

The Origin of Petroleum.

In a late number of the Austrian *Zeitschrift fur Berg- und Huttenwesen,* Professor Hoefer sums up the discussion of this subject, and claims a substantial victory for the theory of the animal origin of petroleum, which he has steadfastly maintained since 1877.

The arguments in favor of this theory were at first chiefly drawn from the observed geological conditions of the occurrence of petroleum ; and the principal argument against it has always been a chemical one. It has been urged that the absence of nitrogen in petroleum must be fatal to the theory of its animal origin, because an oil produced from animal substances could not fail to be nitrogenous. One answer to this argument was furnished when Dr. Engler actually produced from blubber and other animal fats an artificial petroleum, free from nitrogen, as might have been expected, since the fats are non-nitrogenous. And Engler declares that the absence of nitrogen in natural petroleum is a necessary result of its production from animal remains, because the nitrogenous flesh decays rapidly and assumes soluble forms, so that it would be removed before the fat, which is peculiarly stable, began to be transformed by the slower process of dry distillation. This proposition was confirmed by Dr. M. Albrecht, who treated several thousand mussels and fishes in this way, and found that the ammonia and nitrogenous organic bases incidentally produced were easily removed by reason of their extreme solubility in water.

But Peckham's examinations of the petroleum of California, Texas, West Virginia, and Ohio showed the presence of nitrogen, and led to the general acceptance for these oils of the theory of an animal origin, which was still denied by many for the non-nitrogenous Pennsylvania oil. Prof. Hoefer, however, still held to his former view, declaring the geological conditions of the Pennsylvania and New York oil fields to be such as could not be reconciled satisfactorily with the hypothesis of vegetable origin.

In his latest paper he repeats and enlarges an argument based on the presence in natural gas of more nitrogen than can be accounted for by an admixture of air. If natural gas be admitted to have resulted from the decomposition or distillation of animal remains, the probability of a similar origin for petroleum is greatly strengthened.

The large percentage of nitrogen in the natural gas of Pennsylvania—amounting to something more than 25 per cent—is well known. The gases in Baku have been shown to be nitrogenous likewise. Certain earth gases in Alsatia have yielded by analysis up to 17 per cent of nitrogen. And in all these cases the amount of oxygen, free or combined, revealed by the analysis is too little to account for the nitrogen as derived from an admixture of air.

To these evidences, Professor Hoefer now adds the analyses of the natural gas of Ohio and Indiana, as given by Orton in the *Economic Geology of Ohio* and by Howard in the *Mineral Resources of the United States* for 1888. All three of Professor Howard's analyses and two of the four given by Orton show an excess of nitrogen over the amount necessary to form air with the total oxygen.

Moreover, the gases from the mud volcanoes of northeastern Italy have been repeatedly analyzed; and Professor Hoefer cites 13 analyses, the provinces of Bologna, Florence and Ravenna, in which the amount of nitrogen clearly bears no relation to that of oxygen (here present as CO_2).

A further proof is drawn from the interesting report, published last summer by Gumbel, on the mineral and geological character of the samples taken from the sea bottom during the scientific exploring voyage of the Gazelle. In samples taken from depths of 500 meters and over, fine globules of fat were found—similar in character to the *adipocere* sometimes found in ancient graves, or the fat still remaining in some fossil bones. Director Gumbel recognizes the possible significance of this discovery in connection with the origin of petroleum. It is clear that, to some extent, the *adipocere* of small marine organisms is at the present time accumulating in the ooze of the deep sea bottom. The frequent presence of petroleum in nummulitic Eocene strata is at once suggested as a related phenomenon ; and I may add that the petroleum found in the Niagara limestone, and particularly in the pores of *Favosites niagarensis,* seems to be another corroborative occurrence.

The contention of Professor Hoefer may be considered, perhaps, as still lacking complete demonstration—that is to say, it may be said that he has not proved the animal origin of *all* petroleum or absolutely disproved the vegetable origin of that of the Pennsylvania field. But it seems to me that he has made out a strong case, and that the chemical argument once relied upon in opposition to his theory has been much reduced in force, if not entirely destroyed.—*R. W. R., in Engineering and Mining Journal.*

NEW LANTERN EFFECT.

Not every one can go to Europe, but, possessed of a lively imagination, one may go there in spirit, provided only that the scenes are presented pictorially in a truthful and artistic way. Thanks first to the skill of the optician, and secondly to the modern photographic art, any one may be instructed and entertained by the modern lanternist, who will produce storm or sunshine, winter or summer, or the soft effects of moonlight at will upon the screen by the skillful manipulation of the optical lantern with a truly wonderful effect, but there are many effects which seem to be difficult of execution by means of the optical lantern.

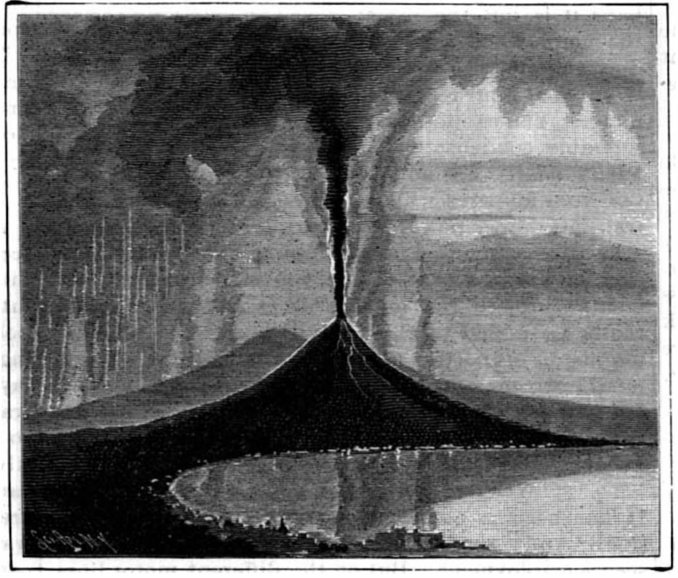


Fig. 1.—ERUPTION OF VESUVIUS.

The saying is, "See Naples and then die ;" but what is seeing Naples without seeing Vesuvius in active eruption? Comparatively few European travelers have the good fortune to witness this phenomenon, and until now, so far as we are aware, no one has been able to faithfully represent this awe-inspiring spectacle.

Mr. H. C. Ogden, of Middletown, N. Y., has come to the aid of the lanternist and the non-traveler, by producing a very simple apparatus by means of which Vesuvius, in full eruption, may be projected on the screen in a very vivid and realistic manner.

Fig. 1 of the engravings shows the scene as it appears on the screen, and Fig. 2 shows the apparatus by which the effect is produced. The main idea of Mr. Ogden is illustrated in this apparatus, but our artist has added an improvement which is designed to represent the flowing lava as well as the upwardly projected flame and smoke.

In a glass tank attached to the lantern are inserted two curved drop tubes, with their extremities placed side by side, and on the rear of the tank is painted a picture of the volcano, which is represented mainly in profile by black varnish applied to the glass. The tips of the drop tubes coincide with the crater of the volcano, and from the crater down the sides there are transparent streaks representing lava. To the side of one of the clamps holding the tank together is attached a spring carrying a strip of metal which extends along behind the opaque portion of the picture, and is provided with teeth, as shown in dotted lines, which are designed to irregularly eclipse the transparent streaks.

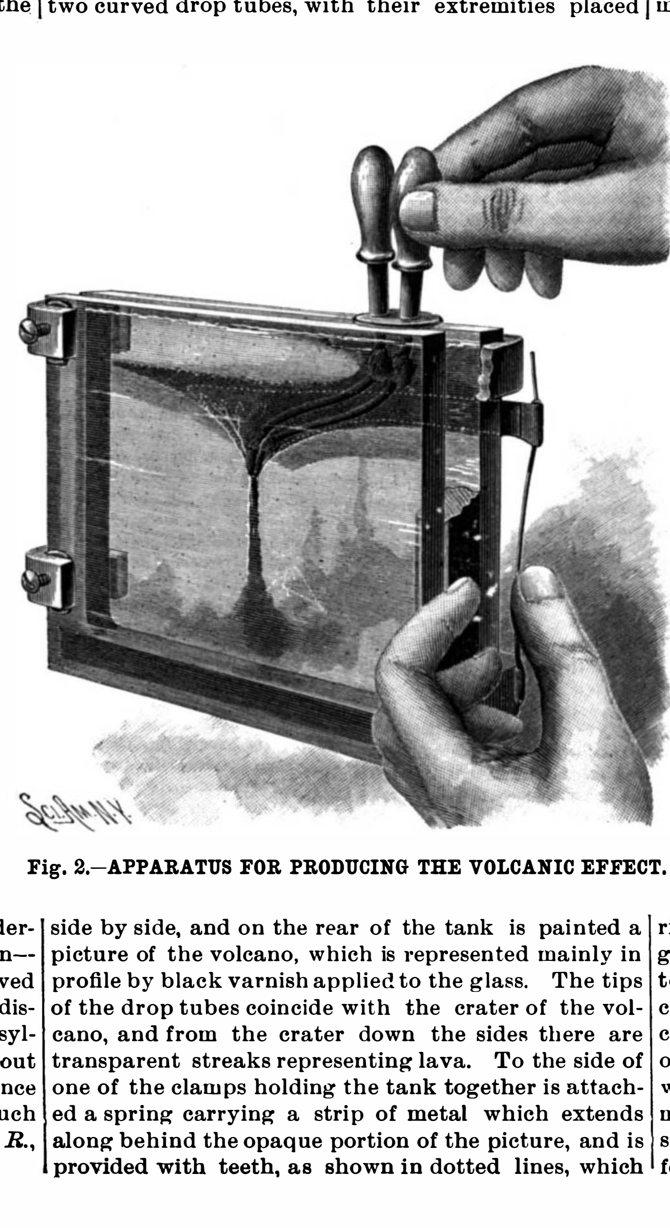


Fig. 2.—APPARATUS FOR PRODUCING THE VOLCANIC EFFECT.

In one of the drop tubes is placed a dark liquid, such as diluted ink, and in the other is placed a bright red liquid, as red aniline ink. The tank is filled with a solution of glycerine and water and inserted in the lantern. Dexterous manipulation of the flexible bulbs of the drop tubes produces red and dark streaks representing fire and heavy smoke, which are forced down in the tank and have the effect of rising in the image on the screen. At the same time the manipulation of the spring at the side of the tank alternately displays and covers the streaks representing the lava.

Electric Cars Run by Waterfalls.

The advance in all electrical matters is really marvelous. Last week we noticed the fact of a village in the Alps being lighted by electricity, the power being derived from a water wheel. And now comes this week's *Engineer* and tells us that in the town of Dover, on the Salmon Falls River, on the division line of Maine and New Hampshire, the water power furnishes not only light and heat to that town but to several distant towns also. Power is also furnished to a street railway seven miles in length. The water wheel has a capacity of 500 horse power.

Greenwood Springs, Col., is in a blaze of electric light ; mills, pumps, hoists, and tramways are successfully run miles away from the power station at the falls. During the winter months the Pelton wheels, though incased in ice for weeks together, keep spinning away without cessation.

In the north of Ireland, the Giant's Causeway electric railway, eight miles in length, derives its power from two Alcott turbines, that drive dynamos which deliver electric power to the motors of the railway.

At Burgenstock, near Lucerne, Switzerland, there is an electric mountain railway, which, with its appurtenances, is a triumph of engineering. The Burgenstock is almost perpendicular ; from the shore of Lake Lucerne it is 1,330 feet, and it is 2,800 feet above sea level. The total length of the road is nearly a mile, and it is operated by two dynamos of 25 horse power, worked by a water wheel of 125 horse power. Between Pazzala and Lugano, in Italy, there is a large waterfall, which supplies the water conducted through iron pipes to the dynamo room, where two Girard turbines, of 300 horse power each, run two dynamos, one for continuous and one for alternating currents, the former working the tramway motors, the latter supplying nearly 2,000 16 candle power lamps at the hotel and in private buildings.

Haulage of Canal Boats by Locomotives.

At a meeting of the Railway Union in Berlin, says *Iron,* Herr Wiebe described some experiments recently made on two lengths of the Oder and Spree canal, 3½ miles long in all, with a view to ascertain the best method of towing large boats. The submerged chain system is, he states, unsatisfactory, nor has the endless rope system of traction given entirely satisfactory results when practically tested during the course of the experiments, though a great many types of supporting posts and pulleys were tried. The difficulty encountered arose from the rotation of the rope as it moved onward, which tended to twist the boat painter about the rope, and the form of connection between the rope and the painter could not be depended on to stop this action. Further experiments were then made by attaching the rope to the center of gravity of a heavy towing car drawn by a light locomotive, such as is commonly used in mines. If the rope is attached directly to the locomotive, trouble may arise from the side pull of the rope tending to overturn the engine. It is for this reason that the towing car was adopted in the experiments in question. This plan is stated to have proved satisfactory, and boats have been towed by it at the rate of from 10 to 12 feet per second (7 to 8 miles per hour), though a speed of 5 feet (3½ miles per hour) will, in general, be sufficient. The tension on the tow rope in starting three heavy coal barges was as much as 1,764 pounds, but rapidly decreased as the boats gathered way.

Improvement in Microscopic Lenses.

It is stated that an immense improvement has recently been effected in the manufacture of glass for optical instruments by means of the addition to the ordinary materials of phosphorus and chlorine, which in some as yet unexplained way cause the glass to be very much more transparent, and enable it to receive a much higher degree of polish than any optical glass hitherto manufactured. Thus microscopes can be made which will render objects of the diameter of only the one eight-millionth of a millimeter visible, whereas with the best instruments now in use the diameter of the smallest object that can be seen is one sixteen-thousandth of a millimeter. This news, we fear, is too good to be true.

Good and Bad Bacilli.

The microscope seems to be demonstrating that our bodies are made up of little else than bacilli, germs, spores, bacteria, microbes, etc. And as in the old tales there were good and bad fairies who influenced the destinies of mankind, so there are good and bad bacilli. Some of them are necessary to our health. For instance, in the mouth of a well person there are always present no less than twenty-four microbes already discovered, with several outlying districts still to hear from. In disease the number of microbes in the body is multiplied innumerably.

Our friends, the microscopists, have not yet reached that point where they tell us the good bacilli are beautiful infinitesimals and pleasing to look upon, while the disease germs are wicked and ugly little monsters, but plainly, that is how it ought to be, if there is any poetry or justice in the microscope world.

The bad bacilli that play havoc with the human insides and produce illness are called pathogenic, while the good bacilli are called non-pathogenic. These are the little fellows that devour the bad monsters, act as scavengers to the system and make the cheeks rosy and the teeth white. Each disease has its own particular bacillus, and when you have one kind of illness sometimes the bacillus of another ailment will attack and destroy the army of the first one, and thus you are cured of one trouble at least.—*Monson (Mass.) Mirror.*

IN the San Francisco *Examiner* Mr. Collis H. Barton gives a description of a device invented by Prof. Barnard, of the Lick Observatory, for automatically detecting comets. The device appears to be an arrangement in which the properties of selenium are taken advantage of. A prism is placed in front of the object glass, but instead of the ocular there is a metallic diaphragm with slits in the position of the three hydrocarbon bands in the yellow, green and blue. Light passing through these slits falls on to a plate of selenium which forms one side of a Wheatstone bridge, connected to a battery and an alarm. The telescope is made by automatic machinery to sweep the semi-diurnal arc in about ten minutes, and then, after shifting northward about two-thirds of the "field," sweeping back again. The light of Sirius is insufficient to disturb the "bridge;" but with the faintest comet the prism analyzes the light, the balance of the Wheatstone bridge is disturbed, and a current is sent to the alarm bell in Prof. Barnard's bedroom, or elsewhere.

The Engineer of the Future.

Since the introduction of electricity into common, matter of fact, every day life, the demands for economical power, says W. D. Tomlin, in *Practical Electricity*, have pressed hard on the brain of the constructing engineer. Some men have boasted that steam as a motive power is doomed and its days are numbered, that electricity is the coming power. Perhaps it is, but the recent developments tend toward the employment of stupendous steam power to produce electricity; simply because electricity can be distributed at a far less percentage of loss than any other motor. You cannot carry steam 200 feet without considerable condensation, but you can distribute electricity nearly 200 miles, and at the point of distribution your amperes will be almost initial. You cannot transmit horse power by gearing, rope, belting, or otherwise without a loss of power by slippage, friction, or kindred causes; but you can distribute electricity through ten miles of lines and give to each renter his pound of electricity through a small dynamo just in proportion as his contract calls for. Young men, I can assure you of one thing: Go into the city and ask for employment as engineer; almost the first thing you are asked is: "Do you know anything about taking care of a dynamo or electric plant?" "No." "Well, we don't want you. Good morning!" It has become almost a necessity that an engineer should know something of electricity if he expects to secure employment. But on the different motor lines, the effect, to an engineer whose earlier experience has been with slide valve, is almost paralyzing. Some form of Corliss valve gear, but the steam expanded through three cylinders and then condensed. The apparent complexity becomes simplicity itself when in the hands of a single man who operates the engine for expansion results, with cylinders 16½", 28", and 42" by 60" stroke at 65 rev., in 150 pounds initial pressure, giving 1,400 horse power. Look through any prominent engineering journal, and you will find from a dozen to fifteen Corliss valve gear motions. An adjunct of the Corliss engine is the indicator; and the time is rapidly coming to us when an engineer's education will be incomplete who cannot use an indicator and adjust the valves of his engine. What the stethoscope is to the doctor, the indicator is to the engineer. Both the professions are thus enabled to examine the breathing organs of the patient. The use of an indicator, while reflecting credit on the engineer who can use it, is a possible benefit to the steam user and owner; because thereby the coal pile is considered. The owner gets the full benefit of every pound of fuel saved, the saving being a *bona-fide* transaction often affecting the balance of a set of books from a debit to the credit account.

The time is close at hand, Mr. Tomlin predicts, when an indicator will be a part of the engine room outfit, and a daily engine log be as carefully kept as the double entry set of books in the general office.

Silvering Iron.

A new process for silvering articles of iron is thus described. The article is first plunged in a pickle of hot dilute hydrochloric acid, whence it is removed to a solution of mercury nitrate, and connected with the zinc pole of a Bunsen element, gas carbon or platinum serving as the other pole. It is rapidly covered with a layer of quicksilver, when it is removed, washed, and transferred to a silver bath and silvered. By heating to 300° C. (572° Fah.) the mercury is driven off, and the silver firmly fixed on the iron. To save silver the wire can be first covered with a layer of tin. One part of cream of tartar is dissolved in eight parts of boiling water, and one or more tin anodes are joined with the carbon pole of a Bunsen element. The zinc pole communicates with a well cleaned piece of copper, and the battery is made to act till enough tin has deposited on the copper, when this is taken out and the ironware put in its place. The wire thus covered with tin chemically pure, and silvered, is said to be much cheaper than any other silvered metals.

To erase the white stains that occur in some of the bricks in newly constructed buildings, wash with dilute muriatic acid.

RECENTLY PATENTED INVENTIONS.

Electrical.

MOTOR.—Daniel J. Chisholm, New York City. This is an electric motor especially adapted for use on street railway cars, and is of that class in which the armatures are made to revolve in magnetic fields. The armature consists of a common shaft carrying independent pulleys to move between the pole pieces, the pulleys having coils held in sockets on their faces, and means for closing the circuit successively through the several series of armature and field magnet coils. The motor is designed to have great power in proportion to the current supplied, and the commutator has to a certain extent the function of a cut-out, whereby the current may be alternately passed through the different series of coils on the armature and field magnets, by means of which the motor may be easily reversed.

CRANE FOR LAMPS.—Emilio Cardarelli, Sumter, S. C. This is a device especially designed for supporting electric arc lamps, while also capable of other useful applications. A short fixed arm is adapted to be clamped at the desired height on the pole, and to this short arm is pivoted a lamp-supporting arm furnished with a pulley and chain, while a chain is arranged to let the lamp or lamp holder down as the pivoted arm is tilted. A housing is also provided near the bottom of the pole in which the operating chain is fastened.

SURGICAL ELECTRODE.—Josephus H. Gunning, New York City. This is a bipolar electrode capable of being flexed in various directions and having independent insulated conductors with independent tip or cap pieces forming the poles, the conductors being adjustable to vary the distance of the poles apart. It is designed for passing an electric current through diseased organs or parts of the human body requiring treatment, the electric circuit being thereby made direct through the parts affected, and much more effectually than through a pole on the exterior of the body not an integral part of the electrode itself and the other pole a component part of the electrode.

Railway Appliances.

CAR STARTER.—James T. Baird, Rosedale, Kansas. Combined with an adjustable rack frame is a pinion on one of the car axles adapted to engage the racks of the rack frame, while an air-holding cylinder is held in alignment, and its piston rod connected with the rack frame. The power derived from stopping the momentum of a car is designed, by this means, to be stored in compressed air in the cylinder, or in auxiliary tanks connected therewith, to be afterward utilized as an auxiliary power in starting the car.

Mechanical Appliances.

POWER WRENCH.—James R. Robinson, Washington, Pa. This is designed to be a very effective and powerful device for conveniently screwing bits on or unscrewing them from the drill rods of well-boring machines. It consists of two wrenches, of which one is adapted to engage the bit and the other the drill rod, with a mechanism adapted to connect with the wrenches to force them apart in order to turn the bit and rod in opposite directions.

WATER MOTOR.—Eleazar Harryman, Juliaetta, Idaho. A series of inclined shields are made to encircle a vertical shaft on which is fixed a series of wheels between the shields, the wheels having near their outer edges vertical concentric bands connected by diagonally arranged plates, while a flume having a circular opening in its bottom is arranged to deliver upon the upper shield, there being a vertically movable gate mounted upon the shaft and adapted to close the opening through the flume. The motor is of simple construction, and is designed to utilize substantially the entire energy of the water.

Agricultural.

FERTILIZER DISTRIBUTER.—James W. Rozar, Rawlins, Ga. This is a machine designed to be equally well adapted for fertilizing and planting, and with it the operation of fertilizing can be done simultaneously with the plowing. An opening plow, beam and handles are arranged in the usual way, and a hopper is secured by brackets to the beam, there being a vibrating shoe or supplemental hopper pivoted beneath the hopper, below which is a delivery chute. A downwardly projecting regulator slide plate is secured to rear side of the hopper, by the adjustment of which the feed is regulated.

THRASHING MACHINE.—Levi Epps and Enos Kibbee, Beattie, Kansas. This is a band cutter and feeder device designed for easy attachment to thrashing machines, while very simple and durable in construction. It is supported from brackets on the rear end of the machine, where a feed hopper is hung with inclined toothed bottom adapted to discharge at its front end on to the feed board leading to the drum of the thrashing machine. Above the front end of the hopper is an open feed drum carrying transverse knives, the revolving of the drum cutting the bands and at the same time regulating the amount of grain passed to the thrasher.

CUTTER BAR FOR MOWERS, ETC.—Seth M. Carter, Jamesport, Mo. This cutter bar, which is especially designed for mowing and reaping machines, has an offset near the middle, with the outer portion set in rear of the inner portion and in a higher plane, and also twisted about its longitudinal axis to bring its fingers on the same level with the fingers of the inner section, each part of the cutter bar having an independent sickle and driving mechanism. The two sickles are connected with a double crank of the driving mechanism by independent pitmen, so that when one sickle is at minimum speed the other is at maximum, thus overcoming all inertia and preventing the possibility of a dead center.

STUMP EXTRACTOR.—John Cornelius, Oakland, Md. The main frame of this device has steel side plates bolted to flanged shoes, and the construction throughout is intended for extra heavy work, as in the pulling of very large stumps. The construction of the frame is such as not to interfere with the ready manipulation of a chain and wire cable, while improved mechanism is provided for supporting the drive worm, looking to its convenient shifting into and out of mesh with its worm wheel. The machine is designed to secure a combined chain and wire cable pulling action, but in ordinary work the chain may be removed and the cable alone be used.

Miscellaneous.

DENTAL MATRIX.—Christian A. Meister, Allentown, Pa. Clamping means are provided for use with this matrix, which is to be applied to a tooth while being filled. The matrix consists of a tooth embracing a flat flexible band, with hooking or engaging lips at its ends and a jaw-like closing device provided with pocket-forming loops at its free ends adapted to receive and hold the lips of the band within them, and for the ready detachment of the band when required. The jaw-like closing device is of spring construction and is provided with transverse adjusting means.

PENCIL.—Lewis H. Sondheim, New York City. This invention provides a simple and inexpensive pencil having a casing preferably made of wood, but which is not to be cut away or removed as the lead wears off. The casing is adapted to hold a movable lead, which is fed forward to furnish new writing points as required, and the lead may also be pushed backward by pressure on its point to protect it within the pencil casing when not in use.

UMBRELLA HOLDER.—Barbara J. Bonn, New York City. This device consists of a small casing adapted for attachment to the outer edge of a counter, on the back of an opera chair, or other place, and containing a hook operated by a cam and spiral spring, adapted to temporarily receive and hold the handle of an umbrella or cane, to prevent its falling upon the floor or being lost.

CANE SPLICING MACHINE.—Gardner A. Watkins, Gardner, Mass. In the manufacture of cane furniture and similar articles the several pieces or strands of cane are first united to make a continuous strand, which is placed on a spool before the cane is woven to the desired form. This invention provides a machine by which the cane may be readily spliced and evenly reeled. The machine has a bed on which slide opposite reciprocating jaws, one of the jaws having a clasp-holding recess with means for pushing a clasp therefrom, and a yielding plunger arranged to strike between the jaws, the machine being automatic in its principal movements.

POOL TABLE.—William H. Violett, Grand Junction, Col. This invention provides a novel combination and arrangement of parts whereby any one or all of the balls may be removed from the pockets, the players having full control of the balls without being compelled to walk about the table to take the balls out of the pockets and place them in the racks. An attachment is provided to notify the attendant when a game is finished, with registering devices whereby the number of games played will be recorded.

HAIR TONIC.—Lemuel C. Peters, Wallaceton, Pa. This is a compound designed to keep the scalp in a healthy condition, aid in the growth of a good strong hair, and prevent it from becoming prematurely gray. It is made of alcohol, cream, oil of wintergreen, oil of bergamot, oil of bay, aqua ammonia, and other ingredients, in stated proportions, and prepared as specified.

HANDLE FASTENING.—Lester Frank, New York City. This fastening is specially designed to conveniently and securely unite the handle to the vehicle body of dolls' carriages and other toy vehicles. It consists of a sleeve secured to the end of the handle and provided with a projecting tongue adapted to be engaged by the screw or pin fastening the axle to the vehicle body, thereby saving considerable labor and expense.

THILL COUPLING.—Anatoile Plicque, Franklin, Tenn. This is an anti-rattling device consisting of a wedge-shaped key having a transverse depression on its forward face to engage the thill iron, a spring attached to its rear face and bearing against the clip, while a hood is attached to the front of the key at its upper end and extending forward at a right angle, a lip being pivotally attached to the hood. The device is also designed to prevent the turning or shifting of the coupling on its seat.

BREAKWATER AND BEACH.—William L. Marshall, Chicago, Ill. This is a combination construction designed to protect the shore or bank of a river or lake and at the same time form an ornamental beach. It consists of a water-tight paved beach adjacent to and connected with the breakwater at the innermost row of piles and sheet piles, and formed by stone paving blocks laid in hydraulic cement, or formed entirely of artificial stone made principally of hydraulic cement.

SHIPPING AND STORAGE BOX.—Charles P. Moore and Frank M. Wolf, Ravenswood, West Va. This is a box made with wooden end sections, to the edges of which one piece of sheet metal is nailed to form the sides and bottom of the box, while a sheet metal cover has flanges on its sides connected by pivotal nails to form a hinge point, the nails passing through the flanges into the wooden end sections. The box is strong and light and especially adapted for use in hardware stores.

SCALE.—William J. Humphreys, Crozet, Va. This is a weighing and price scale in which the poise has rollers adapted to travel on the beam, while a friction roller extends loosely into a slot in the poise, and a slide carrying the friction roller is adapted to substantially move in line with the beam. The table is divided with numerals and lines differing according to the price and money used, and the operator places the poise in the proper place on the beam to counterbalance the load, the amount and value, and the amount worth any sum of money at any price, being indicated without computation.

JUICE EXTRACTOR.—Gabriel Castanos and Guadalupe Lopez de Lara, Guadalajara, Mexico. This invention relates to improvements in machines for crushing and extracting the juice from various plants, especially the Mexican mescal. The machine has a concave bed, above which is a vertical shaft provided with a spider, in the arms of which conical rollers are journaled, while a radial arm carries a conical brush adapted to sweep the material on the bed gradually outward and off, the juice flowing through a central opening in the bed.

LETTER BOX.—Emma C. Hudson, Seattle, Washington. This is a box for attachment to the interior of the doors of buildings, and in connection with it is provided an improved door plate and bell. The box is so attached to the door that it cannot be easily reached, and the entrance to the letter box is closed by a swinging door plate in such way that the entrance will not be noticeable.

RADIATOR.—Patrick B. Fox, Jersey City, N. J. This is a radiator for use with steam or hot water, and may be of cylindrical or quadrantal form. It is composed of a series of similar wedge-shaped radiator sections, each adapted to receive and discharge steam or hot water from and into an integral transverse supply conduit located below each radiator section and integral with it, the sections of the radiator being held together by a bolted connection of flanges on the sections of the steam or hot water supply conduit.

CLOTHES LINE PULLEY. — John J. Leuzinger, West New Brighton, N. Y. The pulley block of this device has a semicircular recess in one face, and there is a grooved pulley journaled in the recess of slightly less diameter than the recess, a band surrounding the block and affording a suspension device for it. The arrangement is such that a line will freely pass around the pulley even when the clothes are attached to the line, novel means for attaching the clothes forming also a feature of the invention.

CLOTHES DRIER. — John McKinnan, Spokane Falls, Washington, and Alexander Jameson, Missoula, Montana. This device consists of a vertical post at the top of which are carried arms to which are secured lines for supporting the clothes, forming a clothes-carrying rack which is revolved by the wind while the clothes are suspended in elevated position. The device is so constructed that the rack may be readily tilted down to facilitate putting on and taking off the clothes.

SUSPENDER HOOK. — Ely R. Dobbs, Poughkeepsie, N. Y. This is a simple device, capable of ready attachment to a garment to take the place of buttons, and consists of a main body having a hook to receive a loop on the suspender end, and a fastening device for securing the hook on the waistband. It can be attached or detached in a moment, and is so made that no part of the clothing can catch upon it, while the suspender end cannot become detached or wear the shirt or vest.

ROUNDABOUT.—William Mangels, New York City. This is an improvement in swings having a combined rotary and reciprocating movement, and commonly known as the "razzle dazzle." This swing is designed to be operated by a motor, and means are provided so that it shall be completely under the control of the operator when in motion, while the construction is very strong, and the parts are adapted to be readily disconnected and packed in convenient form for transportation.

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Joint. See Electric conductor joint.
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Lamps in sockets, tube for holding, J. Dardonville 452,364
Lamps, leading-in wire for incandescent electric, R. A. Fessenden 452,494
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Latch, G. H. Van Winkle 452,738
Lathe, J. Jennings 452,524
Lathe, turning, E. Lindner 452,495
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Letter box, J. Harwood 452,705
Lights, sectional shade for incandescent electric, Gartner & Harris 452,638
Lights, shade for incandescent electric, Gartner & Harris 452,701
Lock. See Cylinder lock. Nut lock. Registering lock. Sash lock. Vehicle seat lock.
Lock, H. A. Palmer 452,385
Loom shedding mechanism, Devigne & Durand 452,451
Loom shedding mechanism, J. H. Stone 452,396
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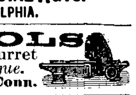
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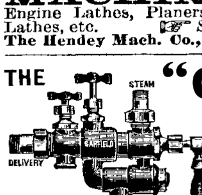
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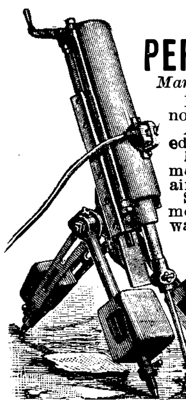
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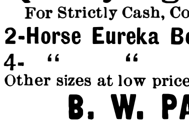
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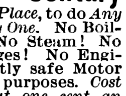
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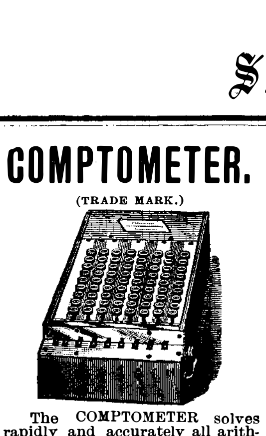
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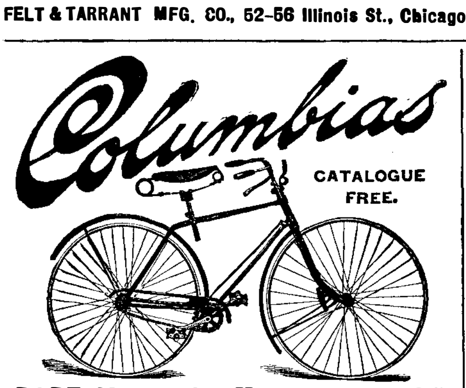

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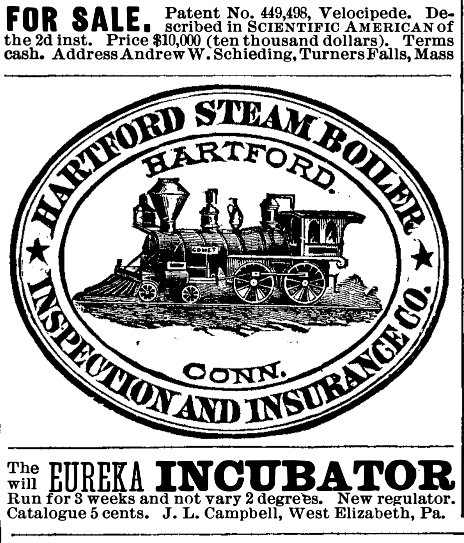

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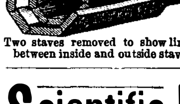
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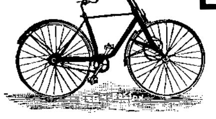
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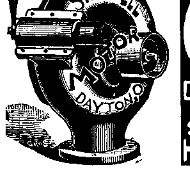

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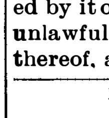
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