SCIENTIFIC AMERICAN

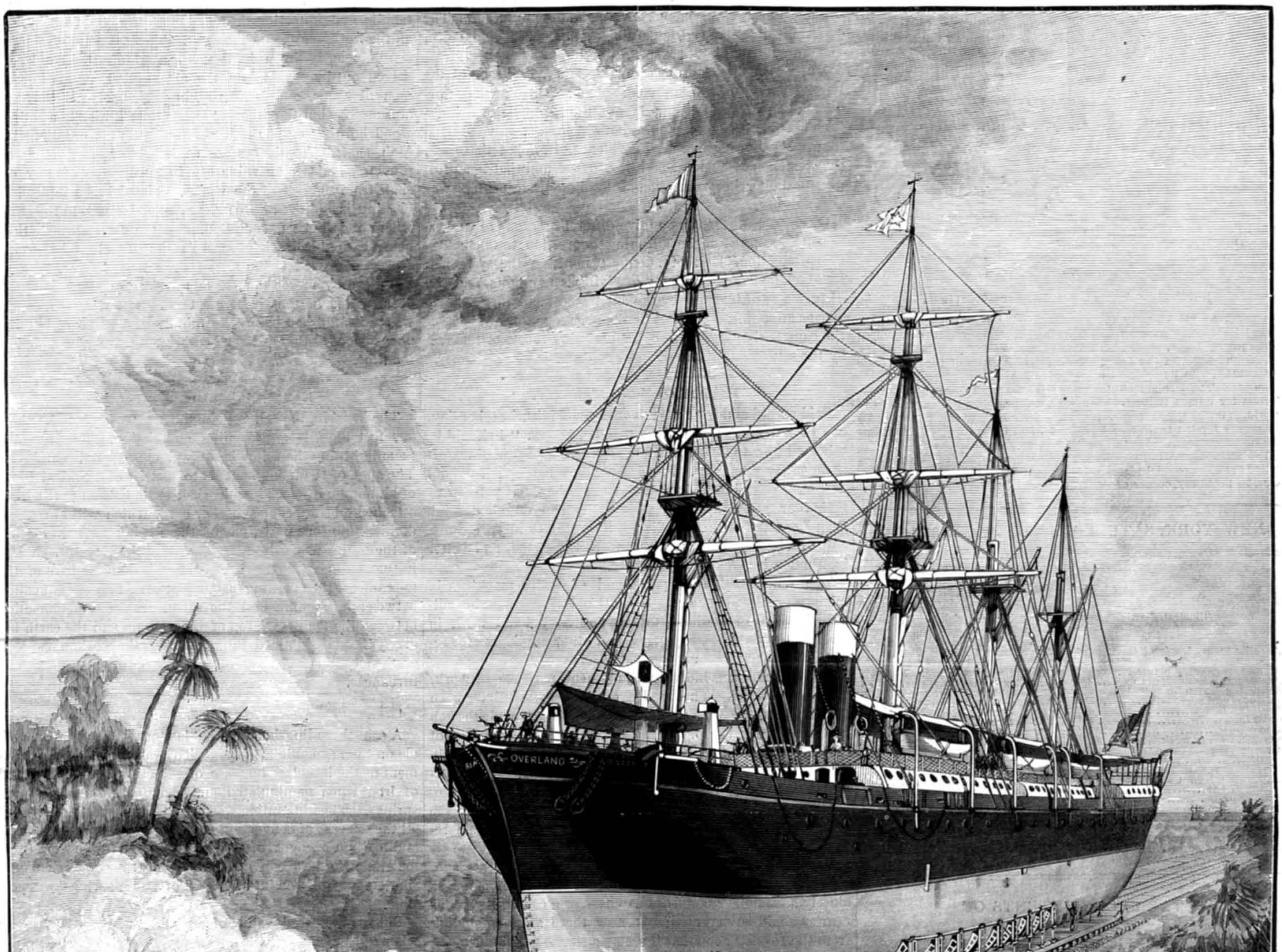
[Entered at the Post Office of New York, N. Y., as Second Class Matter.]

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

Vol. LI.—No. 26. [NEW SERIES.]

NEW YORK, DECEMBER 27, 1884.

[$3.20 per Annum. [POSTAGE PREPAID.]



THE INTEROCEANIC SHIP RAILWAY.—A STEAMER IN TRANSIT.—[See page 428.]

Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

O. D. MUNN. A. E. BEACH.

TERMS FOR THE SCIENTIFIC AMERICAN.

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NEW YORK, SATURDAY, DECEMBER 27, 1884.

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HOW IS BUSINESS?

Somewhat extended presentations of this question to manufacturers over a considerable district of New England elicit a hopeful if not a satisfied reply. The gloom of a despondent winter is partially relieved by the hope of a better future—by the signs, even now, of improved conditions. Establishments which had shortened hours last October have resumed the usual time; others, that had shut down entirely before November 1, have started up, perhaps on diminished time; others, which had discharged men in the latter part of the fall, are encouraging their men to remain with them to meet new orders just received. This is not the picture of the entire territory, but it is that of the larger portion of it; and it comprehends the manufactures of cotton, wool, iron, brass, and wood—in fact, it covers an example of almost every prominent New England manufacture. The general feeling is one of hopefulness; this begets confidence, encourages capital, and inspires purchasers.

During the first ten days of December, 1884, one of the largest dealers in iron and coke made larger sales than during the same term the year before, the facilities for supplying demands being ample in both instances. He reported that in Boston, Mass., and Providence, R. I., at that time, the condition of business had improved, and that the prospect in the territory dominated by these trade centers was encouraging.

Of course, different men give different reasons or suggestions to account for the alarming depression in business—overproduction, lack of adequate markets, the system in some sections of the country of giving long credits, and the disturbance of business by the excitements and unreasonable alarms attending a political national campaign. Whatever the causes, they seem to be gradually in process of removal by the settlement of the political caldron.

IMPROVED WORKMANSHIP.

Said an old and long experienced machinist the other day, one of a firm of well known manufacturers: "I should be ashamed now to father some of the nice jobs I prided myself upon thirty years ago. I was a first class machinist, and got first class pay; but I have men in my shop, not yet out of their four years' apprenticeship, who can do a better job than I could then. And it is not all owing to improved machine tools; it is because better work is exacted, and better instruction is given to apprentices."

The reduplication of parts and of entire machines in modern practice is one reason for this improvement in individual skill. In addition to the necessary hand work in making templates, jigs, gauges, and other appliances for reduplication, there is much more exactness in fitting than formerly, requiring individual judgment, patience of work, and skill of hand. The modes of doing work have been greatly changed; patterns for the moulder are made to such modifications of the old fashioned rule of "one-eighth of an inch to the foot for shrinkage" as would astonish a Rip Van Winkle of a machinist or pattern maker. Some patterns require very intricate calculations and very exact proportions before they finally leave the pattern shop for the foundry. Castings now come from the pickling room requiring only a superficial dressing to fit.

So, the forger must work to the line. Thirty years ago, if the forger's product resembled the object intended as closely as Hamlet's cloud did a whale or a camel, it was as near as could be expected; but now there are jobs coming from the forging shop that it seems a shame to submit to the tearing planer and the rasping milling machine. Thirty years ago a machine tool new from the shop was expected gradually to work itself into usable shape; the carriage and foot stock of a lathe were to gradually adapt themselves to the ways of the lathe, and the crosshead of the new planer had to be gibbed up again and again, and perhaps ground with flour of emery and oil, before it fitted the uprights; and it was a common practice to run the platen of the new planer back and forth, for a day or so, with the Vs loaded with emery and oil.

To-day the new tool works as perfectly when first started as when months old; a result to be attributed more to the patience and skill of the workman than to the improvements in the tools he uses; the scraping to fit of the modern machine shops demands as much judgment and hand skill as it does of patience.

The Washington Aqueduct.

The project of supplying the capital with water by forming a tunnel through several miles of rock, from the distributing reservoir above Georgetown to a much larger one in the vicinity of Howard University, is now rapidly advancing at all points. The great subterranean cylinder, when finished, will be eleven feet wide, seven and a half feet high, and nearly 22,000 feet long, and will be able to furnish a liberal supply for many years in the future. Along the course of the new aqueduct, at convenient distances, five large shafts have been sunk to the average depth of nearly one hundred feet. The shafts are sunk about ten feet deeper than the floor of the tunnel, forming wells to receive the springs that flow through the interstices of the rock. Compressed air is the motive power employed for all the pumping, drilling, hoisting, and ventilating. A substantial edifice has been built at a central point upon the Chesapeake & Ohio Canal, where fuel is delivered at least cost. This building contains six 100 horse power boilers, arranged in one battery, and these are worked incessantly, night and day, except Sundays, for the compression of air. Four 150 horse power compressors receive the air, which, during the process of compression, is cooled by a spray of water injected into the air cylinder, and in this condition passes into the air receiver. A complicated and singular process then forces the compressed air through a 12 inch pipe into a body of water, which experience has shown to be the easiest way of extracting the moisture that would cause it to freeze in the machine using it. The concentration of the power at one point necessitates the use of five miles of 12 and 6 inch pipes to convey and distribute the compressed air. There are in operation in the several shafts twenty-eight rock drills, which work under a pressure of sixty pounds to the square inch, and enable the contractors to proceed with the tunnel about fifty feet per day. Twice in twenty-four hours there is a temporary cessation of the boring apparatus. After detaching and protecting the machinery, the blasts are set, and all the workmen ascend the shaft. The blasts are discharged simultaneously by a battery, the foul air and smoke are driven out by turning on the air, another gang of workmen descends, and boring again begins. Nearly 300 men are employed at the different shafts, in addition to a Lidgerwood hoisting engine and a Knowles pump stationed at each shaft. Appliances are at hand for graduating the pressure, and a stop valve can instantly separate any one shaft from the rest of the works. The debris produced by blasting is removed on cars, propelled on rails to the shaft, where it is hoisted, emptied, and the car returned, there being a double track of rails in the tunnel. The broken rock is conveyed to the site of the new reservoir, where it is utilized by more than 350 men, who are at work on the construction of that immense tank. The whole enterprise was to be finished before the middle of next year; but it is now conceded that at least another year must be added to the time.—*New York Tribune.*

Novel Lightning Protector.

The Washington (D. C.) Monument, which is to be about 500 feet high, is approaching completion. To protect it from lightning the following novel expedient is employed. The apex of the monument is to consist of a conical block of aluminum of considerable size; to its bottom part will be attached a heavy copper bolt or cord, which will at once be divided into four parts, one of these being carried to either of the four heavy columns supporting the elevator. These in turn will be connected with the well near the base of the monument, thus making a complete and ample connection between its summit and the earth. A similar connection between the temporary top of the column and the earth has always been maintained, thus protecting the workmen as well as the structure itself from the effects of any electrical disturbances.

Value of Labor.

A school reading-book of the last generation had an article on the mechanic arts in which was a remarkable statement of the immense increase of value imparted to a pound of iron when manipulated and manufactured into watch springs. The illustration was misleading, because it left out all the expense of conversion from crude iron to spring steel, and took no account of the inevitable enormous waste of material; the idea conveyed was that the conversion of a single pound of iron into a pound of watch springs was possible.

But the increased value of a product of manufacture by labor can be illustrated by an example that is open to no objection of overstatement. A piece of steel bar, square, three-eighths of an inch diameter and two inches long, worth perhaps half a cent, can be increased to more than forty times its initial value by labor. A single blow of a drop hammer on the heated steel punches the central portion against the sides, and forms the steel into a hollowed parallelogram; another blow forms the outside, so that the squared ends become rounded or shaped like the bows of a boat; a final blow completes the shape into that of a sewing machine shuttle. The forging is then placed in a die under a powerful press to compact its substance, is finished on a buff wheel, is drilled, fitted with a tension spring, and is ready for sale, bringing at wholesale from twenty to thirty cents.

A Chance for Our Makers of Dredges.

By reference to another column, it will be seen that American manufacturers of dredging apparatus have an opportunity of filling still another foreign order, this time for the Spanish government, for use at the port of San Juan, Porto Rico. A dragboat is called for, with screw propeller of 100 horse power, five iron barges, and two towboats. Three months are allowed for sending in proposals, and eight months thereafter for building the apparatus. On the Panama Canal, American dredges have been proved superior to the several patterns of dredges of European make also in use there, and our makers of such apparatus are not likely to neglect this opportunity of competing with foreign manufacturers in the same line.

Saw Tempering by Natural Gas Heat.

Messrs. Emerson, Smith & Co., Limited, of Beaver Falls, Pa., are, we believe, the first to use natural gas in heating furnaces for hardening and tempering saws. It is claimed that, natural gas being composed so largely of "hydrogen" and entirely free from sulphur or other base substances, and giving a steady, regular heat, steel is stronger and rendered less brittle and less liable to crumble than when heated by coal or coal gas.

ASPECTS OF THE PLANETS FOR JANUARY.

MERCURY

is evening star until the third, and morning star for the rest of the month. He comes to the front among his brethren on the January record, for he contributes three important incidents to diversify the annals of the month, including his inferior conjunction with the sun, greatest western elongation, and conjunction with Venus.

On the 3d, at 5 o'clock in the evening, he is in inferior conjunction with the sun. Our brother with the winged feet then passes between us and the sun, making the passage above the luminary, and therefore leaving no tiny black spot on the sun's shining face to mark the transit. Indeed, he is at that time far away from one of his nodes, where only transits can occur, nor will our eyes be gladdened by the sight of a transit of Mercury until the year 1891. Through these intervening years he must pursue his appointed path, before he is near one of his nodes, when his inferior conjunction occurs. Only under those conditions, will he be projected on the face of the sun as a black point so small that a telescope is required to reveal its presence on the solar orb.

On the 26th, at 8 o'clock in the morning, Mercury reaches his greatest western elongation, when he is 24° 53′ west of the sun. He will be visible to the naked eye as morning star at that time, and for a week or ten days before and after the elongation. Although he is at the present elongation nearly at his maximum distance from the sun, he will be difficult to pick up on account of his great southern declination. He rises on the 26th about an hour and a quarter before the sun, and may be looked for 3° 30′ south of the sunrise point. Fortunately for observers, the fairest of the stars is in his near vicinity, where he is most easily seen.

On the 24th, at 5 o'clock in the morning, Mercury and Venus are in conjunction, Mercury being 1° 6′ north, a distance a little greater than twice the apparent diameter of the sun. On that morning, the two planets will rise nearly at the same time, a few minutes before 6 o'clock. Venus is so brilliant that she will be seen at a glance in the southeast, and, not far to the north, keen-eyed observers will find the shy planet, so difficult to discover when its place is not known, so easy to pick up when one knows just where to look. Mercury and Venus continue their companionship during the rest of the month, rising on the last day with only a difference of six minutes.

Astronomers thus far have been able to find out very little about Mercury, for his nearness to the sun makes him a difficult object to observe with accuracy. The period of his rotation, supposed to be nearly twenty-four hours, is not considered as established with certainty, neither is the position of his axis. Schroeter, at the beginning of the present century, observing Mercury in crescent form, either saw, or thought he saw, the southern horn of the crescent blunted at certain intervals. He interpreted the phenomenon as due to the shadows of lofty mountains, which, according to his measurement, were twelve miles in height. But the more powerful instruments of the present day fail to confirm these observations. Nothing is considered "proven" in regard to the planet's atmosphere, its deviation from a spherical form, or many other phenomena perhaps due to the imagination of observers.

A more important problem is now puzzling the brains of the men of science. Leverrier, after profound and exhaustive examination of records, announced that the perihelion of Mercury's orbit moves round the sun more rapidly than can be explained by the action of the other known planets, the acceleration amounting to 40″ in a century. The French astronomer searched diligently for the cause, and finally concluded that the effect was due to an unknown planet or planets revolving between Mercury and the sun. He died in this belief, and in confident expectation that one or more planets would be added to the system, and the Mercurial perturbations be accounted for. The incorrigible planet, however, refuses to come under the rules, while the fact that the perihelion point of his orbit moves round the sun faster than it ought to is considered as established beyond question. The cause of the anomaly is no nearer discovery than it was in the beginning. It would seem as if, from its present standpoint, the science of astronomy had here a question to deal with beyond its capacity to grasp.

No problematical Vulcan, no unnamed planets, no group of asteroids, have been seen beyond question to pass over the sun, and restore harmony to the system. Unskilled observers have noted little bodies crossing the sun that had the appearance of planets. Their observations have not been confirmed by observers who for fifty years have never allowed a clear day to pass without scanning or mapping the sun's face. The transit of a planet no bigger than a pin's head would not escape their vigilant watch.

During total eclipses tiny stars have been noted that it was hoped might prove to be the much desired planets. But the preponderance of evidence is against the existence of the unseen wanderers; the problem remains unsolved. The best observers with the finest instruments and the most favorable opportunities have thus far found no clew. Mercury defies the host of terrestrial astronomers and mathematicians, and spins on his course, his perihelion point advancing with an accelerating pace that is incomprehensible to those best versed in the laws that hold in place the sun and his family of worlds.

The right ascension of Mercury on the 1st is 19 h. 16 m., his declination is 20° 24′ south, his diameter is 9·6″, and his place is in the constellation Sagittarius.

Mercury sets on the 1st soon after 5 o'clock in the evening; on the 31st he rises a few minutes before 6 o'clock in the morning.

VENUS

is morning star during the month. She is slowly approaching the sun, and her superior conjunction, which does not occur until May. But she is still very beautiful in the morning sky, as any one may see who commands a view of the southeastern heavens, and makes an observation an hour before sunrise.

She contributes an interesting incident to the planetary annals of the month by her conjunction with Mercury on the 24th, when she acts as guide for those who desire a glimpse of the sparkling planet, who, however, will not deign to show his face unless atmospheric and cloud conditions are the very best. Although Venus and Mercury, as we see them at conjunction, are apparently very near each other, they are in reality far apart. Venus is approaching the sun and moving eastward, being, when in conjunction with Mercury, 22° west of the sun. Mercury is receding from the sun, moving westward, and is, when in conjunction, at the same distance from the sun. The former is approaching superior conjunction, the latter is very near western elongation; and yet they seem, as viewed from the earth, to be projected on the sky side by side.

The right ascension of Venus on the 1st is 16 h. 40 m., her declination is 20° 53′ south, her diameter is 12·4″, and she is in the constellation Scorpio.

Venus rises on the 1st at a quarter after 5 o'clock in the morning; on the 31st she rises at 6 o'clock.

JUPITER

is morning star throughout the month. Although thus ranked in astronomical classification, he will be near enough to opposition to be a superb object in the evening sky, being visible nearly the entire night. He now makes his appearance above the eastern horizon at 9 o'clock in the evening in the northeast, and on moonless nights shines forth with exceeding splendor. He remains almost stationary during the whole month, moving a little farther north, and being carried westward for the same reasons that the stars are, that is, by the earth's eastward motion in her orbit. This makes him appear to rise earlier every night, so that, when January closes, he comes looming majestically above the horizon shortly before 7 o'clock. No lover of the stars can help feeling the imposing presence of this leader of the planetary host.

The right ascension of Jupiter on the 1st is 10 h. 31 m., his declination is 10° 23′ north, his diameter is 39·6″, and he is in the constellation Leo.

Jupiter rises on the 1st about 9 o'clock in the evening; on the 31st he rises about 7 o'clock.

URANUS

is morning star. He pursues his slow course without making the least contribution to planetary records. He is leaving the neighborhood of the sun, and consequently drawing near to the earth. He makes slow progress among the stars, for it takes him seven years to pass through a zodiacal constellation.

The right ascension of Uranus on the 1st is 12 h. 12 m., his declination is 0° 28′ south, his diameter is 3·6″, and he is in the constellation Virgo.

Uranus rises on the 1st at half past 11 o'clock in the evening; on the 31st he rises at half past 9 o'clock.

NEPTUNE

is evening star. He pursues his snail-like course just now far away from any of his brother planets. He is thirteen years in passing through a constellation, and therefore it is easy to keep the run of his place in the heavens.

The right ascension of Neptune is 3 h. 15 m., his declination is 16° 14′ north, his diameter is 2·6″, and he may be found near the border line of the constellation Taurus.

Neptune sets on the 1st at half past 3 o'clock in the morning; on the 31st he sets at half past 1 o'clock.

SATURN

is evening star. He is second to Jupiter in brilliancy and size, and moves serenely on his celestial path with nothing noteworthy to record concerning his progress. When Jupiter rises in the early part of the month, Saturn is nearly on the meridian, and when Jupiter has reached the zenith, Saturn is sinking below the western horizon. Nothing new has transpired in regard to this fascinating planet, but we have faith that something worth knowing will be revealed concerning the complex Saturnian system before the 27th of September ushers in the long anticipated Saturnian perihelion.

The right ascension of Saturn on the 1st is 5 h. 13 h., his declination is 21° 34′ north, his diameter is 19·2″, and he is in the constellation Taurus.

Saturn sets on the 1st at a quarter before 6 o'clock in the morning; on the 31st he sets about a quarter before 4 o'clock.

MARS

is evening star. He is very near the sun, and completely hidden in his rays.

The right ascension of Mars on the 1st is 19 h. 30 m., his declination is 22° 51′ south, his diameter is 4·2″, and he may be found in the constellation Sagittarius.

Mars sets on the 1st about half past 3 o'clock in the evening; on the 31st he sets about half past 5 o'clock.

THE MOON.

The first month of the new year holds two full moons in her bountiful hand. The moon fulls on the 1st, 26 minutes after midnight; and also, on the 30th, 19 minutes after 11 o'clock in the morning. On the 4th, the moon is in conjunction with Jupiter, and on the 6th with Uranus. On the 13th she pays her respects to Venus, and on the 14th to Mercury. On the 16th she is at her nearest point to Mars, and as this is the day of her change it shows how near Mars is to the sun. Those who watch the course of the moon will find it easy to keep in mind the relative position of the planets.

On the 24th, the moon is in conjunction with Neptune, and on the 26th, with Saturn. She thus completes her circuit, and, at the same time, gives the order of succession of the planets, drawing near to the morning stars Jupiter, Uranus, Venus, and Mercury, and after her change to new moon swinging her ponderous sphere near the evening stars, Mars, Neptune, and Saturn. There are compensations in things celestial as well as terrestrial. One of these is the full-orbed winter moon as she "runs high" in the heavens, and pours over the ice-bound earth a flood of silvery light that makes the winter nights beautiful as a dream.

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Opening of the New Orleans Exposition.

On December 16, according to previous announcement, the great World's Industrial and Cotton Centennial Exposition was formally opened, the ceremonies attending the occasion being of a striking character. The attendance was estimated as high as 25,000 people when Major Burke, the Director-General, turned over the buildings and grounds to President Richardson. The latter, in a felicitous address, in the name of the Board of Managers, then presented the Exposition to the President of the United States, the address of presentation being simultaneously telegraphed to the President at Washington. While this was being done at New Orleans, about two hundred officials and distinguished guests, including representatives of foreign powers and committees of the Senate and House, assembled in the East Room of the White House, to be participators, as it were, in the ceremonies going on at the Crescent City, fifteen hundred miles away. The little assemblage in the White House was kept informed by the telegraph of the progress of the exercises at New Orleans: and at 2:45 P. M., when President Richardson's address of presentation was thus received, President Arthur made an appropriate speech in reply—which was likewise simultaneously telegraphed to New Orleans—congratulating the promoters, and officially declaring the exposition open. At the conclusion of his address, President Arthur touched a key at the table before him, ringing a little electric bell near the great engine in the Exposition, which was the signal for the engineer in charge to turn the throttle valve and let on the steam. A cheer followed the tinkle, then the 27 foot fly wheel of the 650 horse power Harris-Corliss engine began to move, with the long lines of shafting; but the big wheel had scarcely made a revolution before four other engines were started, and began to work in unison, and the Exposition was in fact actually under way.

Although the management state there is not in all the buildings 100 feet of space unappropriated, not more than about one-half of the exhibits are really in place. There are some 2,000 car loads of goods not unloaded, as well as many on vessels not arrived from Europe, so that the Exposition will probably not be in complete order till early in January.

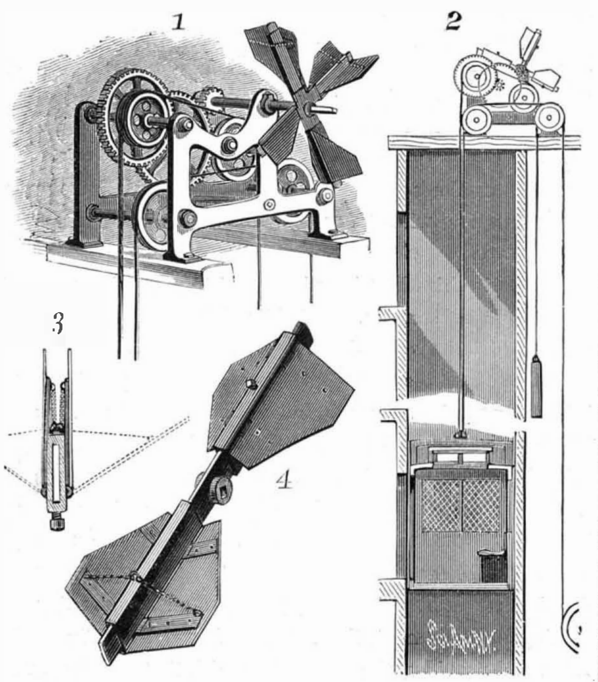
◆

IN another column, J. Pierrepont Edwards, Esq., British Consul in this city, announces the last day that inventors have to apply for space for the International Inventors' Exhibition, to be held in London next year.

A NEW SAFETY REGULATOR FOR ELEVATORS.

A new system to prevent the falling of elevator cars from any cause whatever has recently been patented by Mr. Adolphe Gallinant, of 862 Palisade Avenue, West Hoboken, N. J.

The arrangements for raising and lowering the car are similar to those in common use, the hoisting ropes being secured to the cross head of the car, thence passing over pulleys located at the top of the shaft and then down to the hoisting engine. A second or auxiliary rope is secured to the car, passed twice or more times around a drum mounted on a shaft journaled in a frame placed at the top of the well, thence over a pulley in the frame and down to a counterbalance weight. This weight is not heavy enough to offset the weight of the car, but is designed to always keep the rope taut, so as to prevent all possibility of its slipping on the drum. Mounted on the same shaft with the drum is a gear wheel that meshes with a pinion on a shaft carrying a second gear wheel; this meshes with a pinion on a shaft carrying the fans. The fans are made of light wood backed with canvas, and are so hinged to a bar, as shown in Figs. 3 and 4, that they will be closed (as indicated by the full lines in Fig. 3) during the ascent of the car, and will be opened (as indicated by the dotted lines) during the descent.



GALLINANT'S SAFETY REGULATOR FOR ELEVATORS.

In case the hoisting ropes should break, the fans would be brought into operation to sustain the car, which would descend at a perfectly safe rate of speed; and the auxiliary ropes, having no work to perform except carrying the small counterweight, would not be liable to wear, and could always be relied upon to accomplish this. In general practice the length of the fans—from out to out—should be one-half the width of the shaft, but it will be readily perceived that by changing the number and size of the fans the speed of the car while descending may be perfectly controlled. This device may be easily adapted to any of the elevators or dumb waiters now in use without changing any of the existing parts. Among the many advantages it possesses are its non-liability to get out of order, wear upon the reserve ropes is reduced to a minimum, it is automatic in action, and requires little or no attention.

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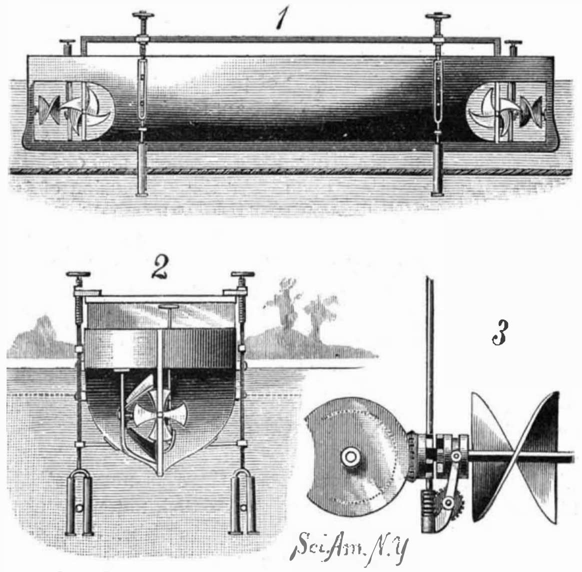
NOVEL METHOD OF PROPELLING VESSELS.

An invention patented by Mr. L. Charles Thorp, of Port au Prince, Hayti, provides improvements in vessels used on ferries in crossing rivers, whereby they can be propelled across the stream by the action of the current. Fig. 1 is a side elevation of the vessel, Fig. 2 is an end view, and Fig. 3 shows the propeller screw and the device for throwing it in and out of gear. The vessel is guided by cables, stretched across the river below the surface, which pass through forks on the lower ends of vertical rods which are swiveled to the lower ends of screws held on the sides of the vessel, and provided with hand wheels at their upper ends, by means of which the forks can be adjusted higher and lower, according to the tide. In each end of the vessel is a propeller screw mounted upon a horizontal shaft. On the inner end of each shaft is a loosely mounted beveled pinion, which engages with a wheel mounted on a shaft placed at right angles to the screw shaft. On the second shaft is a water wheel or bucket wheel, so arranged that it revolves in a vertical plane at right angles to that in which the screw revolves. Clutch teeth formed on the beveled pinion engage with the teeth of a clutch collar mounted upon the shaft so that it can slide on, but revolve with, the shaft. The clutch collar is shifted by means of a fork, on the pivot of which is mounted a worm wheel which engages with a worm on the lower end of a vertical rod, provided at its upper end with a hand wheel. The current, which, as a rule, flows at right angles to the direction in which the vessel is to move, strikes the water wheel and revolves the propeller, thereby moving the vessel across the stream. As each end of the vessel is provided with this device, one of which will propel it in one direction and the other in the opposite direction, and which act independently of each other, it is apparent that the to and fro motion across the stream can be easily effected by throwing the proper wheels into gear while the others remain idle.



THORP'S NOVEL METHOD OF PROPELLING VESSELS.

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Ammonia for Flowering Plants and Strawberry Plants.

A writer in London *Gardeners' Chronicle* says: Last year I was induced to try an experiment in chrysanthemum growing, and for this purpose purchased one pound of sulphate of ammonia, which I bottled and corked, as the ammonia evaporates very rapidly. I then selected four plants from my collection, putting them by themselves, gave them a teaspoonful of ammonia in a gallon of water twice a week. In a fortnight's time the result was most striking; for though I watered the others with liquid cow manure they looked lean when compared with the ammonia watered plants, whose leaves turned to a very dark green, which they carried to the edge of the pots until the flowers were cut. As a matter of course the flowers were splendid. The ammonia used is rather expensive, as I bought it from a chemist's shop; this year I intend getting agricultural ammonia, which is much cheaper. I have also tried it on strawberries, with the same satisfactory result, the crop being nearly double that of the others; it is very powerful, and requires to be used with caution.

◆

Tempering Thin Mills.

It is a somewhat risky job to harden and temper, without springing, thin lathe saws, or milling tools, made from sheet steel. When sprung, they *may* be straightened, if not too much out, by hammering; but not one machinist in ten knows just how to do it, and no verbal instruction can teach the trick.

But a good workman, who is not afraid to tell his secrets, says that he never fails. His plan is to have two disks of cast iron, preferably of a size small enough to allow the teeth of the saw to project beyond their rims. The inner face of these he scores (in the pattern, of course) into radial and annular scores, so that the engaging faces will present only minute points. These castings are chucked and faced so as to be true, and the saw placed between them and held by a nut and bolt passing through a central hole. Plates and saw are heated together and chilled together in the oil, which, by means of the scores, is allowed to reach nearly the entire surface of the saw. There is no springing of the saw under this treatment.

◆

A CROW HUT.

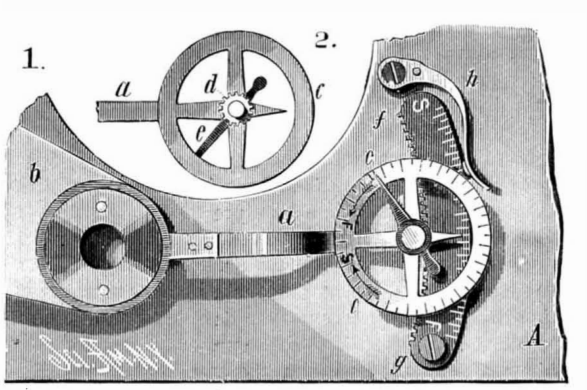
It is well known that crows, buzzards, ravens, and other similar birds attack all owls, even the largest, in the daytime, as they are well aware that the bright daylight blinds owls to such an extent that it is impossible for them to defend themselves; and for this reason the huntsman uses a chained owl for attracting crows and other birds that he wishes to destroy. The owl is chained on an upright post or rod provided with a crotch or small platform on which the bird can sit. This post or rod is connected with a rope or chain passing over suitable pulleys and extending to a hut, so that by pulling the rope or chain the support or platform on which the owl rests can be moved up and down, thus causing the owl to move about, flap his wings, and create a commotion to attract the other birds. A short distance from this post a low shanty or hut is erected, the side toward the post, on which the owl is chained, being provided with small openings, through which the barrels of the guns can be thrust. The hut should be erected at the base of a large tree, as many birds of prey prefer to take a short rest before attacking their enemy, the owl.

A short time after the owl has been chained, it is surrounded by a flying mob that begins to bother and pester it, the large birds being very bold and audacious in their attacks. The hunter in the shanty or hut can take good aim, and kill a large number of birds in a very short time, for it seems that the killing of some of the birds does not disturb the rest, and those dispatched by the hunter are immediately replaced by others.

The engraving on next page, taken from the *Illustrirte Zeitung*, is a copy of a drawing by the well known painter, Ludwig Beckmann.

WATCH REGULATOR.

The engraving shows a regulator, recently patented by Mr. George I. Tuttle, of Aurora, Ill., that will allow of the finest and most accurate adjustment, and one that can be readily used without risk of injury to the parts of the watch. The regulator arm, *a*, is hung on the balance bridge, *b*, as usual. On the outer end of the arm is fixed a graduated dial, *c*, of circular form, that carries an arbor at its center, and on the arbor beneath the dial is a pinion, *d*, shown in Fig. 2, which is a back-face view of the arm. A curved rack, *f*, of suitable length, is attached at one end to the watch plate, A, by a screw, *g*; and a spring, *h*, attached to the plate, bears on the free end of the rack, so as to retain it in mesh with the pinion at all times, while allowing a certain amount of elasticity. The rack plate has a graduated scale on its face for indicating the extent of movement of the arm, *a*, the end of which extending over the rack is pointed.



TUTTLE'S WATCH REGULATOR.

In order to operate the regulator, the pointer, *e*, is turned by using any simple instrument, and the pinion, turning on the rack, causes the arm, *a*, to travel in either direction as the case may be. The movement of the pointer will be considerable to obtain a slight movement of the regulator arm, so that fine adjustment is possible, and the extent of movement is determined by the scale. The dial, being at a distance from the balance, there is no risk of injuring the spring or wheel.

◆

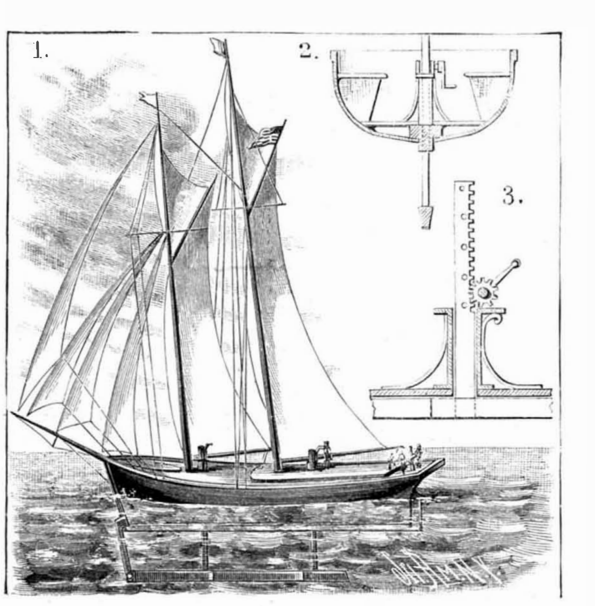
A Splendid Aerolite Secured.

The *Telegraph* reports that an aerolite fell on the farm of C. Francois, at Chateau Richer, a short distance from Quebec, at 3 A.M., on Saturday, Dec. 13, 1884. It was dug from the ground, in which it had embedded itself, and was found to measure about a foot in diameter. The people were so startled by the intense light that many rushed out of their houses to ascertain its cause. They say that the falling meteor presented the appearance of a huge ball of fire, which lighted up the whole country side almost with the brilliancy of the noonday sun.

◆

BALANCING DEVICE FOR VESSELS.

Two or more hollow standards are erected on the keel of the vessel. On each standard is journaled a shaft provided with a crank handle and carrying a pinion, which engages with a rack passed loosely through a standard. The lower ends of the rack bars are connected by a longitudinal bar, parallel with the keel, and having its top edge adapted to rest in a groove in the keel. To the front end of the bar is pivoted a link, the upper end of which slides on a guide bar secured to the prow of the vessel. A heavy bar is fastened to the connecting bar between the racks. During a storm or very strong wind, when there is danger of the vessel being capsized, the crank handles are turned in such a manner as to cause the pinions to move the racks and connecting bar downward; the bar may be lowered more or less, as required. By moving the bar downward the center of gravity of the vessel is lowered, the metacenter is raised, and the stability of the vessel materially increased. Of course the weight of the bar and distance it can be lowered are varied according to the size and shape of the vessel.



SCHAUM'S BALANCING DEVICE FOR VESSELS.

This invention has been patented by Mr. Rudolph Schaum, of Tell City, Ind.

THE DECOY OWL.—ORIGINAL DESIGN BY LUDWIG BECKMANN.

THE INTEROCEANIC SHIP RAILWAY.

The transisthmian projects which for many years have attracted the attention of engineers may be divided, perhaps not improperly, into three classes: 1st. Those in which the construction will be at the mercy of floods. 2d. Those lacking good harbors. 3d. Those which empty into the Doldrums or Zone of Calms. Of these three fatal objections, the Panama tide water canal scheme is open to the first and third, and the Nicaragua lifting-lock plan to the second and third. The ship railway project of Mr. James B. Eads, illustrated in this number, is open neither to the one objection nor to the other, and besides being far less costly, it furnishes a quicker means of isthmian transit than either of them, and will shorten by considerably over a thousand miles the contemplated route *via* Panama between our Atlantic States and San Francisco or the East Indies.

Until the arrival in the field of Mr. Eads, it seemed to have occurred to no one that anything but a waterway would serve for ship transit between the two oceans. It did not appear impracticable to some of the transisthmian projectors to build a ship canal in a region annually inundated by mountain streams, or to expect sailing vessels to traverse hundreds of miles of wind-bereft seas. But to take ships across a narrow isthmus by rail was monstrous, and not to be thought of.

It is no part of the purpose of this article to cast discredit upon the rival projects of Panama and Nicaragua, but the promoters of both the one and the other, in very laudable efforts in support of their own theories, have led at least a portion of the unthinking public to look upon the ship railway scheme as impracticable and visionary, and a comparison is necessary to show the relative practicability of the ship railway and the two most prominent canal schemes, and its superior advantages when considered from a commercial standpoint. In making this comparison, however, we shall endeavor to give each its just due, setting down naught in malice.

A careful study of the engravings as presented in this number, and the explanation which accompanies each, will show that while the ship railway is novel and original when taken as a whole, it demands no other methods in the treatment of a ship than those usually employed in the dry dock and the marine railway, and which experience has shown to be safe. Indeed, the only remarkable thing about the scheme is that no one has ever thought of it before.

In the ship railway project a ship is lifted out of the water by means of a submerged pontoon, similar to those in use all over the world; but no such force as that used in hauling a ship up out of the water on a marine railway is required on the ship railway, although, as well known, ships are constantly taken on the marine railway without injury. In the Eads system, however, there is no necessity for using any force whatever on the ship itself.

It is lifted out of the water in a cradle which rests upon a series of rails; and these being brought even with the tracks on the dry land, the cradle in its capacity of a car is wheeled along an almost level railway across the Isthmus of Tehuantepec, and when it reaches the other side a similar means is employed to float it again. This is the whole project—a combination of the lifting dock in general use and an improvement upon the marine railway, because the ship is never, as in the latter, required to be off an even keel.

Looking upon the chart, we find that the Isthmus of Tehuantepec is in Mexico, and in the extreme northern end of the long, slim neck of land which separates North from South America, and that the Isthmus of Panama is on the extreme south end of Central America, and at the farther end of this strip of land. Having discovered this, we naturally turn to a consideration of ocean lanes from the Atlantic and Gulf States to California and the East Indies, and from California to the British Islands, because, in these days of expedition, the shortest route, all else being equal, is sure to prove the most popular. We have not proceeded far in this inquiry when the advantages of the Tehuantepec route in time and distance become plainly apparent.

From New York to San Francisco *via* the Panama Canal, a steamship would be compelled to pass the Isthmus of Tehuantepec, sail south about 1,200 miles, and after crossing sail north again the same distance before reaching the short route to San Francisco. In other words, she would have to traverse about 1,200 miles more than if she had crossed the isthmus at Tehuantepec. From Gulf ports to San Francisco and the East the difference in distance in favor of Tehuantepec is still more marked; the route between New Orleans and San Francisco *via* Tehuantepec being about nineteen hundred (1,900) miles shorter than *via* Panama. From Liverpool to San Francisco there is a saving of 600 miles *via* Tehuantepec. With sailing vessels—and sailing vessels, much as we hear of steamers, carry fully three-quarters of the world's freights to-day, and are likely to continue to carry slow freights—the contrast is still more marked.

A sailing vessel having crossed the Isthmus *via* Panama is left in a very ocean of waters, over which reigns a perennial calm, broken only by occasional squalls and baffling zephyrs. She must be towed hundreds of miles until the region of the trade winds is reached. This, of course, serves to add a large expense to the voyage and to lengthen it many days, so that when we say the voyage between the Atlantic States and California is shorter by 1,200 miles *via* Tehuantepec than it is *via* Panama, we greatly underestimate the advantages of the former route. It would be a generous estimate to allow for only ten days'—good authorities say from 20 to 30 days'—delay between the Pacific side of the Panama Canal and the point where a sailing ship strikes the northeast trades, by reason of calms and the slow progress made while in tow. Allowing that a sailing ship can average 170 statute miles in a day's run, this would add 1,700 miles to the 1,200 miles extra run required *via* Panama, and hence would serve, practically, to make the Tehuantepec route 2,900 miles shorter in the run from New York to San Francisco, and 3,500 miles shorter in the run from New Orleans to San Francisco.

In confirmation of this, indeed, as showing that in the above we have underestimated the time required by sailing vessels *via* Panama to cross the calm zone, we append herewith the testimony of a practical seaman, Captain Silas Bent, as given before the Merchants' Exchange in St. Louis, pending the unanimous adoption by that body of the resolution recommending a favorable consideration of the ship railway to the United States Government:

"Mere statements of the difference in miles is a very inadequate measure," he says, "of the difference in time that would be occupied by sailing vessels in making these several passages; and when we consider that three-fourths of the ocean commerce of the world is carried in sailing vessels, you can see what an important factor this question of *sailing time* becomes in the solution of the problem before us.

"The northeast trade winds which extend across the Atlantic are so broken and interrupted when they encounter the West India Islands that they never penetrate the Caribbean Sea; but the northwest portion of them, however, do extend into the Gulf of Mexico, and often so far down as to reach well toward Tehauntepec, so that while in the Gulf winds are always found, yet the Caribbean Sea remains a region of almost relentless calm.

"Nor is this all, for the mountain ranges, extending the length of the Isthmus of Panama and through Central America, offer a still more formidable barrier to the passage of these winds, thus throwing them still higher into the upper regions of the atmosphere, and extending these calms far out into the Pacific Ocean, on the parallel of Panama, with lessening width, for fifteen or eighteen hundred miles to the northwest, along the coast of Central America.

"This whole region of calms, both in the Caribbean Sea and in the Pacific Ocean, is so well known to navigators that sailing vessels always shun it, if possible, though they may have to run a thousand miles out of their way to do so.

"This absence of wind, of course, leaves this vast area exposed to the unmitigated heat of a torrid sun, except when relieved momentarily by harassing squalls in the dry season and by the deluging rainfalls of the wet season. With these meteorological facts in view, let us now suppose that the Lesseps canal at Panama and the Eads railway at Tehuantepec are both completed and in running order; then let us start two sailing ships, of equal tonnage and equal speed, from the mouth of the Mississippi, with cargo for China, one to go by the way of the Panama Canal, and the other by the way of the Tehuantepec Railway, and I venture to affirm that by the time the Panama vessel has cleared the canal and floats in the waters of the Pacific, the Tehauntepec vessel will have scaled the Isthmus and be well on to the meridian of the Sandwich Islands; and that before the former vessel can worry through the fifteen or more hundred miles of windless ocean before her, to reach the trade winds to the westward of Tehuantepec, the latter will have sped five thousand miles on her way across the Pacific, and be fully thirty days ahead of her adversary. For it is a fact worth mentioning here, that the strength of the northeast trade winds in the Pacific, as well as the maximum strength of the northern portion of the great equatorial current in that ocean, are both found on or near the parallel of latitude of Tehuantepec, the former blowing with an impelling force to the westward of ten or twelve miles an hour, and the latter with a following strength of three or four miles per hour."

It is not to be supposed that Mr. Eads hit upon the plan of his railway before carefully studying the various canal projects; such was not the case. It was, in fact, the result of these canal studies which led him to seek some other means of crossing the narrow strip of land that separates North from South America. For to his practical mind neither the one canal project nor the other of them gave evidence of feasibility, owing to their excessive cost. It was a great problem to solve! Here were a paltry forty or one hundred miles of earth and rock, which, if pierced, would serve to shorten by ten thousand miles the present voyage *via* Cape Horn from New York to San Francisco, which now is 15,687 miles, and to reduce the distance by water between New Orleans and San Francisco from 16,112 miles to something less than 4,000 miles.

It is not surprising that the mind that conceived the jetty system, as applied to the mouth of the Mississippi River, should not be thwarted by the obstacles which confront the transisthmian projector; nor is it surprising to find that the plan that he has hit upon is thoroughly original, or that it is decried by those who do not understand it. Indeed, it would be more surprising if this were not the case; for have not all original schemes been laughed at? The idea, when first proposed, of forcing carbureted hydrogen illuminating gas through the London streets furnished no little amusement to the illuminati; when the project of sending a vessel across the ocean to England propelled by steam was first made public, an eminent scientist was so sure of the impracticability of the scheme that he promised to swallow the vessel on its arrival; when Captain Ericsson proposed to substitute for the direct action of the paddle wheel the oblique action of the screw, he was looked upon as bereft of reason. Yet all succeeded.

"Whatever is attempted without previous certainty of success," says an eminent writer, "may be considered as a project, and among narrow minds may, therefore, expose its author to censure and contempt; and if the liberty of laughing be once indulged, every man will laugh at what he does not understand, every project will be considered as madness, and every great and original design will be regarded as impracticable. Men unaccustomed to reason and researches think every enterprise impracticable which is extended beyond common effects, or comprises many intermediate operations. Many who presume to laugh at projectors or designers would consider the navigation of the air in a flying machine as the dreams of mechanic lunacy, and would hear with equal negligence of the accomplishment of the Northwest Passage and the scheme of Albuquerque, the Viceroy of the Indies, who, in the rage of hostility, had contrived to make Egypt a barren desert by turning the Nile into the Red Sea."

Mr. Eads knew that ships had been going on and off lifting docks without injury from time immemorial, and that vessels that could safely withstand the terrible buffeting of ocean waves could be moved over a smooth roadbed without fear of injury. In order to be sure as to the roadbed, he took with him, to the Isthmus, Mr. E. L. Corthell, an experienced and able engineer, who had successfully carried out his plans at the mouths of the Mississippi, and is an expert in railroad construction, having been chief engineer of the West Shore Railroad. Being a practical man Eads, naturally sought to discover a route that would furnish a substantial roadbed, possess something in the shape of harbors at either end and above all a location outside of that, to the mariner, vexatious belt of perpetual calm. He found a cross section of the Isthmus of Tehuantepec which combined all these qualities; nay, more, for of all the routes across the narrow strip of land joining Mexico with South America, none shortens so much as this the voyage from the Atlantic and Gulf States to California.

Having selected the site for his ship railway, he now sought a concession from the Mexican Government. This was obtained in 1881, and extends over a period of ninety-nine years from its date. It authorizes the construction across the Isthmus of Tehuantepec of a ship railway, an ordinary railway, and a line of telegraph. Besides this it exempts all ships and merchandise *in transitu* from government duty, grants the concessionaire a million acres of public land, and guarantees protection during the construction and subsequent operation of the works. To crown all, the right is given the company to obtain the aid of any foreign government, and in consideration of this assistance the company is authorized by the terms of the concession to discriminate in favor of the commerce of such government against that of all other countries, save, of course, Mexico. The concession obtained, Mr. Eads set about having a careful survey made, topographical and physical, for the several previous surveys were with reference to a canal or an ordinary railway. One of the Eads surveys was made by Mr. Corthell, and another by a party of engineers under the direction of Don Francisco de Garay, an able Mexican engineer, with forty assistants and linemen; he being assigned by the Mexican government to assist Mr. Eads in making the survey. Two lines were run over the mountains, and a careful hydrographic survey was made of the approaches of the termini. A series of additional surveys were recently made from Minatitlan to Bocca Barra and to Salina Cruz.

The length of the whole line will be about 134 miles from Atlantic to Pacific. Beginning on the Atlantic side, the route will start from the Gulf of Mexico, the ships sailing up the Coatzacoalcos River to Minatitlan, a distance of about 25 miles. From Minatitlan there extends for about 35 miles an alluvial plain having an underlying stratum of heavy, tenacious clay. In the elevation and ridges clay loam and sand are found. Next comes an undulating table land, and then irregular mountain spurs of the main Cordilleras, that run through the entire continent, making at this point one of the most marked depressions to be found in its whole length. From this basin the line passes through a valley formed by a small stream to the plains of Tarifa, where is situated the summit of the line. This is 736 feet above low tide. After traversing these plains, the Pass of Tarifa is reached. This is the most accessible of the many passes in this depression in the mountain chain. From here the line gradually sinks to the Pacific, reaching the plains on this side 118 miles distant from Minatitlan.

The pontoon, or floating dock (see Figs. 1 to 4), is of the same general construction as those in use all over the world, save in some important modifications rendered necessary to fit it for its special work. For it is not enough that the vessel should be docked and lifted out of the water, but that it shall be caused to rest upon a cradle in such a manner that its weight shall be equalized fore and aft, and thus enable the carriage with its load to move easily and safely. This is effected by means of a system of hydraulic rams arranged along an intermediate deck about six feet below the upper deck of the pontoon (see Fig. 2). The arrangement of the rams is in both lateral and longitudinal lines, the former standing a little less than seven feet apart, the one from the other. The area of the combined rams in each lateral line is the same; the area of the one ram under the keel forward or aft is equal to the area of the five or seven rams amidships.

They may be connected and made to work in unison, so that the same pressure per square inch of surface of the rams will exist throughout the whole system, or they may be disconnected by valves, so that a greater pressure may be brought upon the rams in a certain section or on a certain line.

It is no part of the duty of these rams to lift the vessel. They are designed only to resist its weight as it gradually emerges from the basin. They get their power from a powerful hydraulic pump placed on a tower affixed to the side of the pontoon, and rising and sinking with it, but of such a height that, even when the pontoon rests upon the bottom of the dock, it is not entirely submerged. The pontoon itself is directed by powerful guides, which cause it to descend and emerge from the water always in the same position.

A ship having entered the mouth of the Coatzacoalcos River, on the Atlantic side, and come up to the basin, the carriage with its cradle is run on to the floating dock, then water is let into the compartments of the pontoon, and dock and cradle gradually sink to the bottom. Then the ship is brought in from the exterior basin, and so adjusted as to position that her keel will be immediately over the continuous keel block of the cradle, and her center of gravity over the center of the carriage. The water is then pumped out of the submerged pontoon in the manner employed in floating dock systems, and it rises gradually, bringing the cradle up under the ship's hull (see Fig. 2). As soon as the keel block of the cradle is close to the ship's keel, the hydraulic pump is called into action, and pushes up the pendent rods and posts of the supports gently against the vessel, closely following the lines of her hull and the run of the bilge. The pressure upon the rams increases as the vessel emerges from the water, but the water pressure under them being prevented from escaping by the closing of the valves, the ship's weight, when she stands clear of the water, is borne by the rams by means of the supports.

In the case of a ship weighing five thousand tons, each of the fifty lines of rams would, of course, be called to sustain a burden of exactly one hundred tons; and these lines being placed at equal distances the one from the other, it will readily be seen that each unit of the ship's weight is equally distributed. The weight and displacement of the vessel is learned from the pressure gauge on the hydraulic pump.

The vessel being clear of the water, hand wheels or adjusting nuts that move in threads cut in the columns of the supports are run down to the bearings in the girder plates, whereupon the valve is opened and the rams withdrawn, leaving the girders to support the weight of the ship. Now each girder has the same number of wheels, and as described above bears its just proportion of weight and no more, hence each of the multitude of wheels under the carriage is called upon to bear the same weight. This weight has been calculated to be only from eight to nine tons, though tested to twenty.

One of the many ingenious contrivances in the scheme is the "hydraulic governor," so called, and by which the unevenness of the plane of the pontoon when it comes to the surface with its load can be readily corrected. This apparatus is thus described:

"Two cylinders are attached to each corner of the dock, one being upright and the other inverted. Plungers attached to the pontoons move in them. These two cylinders are connected by pipes, and all spaces in the cylinders and pipes are filled solid with water. As the pontoon rises, the water forced out of one cylinder by the ascending plunger is forced into the inverted cylinder on the diagonal corner where the plunger is being withdrawn. Now, if there is say one hundred tons preponderance on one end of the pontoon, one-half this weight, or fifty tons pressure, will be exerted by each plunger on that end upon the water in its cylinder. This pressure is instantaneously transmitted through the pipes to the water in the top of the upright cylinder in the opposite diagonal corner, which acts with the same amount of pressure as a water plunger upon the metal plunger to hold it down; thus an equilibrium is maintained, and the pontoon compelled to rise and fall perfectly level. It is possible by aid of a pressure gauge attached to the pipes to ascertain the exact amount of the excess of weight, so that, should this gauge show too great a preponderance, the pontoon must be lowered and the ship placed in a new position."

The pontoon cannot elevate the rails on its deck above what would be a prolongation of the rails ashore, because of the heads of the anchor bolts or guiding rods, and these will also prevent any tipping of the pontoons when the ship-burdened cradle is moving off. The carriage with its cradle which comes up upon the submerged dock, is calculated to hold a ship even more firmly than the launching cradle used at the ship yards, with its shores and stays. This carriage moves upon six rails, three standard gauge tracks each of 4 feet 8½ inches. Ships themselves are girders, and must of a necessity be so, from stem to stern, because in the tempestuous seas in which they are designed to roam, the one part is constantly being called upon to support the other; now her bow projects over a great billow with nothing under to support it, and again she is poised upon a huge wave, leaving the midship section to support in great measure both the bow and the stern, and were she not constructed as a girder fore and aft, her back would be broken in the first big seas she encountered. Comprehending this, the designers of the ship carriage make its strength reach its maximum in the cross girders, which are spaced like the lateral lines of the rams already described; that is to say, seven feet apart, and having sufficient depth and material in their plates to insure an equal deposit of weight upon all the wheels. These latter are double flanged and are placed close together, each being hung independently on its own journals, and having its own axle. Under an ordinary railway car the four or six wheel trucks move together about a central pin. But in the ship carriage, which is not designed to move off from an almost straight line, this is not required, and greater strength is obtained by adhering to the rigid principle; elasticity being had by placing a powerful spring over each wheel. These springs will, as said before, bear a weight of twenty tons and have a vertical movement of about six inches, while the maximum weight they will be called upon to bear will not depress them more than three inches, and allow for crossing irregularities without bringing an undue weight upon the wheels.

There is also a system of supports for the vessel, each having adjustable surfaces hinged to the top of the supports by a toggle joint in such a way that they may be made to closely follow every depression and yield easily to every protuberance or bulging. They pierce the girders of the carriage, and are exactly pendent over the hydraulic rams when the carriage is on the pontoon and rests in its proper position. Thus, as will be seen, the ship when crossing the Isthmus (see frontispiece) rest upon what might be called a cushion, and indeed she will have experienced far rougher treatment, both in the Atlantic and Pacific under only ordinary conditions of weather, than that had while *in transitu* by rail across the Isthmus.

As said before, the road is designed to be almost exactly straight, since there will be no curves having a radius of less than twenty miles, for the carriage is four hundred feet long, and rests upon wheels which, as already explained, are not set on trucks swinging to a common center. There are only five places in the whole line where it is necessary to deviate from a straight line, and at each of these places a floating turntable (see Fig. 5 to 7) will be built. These turntables in design resemble pontoons, for they rest upon water, and will be strong enough to receive the carriage and its burden. The turntable pontoon will be firmly grounded, when the carriage is run upon it, by the weight of water upon the circular bearers of the basin. The water is pumped out by a powerful centrifugal pump, the water being emitted through an opening in the cylindrical pivot of the pontoon and discharged into the basin. Now, the pontoon has been made sufficiently buoyant to be turned easily upon its pivot by steam power, and the ship carriage is quickly pointed in its new direction. The valves then permit the water to enter once more, and the pontoon turntable again rests on its bearings. These turntables may be made to serve another purpose. By their means a ship can be run off on a siding, so to speak, where she can be scraped, painted, coppered, calked, or otherwise repaired without removal from her cradle, and thus be saved the heavy expense of going on a dry dock.

The locomotives for hauling the ship-carriage over the Isthmian railway will not differ from those in ordinary use. The big freight engines of the day have no difficulty, as we know, in drawing freight trains of a total of two thousand tons; and as the ship carriage moves along three tracks it would be easy, if such a course were necessary, to place three locomotives in front of it and three behind. The time estimated for crossing from ocean to ocean is only sixteen hours.

Having now been over the ground of the ship railway and examined its several engineering features, let us turn to consider from the same practical standpoint the plans on which it is proposed to construct the rival projects at Panama and Nicaragua.

We have seen that, in the proposed Interoceanic Ship Railway, no really new or startling engineering problems present themselves. Is this the case with the canal projects? Let us see. At the International Canal Congress in Paris, in May, 1879, the Panama plan was rushed through despite the protests of the American and English delegates, who insisted that it was altogether impracticable. A simple reconnaissance had been made by Lieut. Lucien Wyse, and this was given precedence by the French over the many and careful surveys which have from time to time been made by skillful American engineers and by engineering expeditions from other countries.

It was evident from the start that the French had made several serious miscalculations. They had not given sufficient weight to the deadliness of the climate in that part of the Isthmus and the extent of the floods—two factors, as we shall see, which, if they do not finally prove an effective barrier to the progress of the work, are sure to greatly retard it and render its construction so costly as to make it, at the best, but a sorry venture from a financial standpoint. When nearly two-thirds of the whole appropriation for the canal was expended, and about one-thirtieth of the work performed, a startling discovery was made. The course of a great river, the Chagres, must be turned, and some means found of diverting the mountain streams, before active work on the canal proper could be resumed. Now, the Chagres River, so say expert engineers who have been on the ground, will require an immense expenditure of money—$20,000,000 at the least—to dam it at Gamboa, and a dam 150 feet high; also a lateral channel to divert these impounded waters *thirteen miles in length and as large as the main canal,* for there will be twenty million cubic meters in it.

Some idea of the destructive powers of this Chagres River may be had from the fact that, in 1879, during an unusual freshet, it flooded its entire valley for thirty miles; there being eighteen feet of water on the line of the Panama Railroad. The lateral canals for carrying off the water are likely to prove dangerous as well as expensive. As to these Colonel John G. Stevens, of New Jersey, one of the most eminent and experienced canal engineers in the country, and who visited Panama some two years since for New York capitalists, says: "Being situate in a depression of the Cordilleras, and flanked on each side by lofty mountain ranges, with steep sides, all water drains rapidly into the valley. Then again the rainfall of the tropics is excessive, and with us would be called phenomenal; at times being six inches in twenty-four hours for days in succession. The river consequently rises rapidly, and the greater part of the valley is submerged. . . . I think I can say that but one efficient plan can be formed, and that is to construct drainage canals on each side of the valley, so as to intercept the water that will drain from the mountain ranges on each side. Now, in severe floods the surface waters of these canals will be about seventy feet above that of the canal proper; consequently heavy guard banks will require to be constructed to restrain these intercepted floods. In other words, *the water will have to be hung up on the sides of the mountains.* Of course, with such a pressure, there will always be a great risk of the water breaking through the banks and the canal so filled by sediment as to stop navigation until it is removed. This would necessarily be a work of time, and destroy the prestige of the canal as an avenue of transport. . . . I do not remember ever to have seen money expended and such slight results effected; but I wish to add that this was evidently not due to the gentlemen in immediate charge, who were capable and zealous."

From evidence furnished by other expert engineers who have visited this region, it may be safely predicted that the wash from the slopes (clayey) in the profuse rainfall of this tropical region will tend to fill up the canal and entail a large expense in removing material.

The original estimate of the quantities of material to be removed has, of course, been greatly increased by the proposed Chagres River dam and the diverting channel back of it. Prices for labor, since the deadliness of the climate has come to be realized, have advanced to double and even thrice their original figures, and labor which at first was had for 30 cents advanced last year to 90 cents; 10,000,000 cubic yards, mostly soft dredging in the terminal marshes, has been done in four years. But even suppose they can do 6,000,000 cubic yards of dredging and rock excavation per year—and this is surely a generous estimate—then $\frac{198}{6}=33$ years to complete the canal. The original estimate was from $120,000,000 to $170,000,000, but with the obstacles now in view, and considering that the rock work has hardly been touched, $200,000,000 would seem to be a not unreasonable figure which the work will have cost when performed.

Let us now turn to the Nicaragua scheme. This project is for a lifting-lock canal—from 17 to 20 large locks being required. The time necessary to cross from ocean to ocean would probably be about three days. The location is 800 miles farther south than Tehuantepec, and consequently far south of the shortest route to California and the far East. It is situated also in the calm zone and in a country frequently visited by earthquakes, and hence liable at all times to serious injury.

The harbor of Greytown (north side) is irretrievably ruined, and Major McFarland estimates that it will cost $14,000,000 to make a good harbor of it. The harbor of Brito, as it is called, at the point where the Rio Grande enters the Pacific, is in fact only a small angular indentation of the land, partially protected by a low ledge of rocks, entirely inadequate for the terminus of a transisthmian canal and incapable of answering the commonest requirements of a port.

No reliable estimate of the expense of the Nicaragua canal has fallen short of $92,000,000; the Government Commission estimated $100,000,000, and Major McFarland $140,000,000. Capt. Bedford Pim, M.P., who is but recently returned from Nicaragua, estimates $200,000,000. The complication with England, too, makes the Nicaragua route to a great extent objectionable. By the Clayton-Bulwer treaty, made with England in 1850, we pledged ourselves to exercise with her only a joint control over any canal that should be built at this point, then looked upon as a favorable position for a canal because at that time there was a good harbor at Greytown. (The natural breakwater was destroyed by the sea in 1859, and the harbor filled up and ruined.) Only two years ago, as we know, England reasserted her claims, and insisted that the terms of the treaty should be complied with. In the recent concession made by Nicaragua, the government of the latter country makes the modest demand for *one-half the tolls collected,* should the canal be built.

The cost of the ship railway as computed by expert engineers will be about sixty million dollars ($60,000,000), or $75,000,000 at the outside.

A careful estimate has shown that it would not be unreasonable to look for a gross tonnage of 5,000,000 tons in 1888 for any passage across the Isthmus. Four dollars the ton would be but a moderate charge—the Panama Railroad demands $15 a ton. This would give $20,000,000 as gross receipts. Now, it has been estimated that 50 per cent of this would pay all working expenses, thus leaving $10,000,000 as net profit, or 10 per cent on a capitalization of $100,000,000

The Tehuantepec ship canal is a private enterprise that does not ask a dollar from the government, and there will

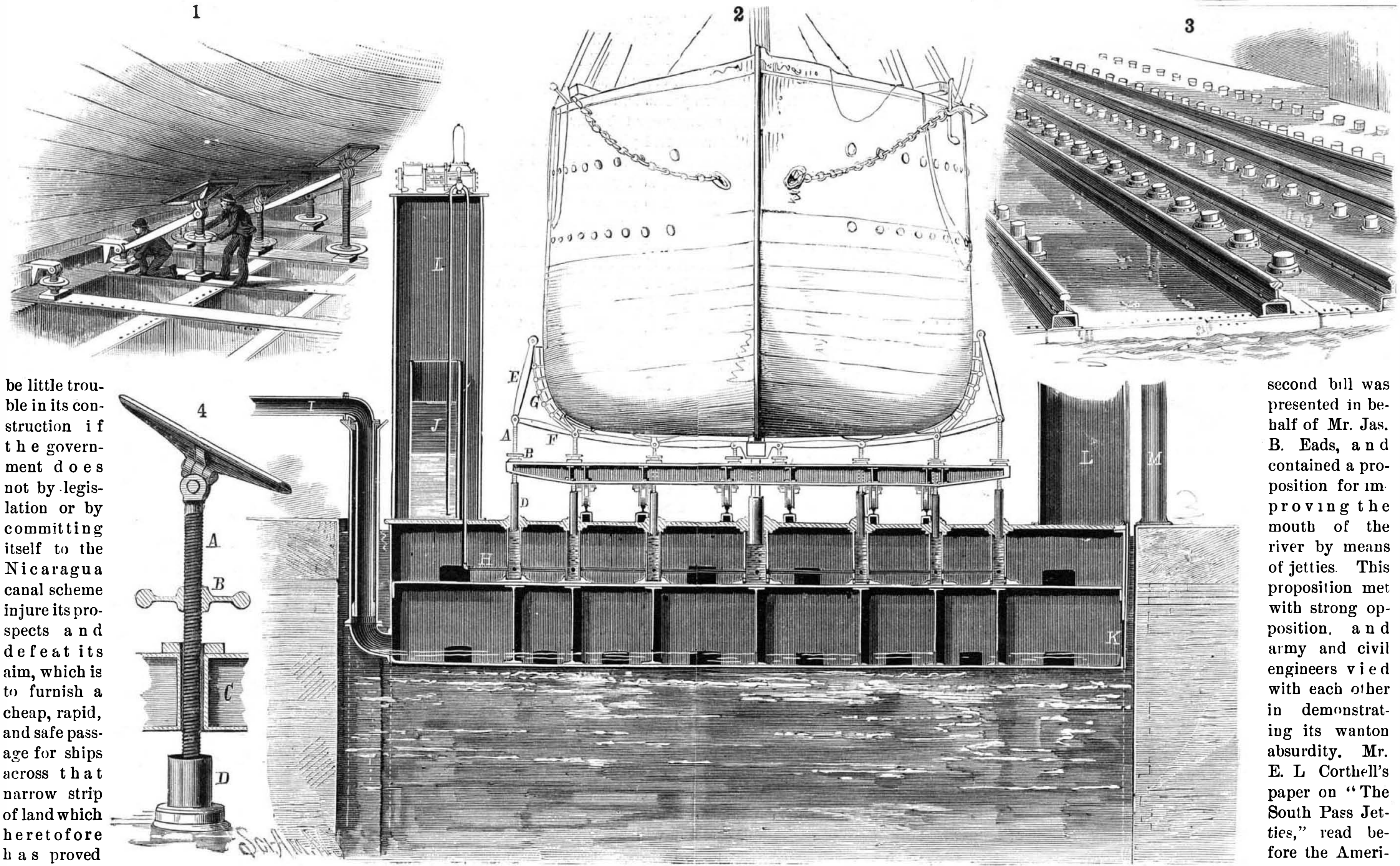


Fig. 2.—THE INTEROCEANIC SHIP CANAL.—SECTIONAL ELEVATION OF PONTOON AND RAILWAY CRADLE.

be little trouble in its construction if the government does not by legislation or by committing itself to the Nicaragua canal scheme injure its prospects and defeat its aim, which is to furnish a cheap, rapid, and safe passage for ships across that narrow strip of land which heretofore has proved an effectual barrier to aspiring canal builders. The promise of an original undertaking may be said to be directly as its author has succeeded or failed in previous enterprises, and hence it is but natural that the reader should like to know something about Mr. James B. Eads.

Ten years ago the bars at the mouths of the Mississippi below New Orleans had approached so near the surface that it looked as though the great city of New Orleans would be open in the near future to nothing larger than sloop navigation. A gradual shoaling had been going on for years, and various devices were suggested for deepening the channel, but none of them seemed to offer any hope of success. At last two bills were introduced into Congress relating to this subject.

One of these came from the headquarters of the Engineer Corps of the army, and advocated the construction of the Fort St. Philip Canal, leading from the river to the adjacent bay, about forty miles above the mouth of the river. The second bill was presented in behalf of Mr. Jas. B. Eads, and contained a proposition for improving the mouth of the river by means of jetties. This proposition met with strong opposition, and army and civil engineers vied with each other in demonstrating its wanton absurdity. Mr. E. L Corthell's paper on "The South Pass Jetties," read before the American Society of Civil Engineers, says:

"The propositions enunciated by the Board of Army Engineers and by the Chief of Engineers, on which they based their published prophecies of failure, were:

"*First.*—That the jetties would be undermined at the sea ends.

"*Second.*—That the foundation on which they would rest was unstable. And

"*Third.*—That there would be a greatly accelerated advance of the bar after the jetties were constructed.

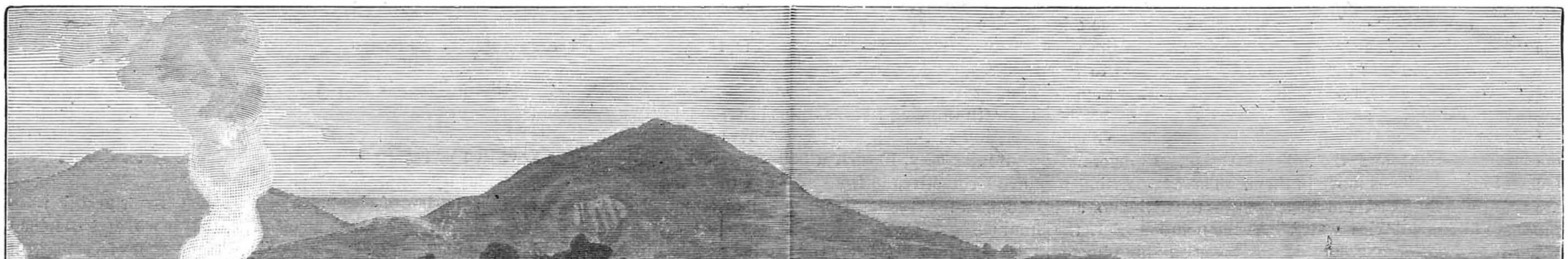
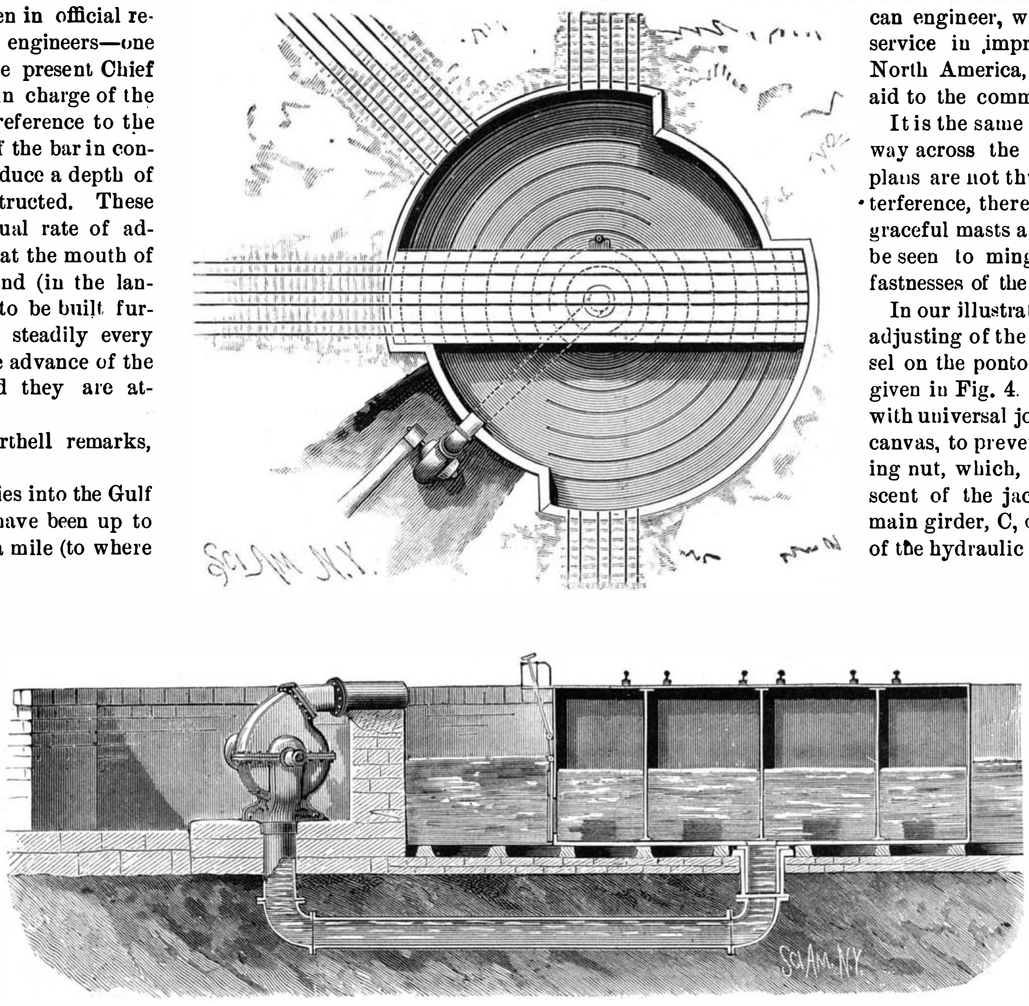


Fig. 3.—THE INTEROCEANIC SHIP RAILWAY.—THE LIFTING PONTOON AND RAILWAY CRADLE.

"Three positive opinions were given in official reports by three prominent United States engineers—one the then Chief of Engineers, another the present Chief of Engineers, and the third the officer in charge of the improvement of the Gulf ports—in reference to the rapid and accelerated growth seaward of the bar in consequence of jetties, which would produce a depth of from 25 to 27 feet, if such could be constructed. These gentlemen respectively gave as the annual rate of advance, after the construction of jetties at the mouth of the South Pass, 670 feet, 2,240 feet, and (in the language of the third) 'jetties will have to be built further and further out, not annually, but steadily every day of each year, to keep pace with the advance of the river deposit into the Gulf, provided they are attempted.'"

Of this ponderous opinion Mr. Corthell remarks, with something very like sarcasm:

"The necessary extension of the jetties into the Gulf with these rates of bar advance would have been up to this date respectively three-quarters of a mile (to where there is now actually 160 feet depth of water), two and one-half miles, and well out toward Cuba."



Figs. 5 & 6.—ILLUSTRATIONS OF THE TURNTABLE.

Mr. Eads finally succeeded in convincing Congress that there was at least something in his scheme, and he was given the contract, with the proviso that he should not be paid until he had secured the depths and widths of channel specified in the contract.

When he undertook the work, the depths in the crests of the bars in the Gulf, outside of the land, were 13 feet at the Southwest Pass, 11 feet at the Pass a Loutre, and 8 feet at the South Pass, all measured at mean low water. From the very inception of his jetty system it was a remarkable success; the South Pass deepened more and more by the scour of the river, until upon its shoalest spot he had 30 feet of water—a depth it maintains to this day, when the Great Eastern, the largest ship in the world, is able to cross the spot where, ten years ago, there was only 9 feet of water.

The fame of Mr. Eads, and his new interpretation of the Old World's jetty system, soon became an absorbing topic among hydrographers and engineers far and near. The Prince of Wales himself presented him with the Albert medal. This medal is inscribed:

"Captain James Buchanan Eads, the distinguished American engineer, whose works have been of such great service in improving the water communications of North America, and have thereby rendered valuable aid to the commerce of the Old World."

It is the same man who has projected the ship railway across the Isthmus of Tehuantepec, and if his plans are not thwarted by unwarranted government interference, there is reason to believe that ere yet the graceful masts and trailing yards of majestic ships will be seen to mingle with tropic palms in the mountain fastnesses of the Cordilleras.

In our illustrations, Fig. 1 shows an elevation of the adjusting of the screw standard for supporting the vessel on the pontoon, the detail of these standards being given in Fig. 4. A is the standard, having a head plate with universal joint, its top cushioned with rubber or canvas, to prevent damage to the ship; B is an adjusting nut, which, when the rams are down, stops the descent of the jack by contact with the top side of the main girder, C, on which they will rest, D being the top of the hydraulic jack of the pontoon, the number of these jacks used being better shown in Fig. 3, a section of the floating pontoon. E F G, in Fig. 2, show the sectional girders by which the weight of the vessel is distributed on the jacks. H shows one of the upper pontoon sections. J shows arrangement in connection with the pump on pumping tower, L, to distribute the load of the vessel equally on all the jacks. I and K show the arrangement by which the water is exhausted from the pontoon. On each side of the basin there are several rods on top of which are nuts capable of holding the pontoon, to prevent its rising above the level of the railway when the ship and cradle have been taken off. Figs. 5 and 6 show a plan and sectional view of the floating turntable, and Fig. 7 a perspective view, with a ship on the turntable.

* * *

THE castor bean plant, says the Los Angles (Cal.) *Herald*, has been found very efficacious in killing grasshoppers by the million, and is also useful for killing flies.

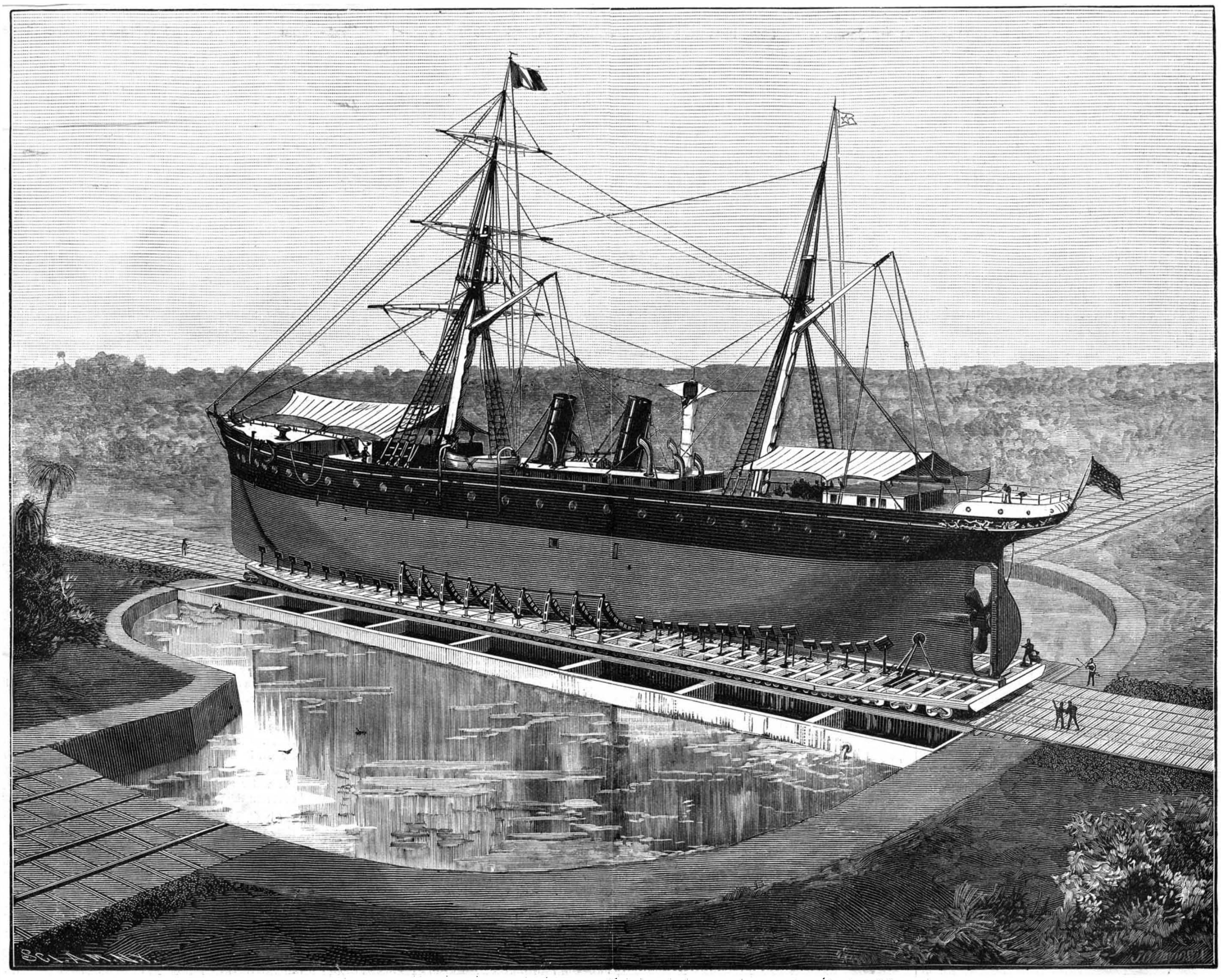


Fig. 7.—THE INTEROCEANIC SHIP RAILWAY.—THE FLOATING TURNTABLE.

ENGINEERING INVENTIONS.

A car coupling has been patented by Mr. William Stamp, of Susquehanna Depot, Pa. This invention covers a novel construction and arrangement of parts to facilitate the coupling and uncoupling of cars in making up and breaking trains, and the device can be worked at the side of the train as the cars pass the train men, thus promoting safety and convenience.

A spark arrester has been patented by Mr. James R. Werth, of Richmond, Va. This invention covers several novel features, a greater area of netting surface being obtained, and the plane in which the netting lies being parallel with the line of the blast, while no attempt is made to separate the smoke from the sparks until after the mingling of the same with the exhaust steam.

A method of casting car wheels has been patented by Mr. William Wilmington, of Toledo, O. This invention relates to a former patented improvement of the same inventor, and by it the chill hardening properties of molten cast iron are modified in various degrees by a method of imparting rich ferro-manganese to the molten iron immediately before or at the time the iron is entering the mould, so the iron composing the brackets and flange of the wheel is somewhat modified without materially affecting the iron of the tread.

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MECHANICAL INVENTIONS.

A screw cutting machine has been patented by Mr. Edward H. Freter, of Roedelheim, near Frankfort-on-the-Main, Germany. It has a hollow head stock spindle, pawl, chuck, sliding rests, die spindle, cog wheels, with various novel features of construction and arrangement for operating a chuck gripping mechanism, feeding the wire, and other details of a complete screw cutting machine.

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MISCELLANEOUS INVENTIONS.

A fire escape has been patented by Mr. William Craddock, of New York city. It is constructed with a carriage moving up and down on guide ropes attached at their upper ends to bars fixed to the building, and at their lower ends to a bar or plate fixed in a vault beneath the sidewalk.

A check rein clip has been patented by Mr. Frederick J. Smith, of Brooklyn, N. Y. This invention covers a special construction and arrangement of parts whereby the horse may be both checked and unchecked without the necessity of leaving the vehicle and without stopping the motion of the horse.

A peanut roaster has been patented by Mr. Louis Rosenkranz, of Rhinebeck, N. Y. It combines a heater, roasting drum, and warming box in which the peanuts are placed after being roasted, all contrived to secure an efficient distribution of heat and economical working.

A wrench has been patented by Mr. Joseph Lussier, of Minneapolis, Minn. This invention relates to wrenches having rocking or adjustable heads, and is especially designed for use in corners and other hardly accessible places, where it is inconvenient or impossible to use an ordinary wrench.

A scaffold clamp has been patented by Mr. Arthur B. Flach, of New York city. It consists of a U-shaped bar having hooks on its free ends and pegs or studs on the inner surface of its cross piece, making an improved clamp for uniting and holding together the posts and beams used in erecting scaffolding.

A life preserver has been patented by Mr. Zenane N. De Ledochowski, of La Salle, Ill. It is formed of a buoyant ring, with a bag for receiving the body, the ring having also a float with inflatable pockets, while on the top of the float are attached slabs of cork, and pockets are formed for receiving different articles.

A seal padlock has been patented by Mr. David B. Reeve, of New York city. It has in its top a slot, through which a ticket or card can be passed into the casing, the card covering an opening in front of the casing, so if the shackle is to be released the card must be cut or destroyed to permit pushing to one side the locking hook in the lock.

A staple setting instrument has been patented by Mr. Henry Rose, of Fayette, Mo. It resembles generally a pair of tongs or pliers, with two crossing links pivoted together, the rear portions of which form handles, and the forward portions making jaws, constituting a setting implement for metallic staples for closing seams in boots and shoes, clothing, etc.

An improved kind of plated ware has been patented by Mr. William A. Warner, of Syracuse, N. Y. The improvement is more especially designed for articles such as spoons, forks, etc., and covers a novel means of plating, whereby the portions most exposed shall receive a heavier plate without making apparent any extra ridge or film of metal at such places.

A saddle girth has been patented by Mr. Peter J. Pefley, of Boise City, Idaho Ter. It combines two bands or strap pieces with a transverse brace bar held at the ends in the centers of the bands by straps, so the bands can be held at a greater or less distance from each other, and the girths can be adjusted to be wider or narrower as desired.

A stove truck has been patented by Mr. John G. Arnold, of Wellsville, N. Y. Combined with a frame having casters is an additional frame connected with and held above the first by pivoted links, thus adapting the upper frame to swing upward and forward, and making a truck to facilitate the lifting and moving of stoves.

A back band has been patented by Mr. James B. McHugh, of Ambrosia, La. It is for draught animals, and made of a web of woven material with attached end skirts of leather, with buckles and straps, securing greater comfort for the horse, and so the connection of the band with the trace chains may be easily changed, while the band may be readily lengthened or shortened.

A see saw has been patented by Mr. Jesse M. Harr, of Baltimore, Md. It is so constructed that the seats may be kept horizontal, and the device is easily operated by very young children, a slight pressure on the treadles working it when the occupants are of equal weight, while, when the occupants are of unequal weight, they may be readily balanced by adjustable weights.

A brick machine has been patented by Mr. Charles A. Tarragon, of Portland, Oregon. It is made with a vertical shaft placed in a vertical hollow cylinder, and having radial arms carrying teeth to break up the clay, and plates to force the clay through a grate secured in the cylinder, whereby the clay will be crushed as it passes down into the machine, with other novel features.

A compound harness for Jacquard looms has been patented by Messrs. Holden Rigby and David Lindsay, of Paterson, N. J. This invention, with several other novel features, covers the use of rubber washers, whereby the shafts connected to the hooks are kept from wearing the knots, the construction and combination of parts being especially adapted to promote durability.

An adding machine has been patented by Mr. Martin O. Dolson, of Eldorado, Kansas. This invention covers a novel construction and combination of parts for rapidly and accurately adding columns of figures by moving a little crank handle which moves hands over dials, one representing the units up to one hundred, another to a thousand, the third to ten thousand, etc.

A nut lock has been patented by Mr. Erastus J. Clark, of Urbana, Ill. This invention covers two forms of nut lock, one of which is intended primarily for railway rails, while the other is for general use, in the former one the key being adapted to take a bearing on the flange of the rail instead of throwing a strain upon the washer, while the key is also adapted to act by gravity.

A calcimine composition and method of preparing the same has been patented by Mr. George A. Marsh, Jr., of Sandusky, Ohio. It consists of glue, gum tragacanth, water, and ground plaster, prepared and mixed in a special way, so that when ground and ready for use it will not harden in the pail, may be mixed with cold water, and will spread smoothly and easily and be free from cracking.

An auger handle has been patented by Mr. Henry Sager, of Girardville, Pa. It is a simple and substantial handle, from which the auger will not slip when pulling chips out of the hole, although it may be readily detached for changing the augers, and it is so constructed that one arm may be detached and the other used in the manner of a wrench for turning the auger in a close corner.

A sash balance has been patented by Mr. Jonathan D. Price, of Cherokee, Iowa. It consists of a frame or plate with a small projecting cog wheel working against a loose, block shaped detent which bears on one side against one spring and on the other side against another, which locks the cog wheel strongly enough to hold the sash through a rack or toothed bar attached to the frame.

A lock has been patented by Messrs. Rudolf E. Woodrich, of New York, and Charles Langbein, of Brooklyn, N. Y. This invention covers an improvement on a former patented invention of the same inventors, and provides a lock which can be fixed and held in place without the use of screws, and can be adjusted at different lengths, and in such manner, if desired, that it cannot be unlocked from the outside.

A pea and bean sheller has been patented by Mr. Ellis R. Young, of Thomasville, Ga. This invention relates to rotary mills, in which circles of long teeth on one plane are opposed by circles of short teeth on the other plane, the teeth alternating with each other on each plane, and tending to catch hold of the shells with more certainty than if the points were in a single plane, while the opposing teeth are not near enough together to damage the fruit.

A hoisting gear has been patented by Mr. William W. Wythe, of Ocean Grove, N. J. This invention relates to an improvement on a former patented invention of the same inventor, and consists in the combination with a yoke of a gear wheel and a grooved pulley united or made integral and journaled in the yoke, and a gear wheel and friction pulley united and journaled in the lower end of the yoke, the gear wheels engaging and the friction pulley pressing the hoisting rope in the grooved pulley.

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"How to Keep Boilers Clean." Book sent *free* by James F. Hotchkiss, 86 John St., New York.

Stationary, Marine, Portable, and Locomotive Boilers a specialty. Lake Erie Boiler Works, Buffalo, N. Y.

Presses & Dies. Ferracute Mach. Co., Bridgeton, N. J.

For Power & Economy, Alcott's Turbine, Mt.Holly, N. J.

The Hyatt filters and methods guaranteed to render all kinds of turbid water pure and sparkling, at economical cost. The Newark Filtering Co., Newark, N. J.

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Send for Monthly Machinery List
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121 Chambers and 103 Reade Streets, New York.

Iron Planer, Lathe, Drill, and other machine tools of modern design. New Haven Mfg. Co., New Haven, Conn.

If an invention has not been patented in the United States for more than one year, it may still be patented in Canada. Cost for Canadian patent, $40. Various other foreign patents may also be obtained. For instructions address Munn & Co., SCIENTIFIC AMERICAN Patent agency, 361 Broadway, New York.

Guild & Garrison's Steam Pump Works, Brooklyn, N. Y. Steam Pumping Machinery of every description. Send for catalogue.

Nickel Plating.—Sole manufacturers cast nickel anodes, pure nickel salts, polishing compositions, etc. Complete outfit for plating, etc. Hanson & Van Winkle, Newark, N. J., and 92 and 94 Liberty St., New York.

Supplement Catalogue.—Persons in pursuit of information on any special engineering, mechanical, or scientific subject, can have catalogue of contents of the SCIENTIFIC AMERICAN SUPPLEMENT sent to them free. The SUPPLEMENT contains lengthy articles embracing the whole range of engineering, mechanics, and physical science. Address Munn & Co., Publishers, New York.

Machinery for Light Manufacturing, on hand and built to order. E. E. Garvin & Co., 139 Center St., N. Y.

Curtis Pressure Regulator and Steam Trap. See p. 390

Woodwork'g Mach'y. Rollstone Mach. Co. Adv., p. 390.

Drop Forgings. Billings & Spencer Co., Hartford, Conn.

Practical Instruction in Steam Engineering, and situations furnished. Send for pamphlets. National Institute, 70 and 72 West 23d St., N. Y.

We are sole manufacturers of the Fibrous Asbestos Removable Pipe and Boiler Coverings. We make pure asbestos goods of all kinds. The Chalmers-Spence Co., 419 East 8th Street, New York.

Clark's Rubber Wheels. See adv. next issue.

Steam Hammers, Improved Hydraulic Jacks, and Tube Expanders. R. Dudgeon, 24 Columbia St., New York.

Emerson's 1884 ☞ Book of Saws. New matter. 75,000. Free. Emerson, Smith & Co., Limited, Beaver Falls, Pa.

Hoisting Engines. Friction Clutch Pulleys, Cut-off Couplings. D. Frisbie & Co., Philadelphia, Pa.

Barrel, Keg, Hogshead, Stave Mach'y. See adv. p. 422.

Munson's Improved Portable Mills, Utica, N. Y.

Machine for grooving chilled rolls for flour mills. Pratt & Whitney Co., Hartford, Conn.

Linen Safety Hose, all sizes, at greatly reduced prices. Greene, Tweed & Co., New York.

Mineral Lands Prospected, Artesian Wells Bored, by Pa. Diamond Drill Co. Box 423, Pottsville, Pa. See p. 422.

For best low price Planer and Matcher, and latest improved Sash, Door, and Blind Machinery, Send for catalogue to Rowley & Hermance, Williamsport, Pa.

Catalogue of Books, 128 pages, for Engineers and Electricians, sent free. E. & F. N. Spon, 35 Murray Street, N. Y.

A Present to Every Lady!

A 25 cent book on Art Needle Work and Crazy Patchwork, with 100 new stitches and transferable designs and full instructions for the work, will be given to every new subscriber to Strawbridge & Clothier's Fashion Quarterly. This offer only holds good to February 1, 1885.

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STRAWBRIDGE & CLOTHIER,
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The Porter-Allen High Speed Steam Engine. Southwark Foundry & Mach. Co., 430 Washington Ave., Phil. Pa.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocom & Son's Shafting Works, Driuker St., Philadelphia, Pa.

Notes & Queries

HINTS TO CORRESPONDENTS.

Name and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.

Special Information requests on matters of personal rather than general interest, and requests for **Prompt Answers by Letter**, should be accompanied with remittance of $1 to $5, according to the subject, as we cannot be expected to perform such service without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Minerals sent for examination should be distinctly marked or labeled.

(1) F. N.—Plante's secondary battery is put through a long course of preparation before it is ready for use. The preparation consists in submitting the plates to an electric current, at first changing the poles at stated times, and finally finishing up for a longer period with the current passing in one direction. The more recent secondary batteries are constructed with lead plates to which is applied minium—red oxide of lead. These plates need no special preparation.

(2) L. A. asks: The strength of alcoholic liquids is quoted differently in various countries of consumption, viz.: In degrees of Sykes', Dycas', Baume's, and Cartier's hydrometer; in bubbles, whatever that may mean; in centigrades of Gay-Lussac; in per cents absolute alcohol, etc. Can you give me the exact equivalent of 40 over proof in either of the above determinations or denominations, or else name a book containing complete tables of comparison? A. Proof spirit, according to the United States national tax law of 1862, is that proof of a liquor which corresponds to 50 degrees of Tralles hydrometer at the temperature of 60° F. Proof spirit therefore is of the alcoholic strength of 50 per cent by volume, having a specific gravity of 0·9335, or a mixture of equal quantities of absolute alcohol at the specific gravity of 0·793 and distilled water at 60° Fah. In other words, proof spirit is one-half pure water and half absolute alcohol. Proof on the Gendar scale is equal to 50 on the Tralles scale, so that 40 over proof on the Gendar scale would be equal to 70 on the Tralles scale, and equal to 0·8892 specific gravity, equal to between 28° and 27° Baume—liquids lighter than water. In Dick's Cyclopædia of Practical Receipts you will find as much information as anywhere. The other book you ask for can be furnished by New York dealers.

(3) W. H. A. writes: Will you please inform me what kind of glue is used for making guitars, and why pine is always used for the sounding board? Is there a better wood for the purpose? If so, what is it? What is used for filling hard wood for instruments, also the best varnish for finishing? Is there a treatise published on the manufacture of the guitar? A. For glue use a good quality of the ordinary article. It has been found that pine has the greatest vibratory power and has the straightest grain. No better wood is known. There are various filling compositions, consisting of equal parts by weight of whiting, plaster of Paris, pumice stone, and litharge, to which may be added in suitable proportions to match color a little French yellow asphaltum, Vandyke brown. Mix with 1 part japan, 2 ounces boiled oil, and 4 ounces turpentine. Grind fine in a mill. There is no special book on the subject as far as we know, but Moore's Universal Assistant and Complete Mechanic contains a great number of receipts that would be useful.

(4) E. W. M. writes: Within the past month, and at least three weeks constant, when disrobing at night preparatory to retiring, in taking off the pantaloons at least a dozen sparks or flashes of light, like a phosphorescent gleam, make their appearance on each leg. During the time these flashes make their appearance, there is a sort of hissing or cracking noise. A. The phenomenon described by you is common in houses in which the atmosphere is very dry, and in articles of clothing not liable to absorb moisture. You have probably discovered that it occurs only on what might be called good electrical days, that is, in dry, cool weather.

(5) J. A. D. writes: About a year ago I built a fence, using three 8 by 8 inch posts, which were supposed to have been seasoned. I primed them with ready mixed white paint, and afterward gave them two coats of white lead (Atlantic) and linseed oil; in a few weeks the paint blistered and cracked off. I sandpapered them and gave them another coat, but the same thing happened again. It has fallen off four times. Can you tell me the cause, and what will stop it? A. Probably the ground is wet, and the posts absorb water. The sun heating the paint may vaporize the water under it sufficiently for blistering. Try covering the parts of the posts underground with tar.

(6) C. M. G. asks how glass may be successfully coated with mercury or quicksilver so as to make a mirror. A. The usual method of coating glass with the amalgam of tin and mercury is to spread a sheet of tin foil evenly upon a flat stone table, and cover it uniformly to the depth of an eighth of an inch with clean mercury. A plate of glass perfectly clean is floated on the mercury carefully, so as to exclude all air bubbles. It is then pressed down by loading it with weights sufficient to press out all of the mercury which remains fluid. The glass is allowed to remain in this condition for about twenty-four hours, when it is

raised carefully upon its edge, and allowed to remain for some days in that position. To silver convex and concave mirrors with amalgam requires a mould, usually made of plaster of Paris.

(7) O. S. writes: 1. Is it to be taken for granted that a wooden house on clayey loam is damp, even if location be well drained? A. A house on clayey loam is not necessarily damp because of its situation. Such soil is generally more damp than a sandy soil, yet thorough ventilation of cellar, as well as drainage, is a vital point in its sanitary condition when so situated. 2. Does a cistern of water, covered with boards, in a cellar where there is a furnace, add, by evaporation, to the dampness of a house, even if the board covering is dry and there is no sign of moisture about the cistern? A. A cistern should not be tolerated in a cellar, according with modern sanitary practice. They are a source of miasma. 3. Of two houses or more situated on the same street, with same foundations, cellar, and soil, and built alike in every respect; apparently, is the one which shows the most frost on the windows, during winter, the dampest house, or is there some other way to account for the frost? A. Frost on windows in freezing weather indicates a moist atmosphere within, but does not always indicate a damp house. There are many reasons for a damp atmosphere within a house, such as the evaporation of water on stoves or furnaces, the use of baths, etc. The kitchen on a wash day is enough to soak a whole house. The hygrometric condition of the atmosphere within a house should correspond with the mean hygrometric condition of the outer atmosphere in fair weather, or from 60° to 70° of saturation. 4. What is the proper temperature for living rooms during the winter months? A. 65° to 75°, according to the vitality of the persons occupying the rooms. 5. What is the proper temperature for sleeping rooms? A. 45° to 55°, for reasons in fourth question.

(8) A. B. writes: 1. I have an engine as follows: 14 inches diameter of cylinder by 24 inches length of stroke. Wishing to ascertain the horse power of it, by my calculation I got 40·73. Am I correct or not? A. Nearly correct for a mean engine pressure of 40 pounds and piston speed of 200 feet per minute. 2. How can it be ascertained what amount of power certain part of machinery requires more than another part of machinery run by the same engine? A. Only by the use of a dynamometer, which you will find described and illustrated in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 194, 272, 309, 314.

(9) P. R.—In ship building, salting is considered beneficial as a preservative. The best rock salt is used, placed between the frames.

(10) F. W. P.—The brilliant star now seen in the east at early morn is the planet Venus. This may have been the star of Bethlehem.

(11) E. B. asks the composition of metal that faucet key makers use, that does not tarnish when exposed to the air. A Supposed to be what is called Britannia metal, composed of 25 parts tin, 50 parts antimony, and 25 parts lead; or pewter made of tin 8 parts, lead 2 parts, or a little harder of tin 8 parts, antimony 2 parts.

(12) J. M. H. asks a recipe for brightening and polishing the nickel plating on a bicycle, and for preventing rust on same. A. Rouge with a little fresh lard or lard oil, on a wash leather or piece of buckskin. Rub the bright parts, using as little of the rouge and oil as possible; wipe off with a clean rag slightly oiled. Repeat the wiping every day, and polishing as often as necessary.

(13) H. P. G. asks where the largest saw mill in the United States is located, and capacity of same. A. One mill at Winona, Minn., cuts 250,000 feet of lumber per day, and several from 150,000 to 200,000 feet per day. Some Michigan mills run from 100,000 to 200,000 feet per day.

(14) L. S. R.—For information on batteries for plating consult SUPPLEMENT, No. 310; it would require thirty cells of Bunsen battery to produce a light equal to that of a good gas jet. We cannot advise you to try producing electric light by means of batteries.

(15) E. W. E. asks: What will take the rust off nickel plating without removing the plating? A. Try rouge applied with a chamois skin.

(16) W. R.—You cannot make rubber moulds by melting rubber and pouring it over the pattern, as in the case of gelatine moulds. The rubber must be vulcanized; any one who understands working rubber could make you such moulds.

(17) F. H. B. writes: I have some office windows which my predecessor had frosted. How may I remove the frosting? A. Only by grinding and repolishing, which would be very expensive. If it is ordinary paint, you can remove it with a strong solution of caustic potash.

(18) R. C. H. asks whether there is any nutriment in buckwheat hulls. A. Little or none.

(19) D. C.—There is no method of brightening up gold frames other than regilding them. Platinum incandescent lamps are not practicable; it would take a large number of gravity cells to run such a lamp; a battery of the Bunsen bichromate type would be better.

(20) H. W. asks how to refine an old silver solution, and how to get the silver out. A. Add salt solution until a white precipitate ceases to form. Collect this white powder on a filter paper, and mix with borax and fuse in a small sand crucible. The silver will collect in a lump in the bottom of the crucible, and on breaking open the crucible, can readily be taken out.

(21) L. E. R. Co.—Stick rouge as used by the jewelers is supposed to be made with paraffine as a cementing element, as little as will hold the rouge together.

(22) F. G. H.—Paraffine and creosote are no doubt good preservatives for fence posts and shingles, but too expensive for general use. Coal tar is much used, and is no doubt cheaper. Crude paraffine can be had at from 7 to 8 cents a pound. Crude creosote, about the same.

(23) F. W. F. asks how the imitation of amber is made which is used on cheap cigar holders, etc. A. A receipt for imitation amber is given on page 210 of SCIENTIFIC AMERICAN, for October 6, 1883.

(24) P. O. B. asks (1) how much coal two 56 horse power boilers and two 50 horse power engines will consume in 12 hours. A. From 2½ to 5 pounds of coal per horse power per hour, according to the construction of boiler and engines. 2. Can I make an Edison dynamo to supply six 16 candle power lamp work with an engine of two-thirds horse power? A. We do not think you can work sixteen candle power lamps with an engine of the size given, as economy in dynamos decreases with the size. For information on making small dynamos consult Gordon on Electric Light or Dredge's Electric Illumination.

(25) J. H. asks if a man is required to have engineer's papers or license to run a steam launch 25 feet long on a fresh water river? A. Yes. 2. What speed will a boat of that length make against a current 3 miles per hour with a 5x6 engine and a 22 inch wheel? A. If a good model boat, probably 4½ miles per hour; possibly 5 miles.

(26) J. T. G. asks how to get daylight into a room having a large window space, there being a blank brick wall about five feet distant from the side of building. A. The common method of illuminating such rooms as you describe is to place outside of a window a mirror arranged at an angle of 45 degrees, which will receive the light from the sky and throw it into the room.

(27) P. B. asks what the preparation is for the portable electric lighter. A. For your battery make a saturated solution of bichromate of potash in hot water, allow it to cool, then add to the solution one-fifth of its bulk of commercial sulphuric acid; this will heat the solution and redissolve the crystals formed on cooling the aqueous solution. To every pound of this solution add a half drachm of bisulphate of mercury.

(28) J. H. M.—We believe that the University of New York gives much attention to biology.

(29) E. H. C. asks our advice how he may become a civil engineer. A. If you can associate yourself in some capacity with a first class civil engineer, so that you might study and practice with him, we think it would be your best course. You might, however, enter some of our technical schools, and take a course in civil engineering. If you wish to pursue the study alone, you might send to some of the technical schools for their prospectus, and pursue the course laid down for their students.

(30) R. G. asks: Why is the point 32 degrees below the freezing point on Fahrenheit's thermometer called zero? A. The Fahrenheit thermometer scale was invented in 1714; a mixture of equal weights of sal ammoniac and snow produced the lowest artificial temperature then known, and was thought to represent absolute cold, which was marked as the zero point of the scale. The interval between this point and the boiling point of water was divided into 212 degrees; the melting point of ice is at 32 degrees of this scale.

(31) A. A. A. writes: What can I do to stop my eyes from tearing? My time is very precious to me, and very often this tearing of my eyes prevents me from learning. I study in the evening for about three hours, and one in the morning. Do you think it does any harm to my eyes? A. The eyes are too delicate and too important to be treated by random advice. Much injury is constantly caused by so doing. Go to a good physician for treatment; that is your only wise course. At your age there must be some special, perhaps local, cause for the increase of the lachrymal secretion, and you may injure your eyesight permanently by attempting to remove it without sufficient knowledge.

(32) L. L. D. asks the cause of the disease called "hives," also its cure, if there is any. A. The trouble is caused by a perversion of the digestive functions accompanied by a disturbance of the circulation. It is not attended with danger, and is of importance only from the annoyance which it causes. Relief may be obtained in most instances by the use of cream tartar daily to such extent as to move the bowels slightly. Make a strong solution, sweeten it pleasantly, and take a teaspoonful, say after each meal, until the effect above mentioned is produced, and continue the treatment until the hives cease to be troublesome.

(33) L. C. Z.—For browning gun barrels, wet a piece of rag with antimony chloride, dip it into olive oil, and rub the barrel over. In 48 hours it will be covered with a fine coat of rust; then rub down the rust with a scratch brush and wipe with boiled linseed oil. All varnish or old dry oil must be removed before the application of the chloride by caustic potash, or if a plain barrel fine emery cloth may be used. A fresh, clean surface gives the best result.

(34) I. D. W. & Co., ask how to treat rancid or old butter to make it sweet. A. Rancid butter may be restored, or at all events greatly improved, by melting it with some freshly burnt and coarsely powdered animal charcoal (which has been thoroughly freed from dust by sifting) in a water bath, and then straining it through clean flannel. A better and less troublesome method is to well wash the butter with some good new milk, and next with cold spring water. Butyric acid, on the presence of which rancidity depends, is freely soluble in fresh milk.

(35) R. W. C.—There is no part of chemistry devoted to this special subject of the internal corrosion of marine boilers. There is a large "blue book" of the British Admiralty devoted to the subject. The trouble with the decay of steam boilers seems to be beyond the reach of chemistry.

(36) W. W. S. asks what to use that will brighten up, and make shine as when new, white metal or nickel plated show cases that have become tarnished, dull, and dirty. A. Ordinary rouge is used by nickel platers. The following is excellent: Take equal parts of precipitated iron carbonate and prepared chalk, or take quicksilver with chalk half an ounce, and prepared chalk 2 ounces; mix them. When used, add a small quantity of alcohol, and rub with chamois leather.

(37) J. Y. asks for information concerning the manufacture of nitrate of silver. A. Silver nitrate is prepared by dissolving silver in nitric acid and evaporating to crystallization. This operation is repeated until the crystals are considered sufficiently pure.

(38) S. M. G. asks how to make a gum to put on cardboard so that when wanted for use it can be moistened the same as stamps or envelopes. A. Use gum dextrine, 2 parts; water, 5 parts; acetic acid, 1 part; dissolve by aid of heat and add 1 part alcohol.

(39) J. G. writes: We are heating our office by steam. The boiler is on the basement floor. We intend carrying the pipes to the second and third floors. Can the condensed steam be returned to the boiler? If so, at what particular place on the boiler? A. Return the water of condensation to any part of the boiler where the feed is usually supplied; generally at the bottom of the front head near the hand hole. In a closed return circuit the coils or radiators should not be less than from 3 to 5 feet above the water line, as the water enters the boiler only by its gravity. Also the pipes conveying steam to the coils or radiators should be larger than for the discharge system, that the pressure in the whole line of pipe and coils shall be as near as possible to that in the boiler.

(40) L. J. S. writes: We use shellac varnish to varnish our fermenting tubs, which are of oak and pine woods; would paraffine heated (and the tubs heated), and then applied hot, be just as good? Would it be detrimental to the beer fermentation, etc.? A. We think paraffine would answer your purpose, if applied to the wood when dry and hot. It would not affect the fermentation.

(41) J. C. asks: 1. Will a 13½ inch propeller drive a boat 16 feet long by 3 ft. 6 in. beam 8 miles an hour? A. We think your propeller should not be less than 15 or 16 inches diameter. 2. What is the best speed to run such a propeller? A. Engine should make 350 to 380 revolutions per minute.

(42) B. G. F.—It is not necessary to superheat the steam for digesting bone material. Steam at 80 to 100 pounds pressure is equal to the work. Use a cylinder upright with a conical bottom made double for a steam jacket, and a short perforated coil upon the inside for direct steam upon the material. The digester should have a strong manhole at the top and bottom, to facilitate charging and discharging. The whole to be made strong enough to work at 100 pounds pressure. The usual process is to charge the digester with bones one-half or two-thirds full, cover with water, and boil under the full pressure of the boiler, regulating the height of water by addition of steam through the perforated pipe. Draw off the oil and grease through a pipe inserted at the water level. When no more oil or grease flows, blow out the water from a tap at the bottom, open the manholes, and discharge the bones at the bottom. Any boiler maker can make the apparatus required.

(43) E. N. L. asks: 1. How can I on a short line of ordinary telegraph wire, say 200 feet long, duly insulated and connected to batteries, make resistance sufficient to equal 100 miles, 1,000 miles, and 10,000 miles, or a resistance that would indicate the same as if the same (electrical) currents were passing over 100, 1,000, or 10,000 miles of the same wire? A. We know of no means of producing an artificial circuit which will fulfill all of the conditions of the actual line. The resistance of the circuit is an insignificant matter compared with leakages and the effects of induction. A telephone that will work through a resistance equivalent to 10,000 miles of line wire might be incapable of working over an actual line 100 miles long. You can readily supply the artificial resistance by means of an ordinary rheostat. 2. Does the electricity help carry the human voice or any other sound along the wire, or does it simply insure the same movements in the receiving diaphragm as the sound waves make upon the transmitting diaphragm? A. The electric current does not carry the sound, but reproduces in the receiving instrument movements similar to those in the transmitting instrument. 3. How can I also make resistance to sound alone, without any electric connection for the same distance on the same length line (200 feet), that is, 100, 1,000, or 10,000 miles. My particular object is long distance telephoning. A. By using a poor conductor of sound, or in some manner damping the conductor so as to prevent its free vibration. 4. If you should recommend the getting of some instrument now in the market, please state where it could be purchased. A. You can purchase a rheostat from any of the dealers in electric instruments who advertise in our paper.

(44) M. E.—For laying up your boilers for the season, change the water by thoroughly blowing out, so as to have it as fresh as possible, then pump or put into the boiler about 3 quarts of kerosene oil for each 10 horse power, get up steam, and draw the fire; then blow out all of the water and close all openings to boiler. Clean flues and furnace thoroughly. If the boiler is set in brick work, time must be given for the brick furnace to cool down before blowing off, so the hot brick work may not injure the shell by overheating. Frequent blowing off is the only recourse, where salt or brackish water is used, for preventing foaming or scale.

(45) F. H. L. asks for a good and inexpensive receipt for making a liquid cement for cementing leather, that will not be affected by the action of water and can be applied cold and adhere the parts with little or no pressure. A. We know of nothing that can be applied cold that is satisfactory, and therefore recommend the following: A good cement for splicing leather is gutta percha dissolved in carbon disulphide, until it is of the thickness of treacle; the parts to be cemented must first be well thinned down, then pour a small quantity of the cement on both ends, spreading it well so as to fill the pores of the leather; warm the parts over a fire for about half a minute, apply them quickly together, and hammer well. The bottle containing the cement should be tightly corked and kept in a cool place. Another excellent recipe is given on page 3727 of SCIENTIFIC AMERICAN SUPPLEMENT, No 234, that can be used for this purpose.

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December 9, 1884,

AND EACH BEARING THAT DATE.

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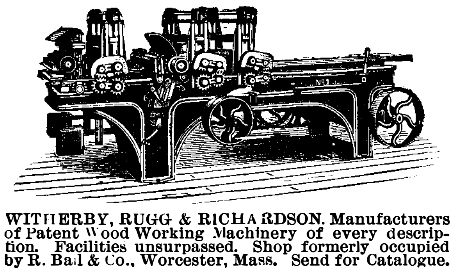

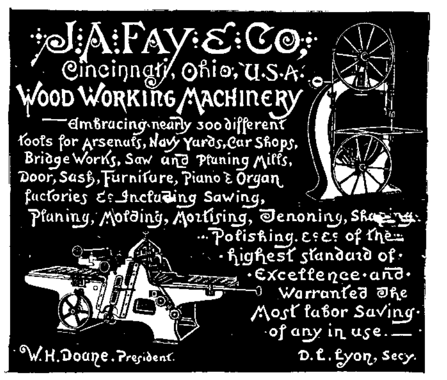

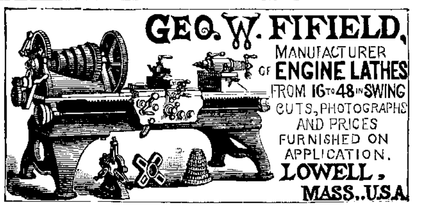

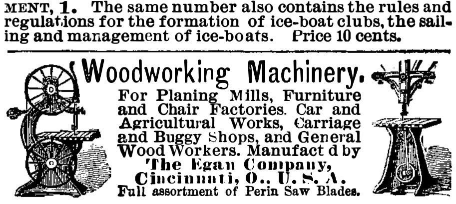

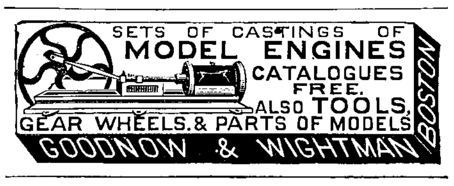

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