SCIENTIFIC AMERICAN

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THE ENGINES OF THE STEAMER CONNECTICUT.

We illustrate in the present issue the engines of the Connecticut, a new steamer built for passenger traffic on Long Island Sound. These engines are notable as well from their size as for their type, one hitherto little used for this particular service. The engine is a compound oscillating engine, with one high and one low pressure cylinder. The two cylinders, as will be seen from our drawings, work upon a single crank, and form an angle of 90 deg. with each other. The high pressure cylinder is 56½ inches, and the low pressure cylinder 104 inches in diameter. The stroke, necessarily the same for both, is 11 feet. Each cylinder is provided with two piston rods. Those for the high pressure cylinder are 9 inches in diameter; those for the low pressure cylinder are 10 inches in diameter. The arrangement of the piston rods is peculiar. Those of the low pressure cylinder lie one above the other in a vertical plane, and at their ends are united to a single journal box inclosing the crank pin. The piston rods of the high pressure cylinder lie in a horizontal plane, and at the crank pin are connected to two journal boxes, one lying on each side of the journal box of the low pressure cylinder. The steam enters the engine through the trunnions of the high pressure cylinder, the inside diameter of whose stuffing box sleeve is 24 inches. The steam pipe connecting its valve chests is 18 inches inside diameter. A 26 inch pipe connects the exhaust of the high pressure cylinder to the low pressure trunnion. This pipe is surrounded by a steam jacket with two inch space. The final exhaust pipe from the low pressure cylinder is 33 inches diameter. This pipe runs to a grease extractor, seen on the left of the diagram, page 56, and thence to a surface condenser, still through the 33 inch pipe. All the steam pipes are made of copper with brazed joints and flange connections. The steam ports for the high pressure cylinder measure 6 × 41 inches, those for the low pressure cylinder 8½ × 100 inches. They are of the gridiron type, which accounts for the very large area indicated by these figures.

The general arrangement of the valve gear is shown as clearly as possible upon the scale adopted in the diagram of the engine construction. For each cylinder an ordinary link is worked by means of two eccentrics. According to the position of the link block, a large secondary link is moved up and down parallel to a line connecting the center of the main shaft with the trunnion of the cylinder to which it belongs. This link is slotted in an arc whose curve is struck from the center of the trunnion. A block moves in the slot and is carried from end to end by the oscillations of the cylinder.

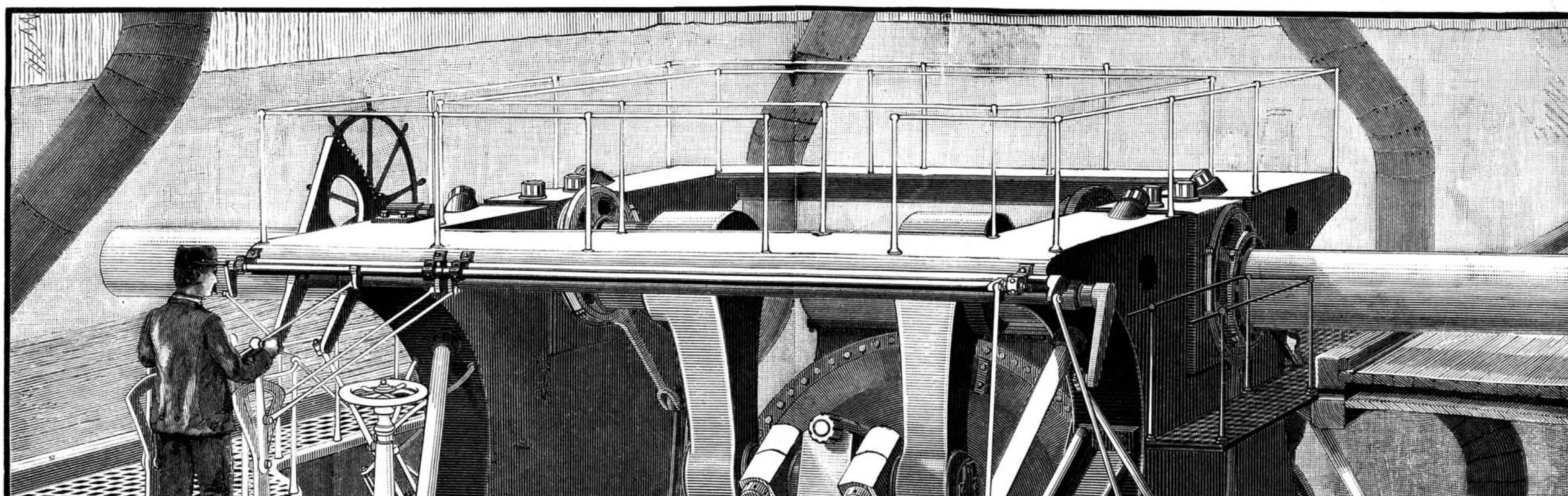
If this secondary link is held stationary, the block undergoes no movement in the direction of the cylinder axis. This block marks the end of a bell crank lever which is journaled to the cylinder, and which, by other bell crank connections, works the valves. If the secondary link, however, is forced to reciprocate backward and forward in the direction of the axis of the cylinder, then the bell crank lever will be forced to vibrate and the valves will be caused to operate. The movements of the secondary link are controlled by the eccentrics which actuate the first link.

To start the engine, two throttle valves are provided. One is on a small pipe which admits enough steam to start the engine slowly. When thus started, a second throttle valve can be opened, admitting the full amount of steam. The link motion for controlling the valve can be actuated either by hand or by steam. A large hand wheel, with projecting handles, is provided for actuating the link motion. When it is desired to do it by power, steam is admitted to a special cylinder, which can be seen at the side of the high pressure cylinder.

The pistons are packed with cast iron rings, with steel springs for setting out the rings. The cylinders are cast without heads, both upper and lower heads and the steam chest being bolted on.

By the use of this engine in a steamer of the type of the Connecticut, several important ends are attained. A low center of gravity, insuring high stability, is one feature; as there is no walking beam above the deck, with its pitman and connecting rod, a great deal of room is saved for the upper saloons. As the cylinders are placed at right angles, there is no dead point, so that the motion of the wheels will be much smoother than

(*Continued on page* 56.)



COMPOUND OSCILLATING ENGINES OF THE STEAMER CONNECTICUT.

Scientific American.

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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 682.

For the Week Ending January 26, 1889.

Price 10 cents. For sale by all newsdealers.

AN ELECTRICAL COURSE AT COLUMBIA.

Columbia College, New York, has decided to have a special course in electrical science, and not a moment too soon, for this has long been seen to be a department by itself, and, while allied to other branches of natural philosophy, requiring, at least from those who would adopt it as a profession, an undivided attention. Because of this it is to be made a post-graduate course of one, two, or three years, thus allowing those who have completed the rudimentary studies in electricity and magnetism in the School of Mines, and outsiders with elemental experience, to continue their studies. The proposed course will consist in practical work, construction of lamps, dynamos, primary and secondary batteries, insulation and installation of the plant, and, of course, investigation of the phenomena of electricity.

There is that called "theory" and that called "practice," and while one may be had without the other, no man may justly consider himself an electrician who is not familiar with both. In all the large electrical shops, as in the engineering ones, experience has been had with men schooled only in the theory of their work, and though it is an invaluable capital to commence practical work with, it has not been found infallible in the making of a first rate workman, while in some shops they prefer a slight acquaintance with practical work, if the man is intelligent and industrious, to a deal of theory where the latter is allied with over-confidence. On the other hand, it is hard to find a shop-bred man, let him be ever so skillful, who does not sorely regret his lack of theoretical knowledge. Few such men can draught their own designs or make their own calculations; often witnessing phenomena while experimenting, or during the course of their labors, which, were they read in the natural laws, those that have been formulated, they could perhaps appreciate and reproduce.

A workshop, laboratory, and lecture room such as it is designed to place at the disposal of the electrical department of Columbia College, ought to be sufficient to turn out men capable of original investigation; men at least capable of taking a responsible position in the practical work in the mercantile field; who can design and work or superintend work from their own drawings. In a practical age like this, that would seem to be the most valuable college instruction which most nearly resembles what its recipients are looked to to accomplish outside of it.

A NOVEL EXPERIMENT WITH CRIMINALS.

The report of the Elmira Reformatory, now eight years in operation, will be found worthy the attention of the scholar, as well as that of the humanitarian. It shows, so far as so limited an experience can be relied on, that the contamination of a penitentiary tends to encourage those to adopt careers of crime who are not naturally vicious, and, *per contra*, that education and the absence of vicious surroundings serves, at least in the case of first offenders, to wean them from the course they have only just set out upon. It says that 60 per cent of the convicts released from other prisons find their way back again, while, thus far, 80 per cent of those discharged from the Elmira Reformatory, during the eight years of its existence, are believed to be permanently reformed and engaged in honest labors.

It must be remembered, while considering this statement, that only first offenders are admitted to the Reformatory, while into the ordinary State's prisons come the old criminals, from whom little or nothing can be hoped. But it has been set down as a rule: "Once a criminal, always a criminal," that those who have served one term in a penitentiary are likely to return; the prison authorities infer this where they do not say so in their reports, and the statistics they give seem to confirm the statement. At the Reformatory the system of discipline is wholly different. The terms of confinement, however long, may be remitted by the board of managers after one year's incarceration.

A regular system of instruction is maintained; the prisoners devoting themselves to studies which will the better enable them to be self-supporting; the fact that good behavior, attention, and industry will free them quickly, and that they have yet a chance to go on again without the stigma that always attaches to those serving a term in the penitentiary, encourages those with the least spark of intelligence; nor does intellectual development, as has been alleged, increase the capacity for wrong doing. At least the authorities of the Reformatory say they have not found this to be the case.

DANGEROUS FLAT HOUSES.

The London *Lancet* sees a menacing danger in the present system of living in large flats, save when unusual caution is observed in drainage inspection. It says that persons so living are at the mercy of the janitor, though to the lay mind it seems obvious that they would be still worse off without one. If he is ignorant or neglectful in the matter of the drain pipes, "the whole house may be rendered unhealthy." But if such should happen, the occupants would leave, the house get a bad name, and its owner lose money. Hence, happily, it is to the interest of the owner to employ an efficient janitor and to see that he attends to his duties.

The suggestion that those about to rent a flat should, as a preliminary, employ a physician to investigate its sanitary condition, has, of course, much to commend it, while, at the same time, a precaution that those of very moderate means, dwelling in the poorer, and, perhaps, for that reason, the most scantily protected flat houses, are not likely to take. So far as New York flat houses are concerned, the Board of Health reports them to be fairly well aired and drained, and has not, as yet, found reason because of any prevalent disease to discriminate between those above the rank of common tenements and the expensive "apartment" houses. The *Lancet* goes on to say: "If the main drain is not both water-tight and so disconnected with the sewer as to admit of a free current of fresh air through its entire length, we have no hesitation in asserting that the risk of living on the premises is a substantial one, and that it is increased by reason of the multiple occupation which always occurs in the case of flats."

A medical inspector of the New York Board of Health being shown this, said, substantially: "So far as New York flat houses are concerned, such private inspection as is here suggested is scarcely necessary. By the rules established by the Board, each apartment must be furnished with trap and siphonage of its own, and as each of these is connected with the main drain, any imperfection there is quickly noticeable throughout the house, and we are notified. As a rule, however, owners through their janitors take great care to correct troubles of this kind, at the earliest possible moment, it being to their interest to do so."

THE USE OF RADIATED HEAT.

Its scientific production and application is new, and interesting as the use promotes economy.

A demonstration of this has recently been made by James Henderson at McKeesport, Pa., where he erected a furnace for heating scrap iron by burning natural gas; in the construction of this furnace six 1-inch gas pipes are placed at one end, which deliver the gas into a large expansion chamber, the quantity being regulated by valves and a blast gauge. The gas expands greatly in the chamber and travels from the open end of this chamber to the air tuyeres, situated at the end of the gas passage, where a measured quantity of cold air is delivered to the gas, which has become highly heated in its passage to meet the air by the heat radiated by the burning of the preceding gas. The heat is probably 3,000° F. before it meets the air. The air is delivered diagonally forward across the gas flue, so that its focus is but 6 inches from the heating chamber. The gas passes through the air, and is so thoroughly mixed that the combustion is perfect by the time the flame, thus produced, enters the heating chamber, and there is no smoke anywhere; the chimney top presents the appearance of radiated heat observable out of doors on a hot day.

The bed or hearth in the heating chamber is 20 feet long, 4 feet 6 inches wide, and 5 feet from hearth to roof in the clear; the flame passes clearly above the iron on the hearth, and about one foot clear of the roof to the uptake. Iron charged simultaneously at each of the four doors of the furnace becomes as quickly heated at the uptake as where combustion takes place, or in five minutes 250 pounds at each door is at welding heat and ready to draw, so that five piles may be heated every five minutes, of 250 lb. each. By charging at each door consecutively, a pile may be drawn every minute, or 1,440, or 180 tons, in 24 hours. It is claimed for this furnace that if air be excluded from passing through the doors, except when drawing and charging the piles (which is not the case at McKeesport), nearly all of the waste of 10 per cent usual in heating iron may be saved. The economy of fuel is very great, as the production is from three-fourths of that now generally used for heating, with seven times greater output from the less quantity.

Wrought iron exposed on the hearth of this furnace in large lots begins to melt in ten minutes, becoming mushy or so soft that it cannot be balled except it is first cooled by throwing water upon it, indicating that the furnace will be economical for making open hearth steel—its cost not being over $3,000 to make it, with a bed to convert 20 tons per cast. There are no regenerators, nor is heated air used, nor is there any additional expense incurred in heating the gas. This furnace dispels the illusion that regenerators are essential to making high temperatures for steel making, and shows that steel may be made for about one-eighth the cost for furnace now incurred.

A small fan blower is placed in the gas pipe, where there is a possibility of a short supply of gas, to exhaust the gas from the wells, and at the same time measure the quantity used. The fan may be placed on the same shaft and be driven by the same pulley that drives the blower that supplies the air to burn it, thus automatically regulating the working of the furnace.

POSITION OF THE PLANETS IN FEBRUARY.

SATURN

is morning star until the 5th, when he becomes evening star. He is an interesting member of the solar brotherhood during the whole month, for he reaches and passes the great epoch that brings him nearest to the earth, and is seen under the best conditions for observation. This epoch is his opposition with the sun on the 5th at 5 h. 17 m. A. M. He then rises at sunset and is visible during the entire night. After opposition, he rises about four minutes earlier every evening. The beautiful planet may be readily found in the northeast, soon after sunset, a few degrees northwest of Regulus. Saturn rises on the 1st at 5 h. 23 m. P. M. On the 28th, he sets at 5 h. 38 m. A. M. His diameter on the 1st is 19".2, and he is in the constellation Leo.

VENUS

is evening star. An important event in her course is her arrival at her greatest eastern elongation from the sun, on the 18th, at 2 h. 18 m. A. M. She is then 46° 36' east of the sun, and, changing her course, retraces her steps toward him. Observers will soon perceive that she sets earlier, but at the same time her brilliancy increases as she approaches the earth, making her the peerless star of the February evenings. Venus sets on the 1st at 9 h. 2 m. P. M. On the 28th, she sets at 9 h. 43 m. P. M. Her diameter on the 1st is 20".8, and she is in the constellation Pisces.

MERCURY

is evening star until the 14th, and then becomes morning star. He is in inferior conjunction with the sun on the 14th, passing between the sun and the earth, like the moon at new moon. This swiftly moving planet is visible to the naked eye during the first week of the month. He may be found in the west, three-quarters of an hour after sunset, about 7° north of the sunset point, setting on the 1st an hour and a half later than the sun. Mercury sets on the 1st at 6 h. 41 m. P. M. On the 28th, he rises at 5 h. 29 m. A. M. His diameter on the 1st is 7".4, and he is in the constellation Aquarius.

JUPITER

is morning star, and is a conspicuous object in the morning sky, making his appearance in the southeast three hours and a half before sunrise, when the month closes. He will be recognized at a glance, for no neighboring star equals him in brightness. Jupiter rises on the 1st at 4 h. 31 m. A. M. On the 28th he rises at 3 h. 5 m. A. M. His diameter on the 1st is 31".6, and he is in the constellation Sagittarius.

MARS

is evening star. Though near the sun, and far away from the earth, he is still visible, for he is moving northward, and on the 1st sets three hours after the sun. Mars sets on the 1st at 8 h. 5 m. P. M. On the 28th he sets at 8 h. 5 m. P. M. His diameter on the 1st is 4".8, and he is in the constellation Aquarius.

NEPTUNE

is evening star. He is in quadrature on the sun's eastern side on the 17th at 6 h. P. M. Neptune sets on the 1st at 2 h. 7 m. A. M. On the 28th he sets at 0 h. 21 m. A. M. His diameter on the 1st is 2".6, and he is in the constellation Taurus.

URANUS

is morning star. He rises on the 1st at 10 h. 56 m. P. M. On the 28th he rises at 9 h. 7 m. P. M. His diameter on the 1st is 3".8, and he is in the constellation Virgo.

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

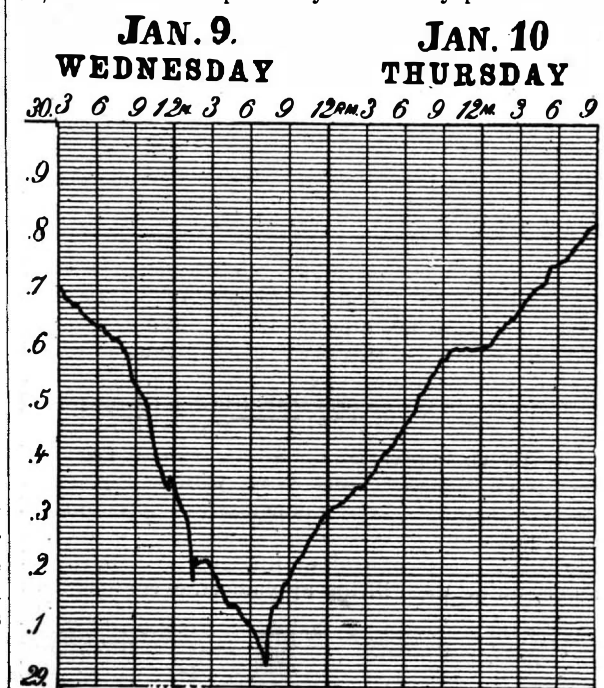
The Dread of Death.

Sir Lyon Playfair, in a letter to Junius Henri Browne, author of a paper in the New York *Forum*, for October, under the above title, says: "Having represented a large medical constituency (the University of Edinburgh) for seventeen years as a member of Parliament, I naturally came in contact with the most eminent medical men in England. I have put the question to most of them, 'Did you, in your extensive practice, ever know a patient who was afraid to die?' With two exceptions, they answered, 'No.' One of these exceptions was Sir Benjamin Brodie, who said he had seen one case. The other was Sir Robert Christison, who also had seen one case—that of a young girl of bad character who had a sudden accident. I have known three friends who were partially devoured by wild beasts under apparently hopeless circumstances of escape. The first was Livingstone, the great African traveler, who was knocked on his back by a lion, which began to munch his arm. He assured me that he felt no fear or pain, and that his only feeling was one of intense curiosity as to which part of his body the lion would take next. The next was Rustem Pasha, now Turkish Ambassador in London. A bear attacked him and tore off part of his hand and part of his arm and shoulder. He also assured me that he had neither a sense of pain nor fear, but that he felt excessively angry because the bear grunted with so much satisfaction in munching him. The third case is that of Sir Edward Bradford, an Indian officer now occupying a high position in the India Office. He was seized in a solitary place by a tiger, which held him firmly behind his shoulders with one paw and then deliberately devoured the whole of his arm, beginning at the end and ending at the shoulder. He was positive that he had no sensation of fear, and thinks that he felt a little pain when the fangs went through his hand, but is certain that he felt none during the munching of his arm."

THE RECENT TORNADO IN NEW YORK.

The accompanying illustration is a diagram from the Draper self-recording barometer in the SCIENTIFIC AMERICAN office. It shows the changes in atmospheric pressure during the tornado of January 9. I have compared this diagram with that of four other instruments located in different parts of New York City. They all substantially agree. These instruments were located at different points in a line nearly parallel to the course of the tornado and about a mile and a half distant from it. I had also four barometers directly before me in New York City at the time the tornado spent its fury in Brooklyn, and was observing one with a very large scale at the moment of the atmospheric disturbance—which was a sudden and violent squall, change of direction of wind, downpour of rain, and fall in temperature. The fall of the barometer was rapid, but the marked peculiarity was a sudden and instantaneous rise of six hundredths of an inch.

The fall of the mercury may be likened to the slow motion of cocking the hammer of a gun, and the rise to the motion of the hammer when the trigger is pulled. Or, to take what is probably an exactly parallel illus-



PHOTOGRAPH FROM THE SCIENTIFIC AMERICAN SELF-REGISTERING BAROMETRIC SHEET.

tration from another element, it is like the drawing away of the water from the banks of a narrow river before a large steamer, as shown in the upper Hudson, and the return of the big wave that follows. As far as I know, no observations have been made of the atmospheric pressure in the center of a tornado, and it is possible the ones we here refer to are the nearest that have ever been carefully observed. There must be an almost instantaneous change of pressure, and that such can occur is evident from the observation referred to.

Let us take the gas tank destroyed in Brooklyn as an illustration. According to the theory of Bernouilli, the difference of six hundredths of an inch would be equal to a wind velocity of forty miles an hour. This accords with the conditions at our point of observation.

A wind of eighty-two miles an hour, according to the same authority, indicates a difference of pressure equal to a quarter of an inch in the barometrical column.

Now this was about the progressive motion of the tornado that struck Brooklyn. When this rarefaction occurred over the gas tank, it exercised a lifting force of about eighteen pounds per square foot on the tank, which, with the lateral pressure of over thirty-three pounds to the square foot in a line with the direction of the storm, lifted, tilted, and overthrew the gas tank, allowing its contents to escape and ignite. We have omitted as an unknown quantity the rotary motion which ordinarily occurs.

Indications of such sudden rarefaction of the atmosphere have been noticed in Western tornadoes. Roofs have been lifted and the four walls all fallen outward. Buildings have also been lifted and moved without destroying them. Many reports that we know to be true seem to be almost incredible, but the greatest mystery is the tornado itself, for, as far as yet discovered, its central substance is simply air of less pressure than that which surrounds it. Yet it has a force of translation that moves it at a rate of over a thousand miles in twelve hours, holding it in a path of about one hundred yards in width, and destroying everything in its course.

It seems to have a self-generating power, and is not weakened by its own efforts, but becomes, like the Antæus of mythology, the stronger each time it touches the earth. When we consider the annual loss of life and property in this country by tornadoes, it is apparent that the subject is worthy of the deepest investigation. That people may be forewarned is evident by the fact that our own preparations for observation were made from reading the telegraphic reports in the afternoon newspapers; and by following these reports of its course, it was evident that the tornado was coming toward us at the rate of about eighty miles an hour, and that we had then over four hours to prepare for it. JOHN C. GOODRIDGE, JR.

Edward Anthony.

In the death of Edward Anthony, which occurred on December 14, 1888, the photographic fraternity loses one of the oldest and foremost merchants in photographic materials in this country and city.

Mr. Anthony was born in New York City. He received a liberal education, graduating from Columbia College in 1838, with an excellent record for scholarship in all departments. Beginning active life, he chose the profession of civil engineering, and soon obtained employment in the corps engaged in building the Croton Aqueduct. Before the completion of the aqueduct, however, he was called to accompany Professor James Renwick on the survey of the northeastern boundary of the United States at the time of the dispute with Great Britain. When engaged in the construction of the Croton Aqueduct Mr. Anthony had amused himself as an amateur with the new art of making pictures by the aid of sunlight, then just introduced by the famous Daguerre. It occurred to Professor Renwick that Mr. Anthony's knowledge of this new discovery might be utilized on the survey, as England denied that there were any "high lands" on the line, as claimed by the United States. The testimony of the daguerreotype could not be controverted, however they might dispute that of the barometer and the spirit level. Mr. Anthony, accordingly, took with him the necessary apparatus and plates, and produced satisfactory images of the hills, which were forwarded to the State Department. This, it is said, is the first instance in which the art of photography was ever made use of by any government.

After finishing this survey, which occurred at a time of commercial depression, when most public works were stopped, Mr. Anthony took up the photographic business. Then after a short time he founded the house of E. & H. T. Anthony & Co., which soon reached the front rank of mercantile and manufacturing establishments in photographic goods.

He was one of the first to introduce commercially the daguerreotype in this country, and was very particular in supplying only the best materials for the purpose. It was but a short time ago that he showed us a daguerreotype made by himself in 1840, which was apparently as perfect and free from any sign of deterioration as when first made. The cause of his death was heart disease; he had reached the allotted age of three score and ten.

In stature he was a small, slim man slightly bent at the shoulders. It may be said of him that he was always a genial, affable, kind-hearted man, honest in all his business transactions, and ever ready to encourage those who sought to help themselves. His example will live in the memory of those who knew him as one to be patterned after.

Rats.

A writer in last month's *Chambers's Journal* repeats the method which is in quite general use here for the extermination of rats. These animals are the wisest of domestic vermin, and any means taken for their destruction is, as a rule, quickly discovered by them; if not, the terror alone engendered by the ever-diminishing tribe is sufficient to cause them to flee the mysterious power which haunts them. Taking advantage of this trait, the writer in question constructed a trap for the rats. This was a water barrel carefully concealed. On the top was a trap door (simply balanced by a pivot in the center), and beyond this some food was placed for which the rats had a strong liking. They could only get to this by walking over the door, and in order to entice them, the door was fixed for about a week; then the bolt was drawn, and for several nights a plentiful supply of drowned rats rewarded the ingenuity of the rat killer, and the remainder of the colony sought "fresh woods and pastures new."

THE relative hardness of woods is calculated by the hickory, which is the toughest. Estimating this at 100, we get for pignut hickory 96, white oak 84, white ash 77, dogwood 75, scrub oak 73, white hazel 72, apple tree 70, red oak 69, white beech 65, black walnut 65, black birch 62, yellow and black oak 60, hard maple 56, white elm 58, red cedar 56, cherry 55, yellow pine 54, chestnut 52, yellow poplar 51, butternut and white birch 43, and white pine 35.

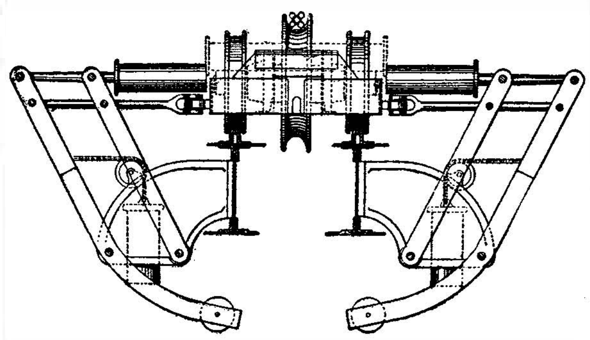
REVOLVING HERCULES CRANE.

There is little doubt the construction of harbors has been greatly facilitated, and consequently their number much increased, by those gigantic appliances for lifting and setting blocks, the various genera of which appliances have received the names of Mammoth crane, Titan, and Hercules. Messrs. Stothert & Pitt, of Bath, were early in the field in the construction of these giants, and, indeed, they have made nearly all that have been constructed in England for the leading harbor engineers, including Sir John Coode, Sir J. Hawkshaw, Mr. P. J. Messent, and Mr. W. Parkes. This company has supplied the block setting apparatus for the harbors of St. Helier's, Jersey; Madras, Kurrachee, and Mandavee, in India; East London, Port Alfred, and Port Elizabeth, in South Africa; Goa, the capital of Portuguese India; and Colombo, that of Ceylon; Gisborne, New Zealand; and Hartlepool and Tynemouth, in England.

The Hercules illustrated below is the latest development of this type of machine. It was made, under the direction of Mr. James Walker, M. Inst. C. E., for the Isle of Man Harbor Commissioners, and is now at work extending the Victoria pier at Douglas, where it forms a striking object that cannot fail to be noticed by every visitor to the island. This appliance is designed for setting 15 ton concrete blocks at any point within a circle of 150 ft. diameter. There were some special circumstances which governed the design, notably the necessity of having the block yard at a distance, and of bringing the blocks by water, so that there should be no interruption to the traffic of the harbor. The Hercules unloads the blocks from a steam barge, stacking them on the pier behind itself; and, in order to save the tides and to clear the barges quickly, the machine has been made to work at a very high rate of speed. For instance, a complete revolution of the jib can be accomplished in a minute and a half.

The depth of water in Douglas harbor is very great, so that the total range of lift of the machine is required to be 95 ft., the horizontal travel along the jib being 55 ft. This horizontal motion is an absolutely essential feature in block setting machines, for enabling the divers to adjust the blocks in place with accuracy. In order to facilitate setting under water, there is also an arrangement on the snatch block by which the diver can twist the concrete block by means of a worm wheel and ratchet handle. All the motions of crane, except that for lifting, are worked by friction clutches, and are so arranged that any two of them may be worked simultaneously, thus greatly facilitating the work of unloading the blocks from the barges. The jib of the crane consists of two horizontal girders carrying the rails on which the jenny runs. These girders are braced together by built-up brackets of U form, the object being to preserve the girders from any tendency to twist owing to the one-sided pull of the tie rods, and at the same time to afford a passage for the jenny. The lifting chain is supported along the jib by Pitt's patent chain porters, which consist, as shown by the engraving, of an arrangement of rollers butting together and forming one complete roller in their normal position; but when the jenny passes they are separated, and, by the action of a pivoted parallel motion and pendulum weight, are dropped from under the chain and again brought up under it when the jenny has passed.

The superstructure is carried by fourteen steel rollers arranged in two segments. Over the front segment is a kingpost, 21 feet high, built up of girders and bracing, and to the top of this the front and back tie rods are attached. The back tie rods carry a



PITT'S CHAIN PORTER.

strong framework of girders covered with rolled iron checker plates forming a platform, on which are placed the lifting machinery, boiler, feed pump, feed tank, etc., and to the under side of the platform are slung about eighteen tons of counter ballast. The lifting barrel is 4 feet 3 inches in diameter, and is cast with a spiral groove, so as to take the whole of the chain in one coil without overlapping. The engine is fitted with two cylinders of 10 inches diameter by 14 inches stroke, and steam is supplied by a vertical cross tube boiler. The principal gearing is machine moulded and works very smoothly. All the handles are brought together in a handle box arranged like the levers in a railway signal box, so that the whole machine is under the complete control of one man. The truck of the machine is formed with a clear height of 17 feet 2 inches, this great height being given for permitting the crane to be run back over the stacked blocks. It is built up of wrought iron girders and carries on the top a steel race on which the superstructure runs, the whole pivoting on a center pin. The truck travels on twelve wheels fitted with heavy double flanged steel tires. The whole machine is self-propelling, and the motive power is sufficient to traverse the whole with a load of fifteen tons. With this crane, unlike most lifting appliances, every load is the maximum, a circumstance which requires that the design, material, and workmanship be all of first class quality. All the plates throughout were planed at the edges, and all the holes drilled.

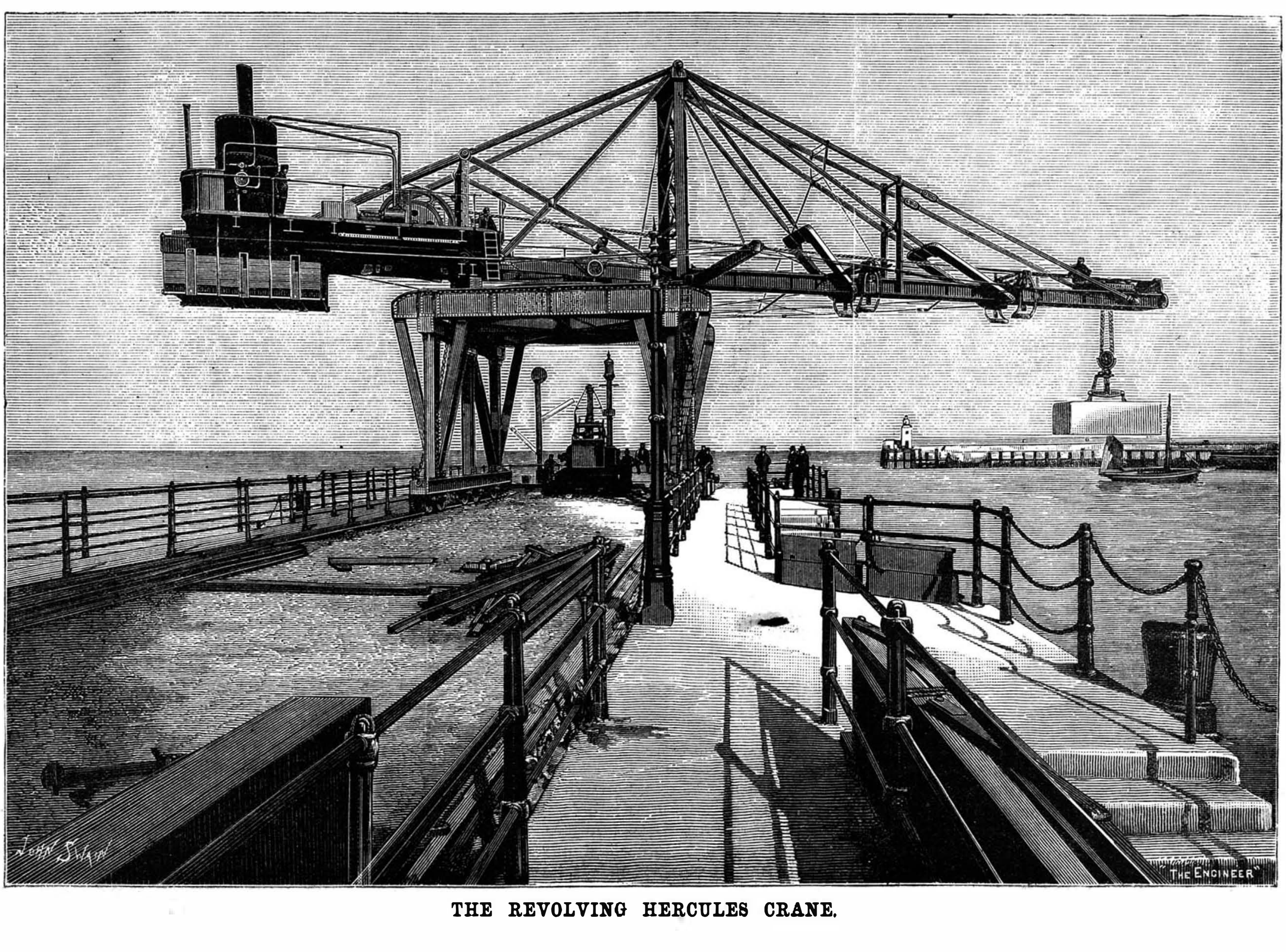
The crane was tested in Messrs. Stothert & Pitt's works with a 20-ton load, and again with 20 tons after erection at Douglas. We understand that it has given the most satisfactory results in actual work, and that Mr. Walker, the engineer, and the Isle of Man Harbor Commissioners have expressed their entire approval of the manner in which the work has been carried out. We are informed that as many as 530 tons of blocks have recently been set by helmet divers in one working day. The whole machine is a very fine example of a specially designed lifting appliance, and reflects great credit upon all who have been concerned in its design and manufacture.—*The Engineer.*

Instantaneous Photography.

At a recent meeting of the Berlin Physical Society, Dr. Konig gave an account of experiments which he had made with Ottomar Anschutz on the instantaneous photography of projectiles. After exhibiting and explaining the instantaneous photographs which Anschutz had made during the last few months, such as those of the funeral procession of the late Emperor Frederick, of episodes at the maneuvers, wild beasts at the Zoological Gardens in Breslau, of the several positions of a soldier marching on parade and of a lady dancing, he described the arrangements necessary for photographing a cannon ball traveling at the rate of 400 meters per second. The cannon ball was projected in front of a white screen illuminated by direct sunlight, occupying in its passage one-fortieth second. During this time four negatives were taken. The firing of the cannon, the momentary exposure of the plate, and the recording of time on the chronograph were provided for by electric currents. The experiments were made at Magdeburg at the Gruson rampart, and had to be completed in one day. Only one successful picture of the projectile was obtained, but the possibility of such experiments and of the accurate determination of the several time intervals was sufficiently indicated.

The Largest War Ship.

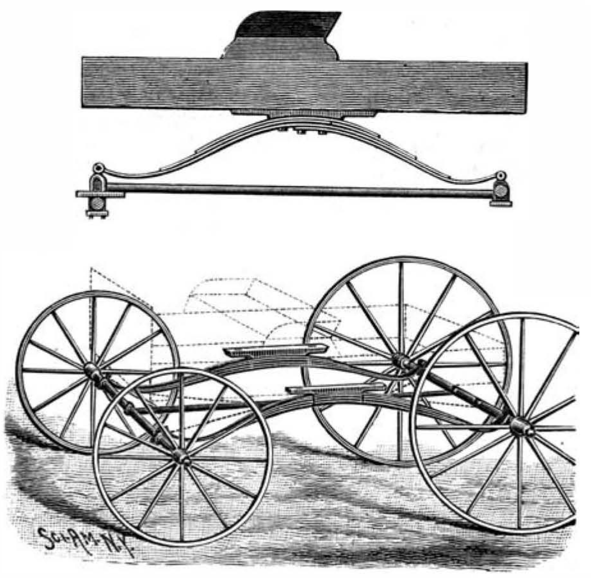
The Re Umberto, lately launched for the Italian government, is one of the largest war vessels in the world, her displacement being 13,298 tons, or 1,358 tons more than the Trafalgar or the Nile. She is 400 feet long by 76 feet 9 inches broad, and draws 29 feet of water. The armor on her barbettes is 19 inches thick, and she is fitted with a 3 inch steel protective deck as well. Her main armament will be four 104 ton guns and twelve of 4½ tons, while her engines are expected to give a speed of 18 knots.



THE REVOLVING HERCULES CRANE.

AN IMPROVED VEHICLE SPRING.

The accompanying illustration represents a novel construction of side springs for wagons, which has been patented by Mr. James F. Thomas, of Alexandria,



THOMAS' VEHICLE SPRING.

Neb. The springs are bent laterally inward at the middle parts, and there secured to the vehicle body or a cross-piece on its bottom, the springs thence diverging in straight lines outward, and being clipped to the front and rear axles. Each of the springs is strengthened in its rear by adding a half leaf beneath the other leaves, this leaf being secured at its forward end by the usual center bolts, and extending backward to form part of or connect with the clip coupling on the rear axle. The clips or couplings with which the spring is connected at its outer ends with the front and rear axles are bent where the connection is made to present skew-joints or knuckles, adapted to conform to the laterally diverging portions of the spring. This spring is designed to combine all the advantages of both end and side springs, holding the body of the vehicle substantially level when the load may be very unequally placed.

African Goats.

A pair recently brought from Africa has been added to the Central Park collection of animals.

"There is no particular value attached to the animals, except from their rarity," remarked Director Conklin. "They are the first pair of Morocco goats probably that ever found their way to this country. They are young, in their second year, quite gentle, as you see, and will eat out of your hand. But if startled, all their inherited wildness comes out. I never saw such animals. They seem to have muscles of rubber, from the way they jump. I have never had so much trouble with the most dangerous animals we have here.

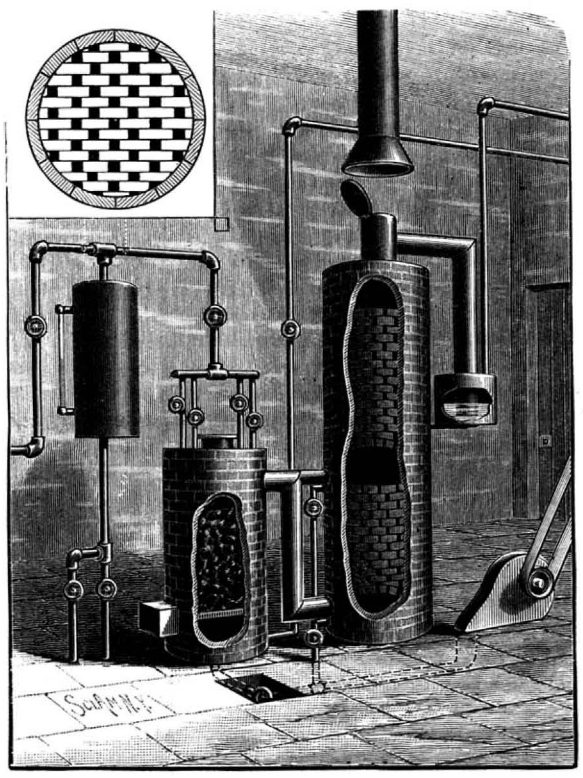
"The jumping of the thoroughbred hunters in Madison Square Garden a few weeks ago doesn't begin to compare with that of these goats. I put them in a yard having a fence eight feet high, but they jumped it so easily that now I have a fence ten feet high.

"The space within their inclosure is so limited that they cannot get a good start to go so high, or I would not trust them with anything less than a fifteen foot fence. Then, they are getting accustomed to these quarters and are not so easily alarmed as they were, but I think, if startled, they might still clear this fence. Their leap is peculiar. They crouch a little, give a short jump in the air, and as they strike the ground, bound upward again as if they were shot from a catapult. The muscles of their legs are extremely tough, but the legs are not adapted for great rapidity or endurance in running. They have been developed by generations of climbing on the Morocco hills. As these goats get older and their bodies in captivity become heavier, they will probably become less active. Possibly our native goat has lost his faculty of high jumping, if he ever had it, since he became partly civilized and accustomed to a diet of brown paper."

AN IMPROVED GAS MANUFACTURING APPARATUS.

The illustration herewith represents an apparatus for the rapid and economical manufacture of water gas from oil, steam, and coal, which has been patented by Mr. John A. McCollum, of Riverside, Cal. In this apparatus, the furnace is charged, through a door at the top, with coal or coke, there being at the bottom a door leading to the grate bars, under which discharges a blast pipe connected with a blower. A series of pipes are arranged to spray oil into the top of the furnace, these pipes being connected with a tank at the left, while the tank itself is connected at the top with a pipe from the storehouse, and at the bottom with a pipe admitting water under pressure, and also providing for the escape of water, when the valves are properly turned for either purpose, the water pressure being made to force the oil into the furnace and spray it upon the fire. From the upper end of the furnace extends a horizontal pipe, having two branch pipes leading into a double "fixing" chamber, one pipe leading to a bottom fire-place and the other to a fire-place about midway of the chamber, fire-bricks being arranged in checker-fashion, as shown in the small view, above each fire-place. In the upper end of the chamber is an outlet pipe leading to a smokestack, and having a valve on its outer end to cut off the smoke-pipe connection, while from the same pipe extends horizontally, and then downward, a discharge pipe leading into a "washer," which has the usual outlet pipe. A pipe conveying live steam from a boiler is connected with the apparatus, being passed vertically through the branch pipe between the furnace and "fixing" chamber, to discharge steam on the under side of the furnace grate bars.

In operation, the coal or coke in the furnace having been ignited, the combustion is forced by an air blast from the blower, a portion of this blast being also at first discharged into the two fire-places of the fixing chamber, while the valve leading to the smoke-pipe is open. The checker bricks having become about a straw color, the air blast is shut off, and the valve leading to the smokestack closed, while the steam is admitted, being superheated on passing through the branch pipe from the furnace before its discharge under the grate bars. At the same time the oil from the supply tank is caused to spray on the top of the fire, whereby light and heavy hydrocarbon gases are formed, which mix with the hydrogen gas, carbon monoxide and carbon dioxide produced by the steam passing through the fire, this mixture passing through

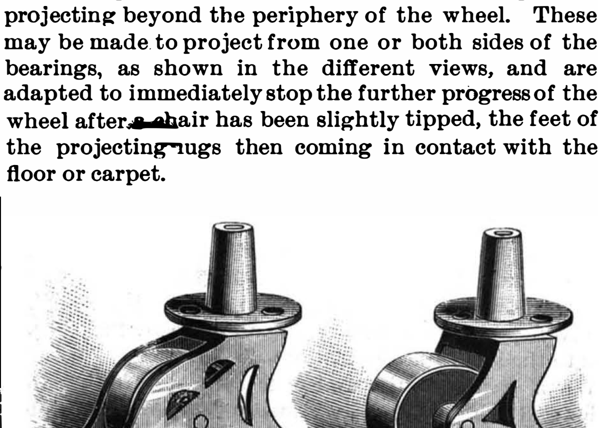


McCOLLUM'S GAS MANUFACTURING APPARATUS.

the bricks of the "fixing" chamber, and making an enriched or carbureted water gas, which passes into the washer to be further treated in the usual manner.

AN IMPROVED SAFETY CASTER.

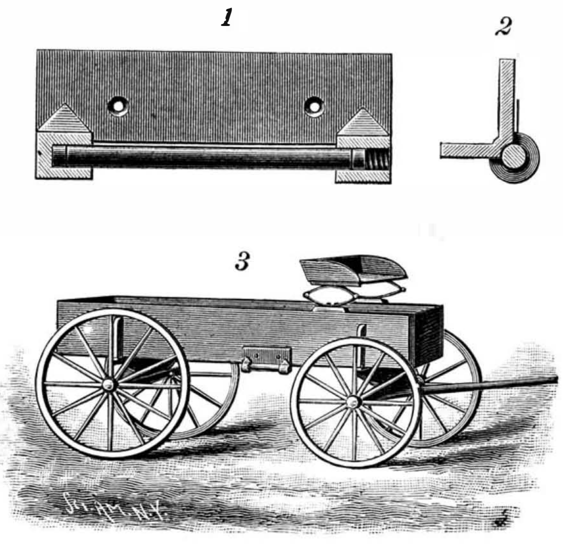
A simple frame or horn, making a socket for casters in chairs or other articles of furniture which will tend to prevent their tipping over, is illustrated herewith and has been patented by Mr. James J. Sullivan, of No. 59 Second Place, Brooklyn, N. Y. It often happens, as a caster is ordinarily attached to a chair, that a person sitting in the chair and slightly tipping forward will cause the chair to roll back from under him, and similar results will follow when the chair is tipped too far back, both being accidents which this invention is designed to prevent. The frame in which the wheel is journaled has at its base horizontally aligning integral arms or lugs, at each side of the wheel bearings, and projecting beyond the periphery of the wheel. These may be made to project from one or both sides of the bearings, as shown in the different views, and are adapted to immediately stop the further progress of the wheel after a chair has been slightly tipped, the feet of the projecting lugs then coming in contact with the floor or carpet.



SULLIVAN'S SAFETY CASTER.

IMPROVED WEAR IRON FOR VEHICLES.

The accompanying illustrations represent a wear iron for taking up the wear of the wheels against the body of a vehicle, as in turning. It has been patented by Mr. Jacob M. R. Gedney, of Little Falls, N. J. The



GEDNEY'S WEAR IRON FOR VEHICLES.

device consists of a plain friction roller, preferably made of chilled steel, mounted to turn in bearings formed on an angle plate adapted to be attached to the body of the wagon, Figs. 1 and 2 showing a sectional side view and a cross section of the device. The roller is held detachably in place by a set screw working in one of the bearings against the corresponding end of the roller, a cylindrical rubber or other yielding block or spring being interposed at each end bearing of the roller to prevent all rattling. The angle plate attached to the body of the wagon has a concave bearing or seat on its apex or ridge, throughout its length, in line with the bearings of the roller, whereby the roller will be supported, and there will be no danger of its being bent or broken by a blow of the wheel in turning the vehicle.

Contrast of Colors in Nature.

Nature is very sparing of showy contrasts of warm and cold colors. Red and blue are very rare, and of yellow and blue the cases are but few, and black and blue are found in lepidoptera more often than white and blue are seen in our flora or fauna. It is not uncommon for one of two strong colors to be overcast with a tinge of its fellow, or for both of them to be reconciled by a common touch of black or of some third color, or for one of them to be lightened by a dash of white, while the other is lowered by as much black, and so red, off-hued with black—russet and green up-brightened with white—often meet in the autumn in dead and dying patches of fading leaves. It may be shown, I believe, by the refractions of light in crystallized gypsum that brown is the complementary color to lavender-gray; and how true to herself is nature we may go forth and see, in the fall of year, in the dead and curled leaves of the mugwort, or meadow sweet, which are beautiful even in their death, with one side brown and the other the brown-matching gray; and, if brambles be cut in the leaf-greeny season, their two surfaces soon wither into the harmony of gray and brown.

And what use are we to make of these hues of nature? They are warrants for a gray mantle under locks of brown hair, or a brown bonnet or trimmings, or a gray room wall with brown furniture; and if, in a hot summer's day, I see the dark leaf-shades playing on the gray bark of a young beech, I can boldly lay darkish leaf shades on a wall of the beech bark's hue; or if, after the winter rains, I find a barkless pole in railings, tinted with the palest blue-gray, and on breaking off a splinter of it I find its inner wood of its true color of pale brown-yellow, why should I not take the inner tint for my wall and the outer one for the skirting? Or, if I pick up a piece of lichen of dull green on one side and dull gray on the other, why should I not bind my book in one color and lay on it a lettering piece of the other? Nature is the best school of art, and of schools of art among men those are the best that are nature's best interpreters.—*W. Barnes, in The Architect, London.*

Oiling the Waves.

Almost every vessel that encounters heavy seas reports, on reaching harbor, that oil was used in calming the waves with great success, and had it not been for the oleaginous liquid, the ship and all on board would certainly have gone to the bottom. Notwithstanding these multifarious statements, the percentage of vessels lost appears to remain about the same. Even if the oil has no great effect on the angry waters, it certainly produces a powerful influence upon the imaginations of the mariners. They believe it adds to their safety, fears are allayed, good judgment is preserved, and all hands work intelligently.

The Amber Fishers of the Baltic.

The Samland, the region lying between the Frisches Haff and the Kurisches Haff, equidistant nearly from Dantzig and Memel, is the home of the amber fishers of the Baltic. Germans call it the California of East Prussia, and, standing under the shadow of the lighthouse at Brusterort, where the peninsula juts out into the sea, one can see with the naked eye, on a moderately fine day, the entire stretch of coast from which, for more than three thousand years, the bulk of the amber supply of the world has been obtained. Twenty, thirty feet deep, and more, beneath the sand dunes that extend for miles around, and form the ocean floor here, are the veins of "blue earth," as it is termed locally, in which the petrified yellowy and yellow-brown masses are found embedded; and a little way out beyond the lighthouse, on the Fox Point, where a fleet of black boats generally rides at anchor on the gray-green water, is one of the great amber reefs of the "Bernstein-Kuste," a veritable layer of amber cropping up in the sea bed, and heaped up by the ceaseless action of wind and water. The "blue earth" formation runs far back inland, so that amber can be mined as well as fished, as it, in fact, is in some places in the district. But as the deposit is so much nearer the surface under water, where it is being continually exposed by the gradual sinking of the sea level, while the ebb and flow of the tide and the frequent storms that occur along the coast help to free the amber from the sand and weeds in which it is hidden, it is found more profitable, as well as easier, to "fish" than to "dig" it.

A few years ago, digging was largely carried on in the Samland, and assumed almost the proportions of a regular industry. Five or six peasants, not possessing the right to "fish," would combine, and obtain permission to excavate in likely spots on the estates of private persons. The result was profitable, but, in the end, the "digging" proved a source of unmixed evil to the locality. The "diggers" began to cheat the proprietors of their proportion of the yield, and invariably concealed a good find. Dealers, who crowded into the district, in the hope of picking up bargains, cheated the diggers. Then people commenced digging in parts forbidden to them, making what was termed "moonlight" expeditions to promising grounds. Fights with inspectors were of constant occurrence. When disturbed, the "diggers" had no hesitation in having resort to firearms, and murders became quite common, so that the government was obliged to prohibit this form of amber getting. The right to "fish" belongs to the coast villages and communities, and, in parts, to the state. The latter farms out the grounds belonging to it to certain Konigsberg and Memel firms. One of these, Messrs. Stantien & Becker, agreed, in 1862, to keep open the waterway of the Frisches Haff—which needs constant dredging—and pay 25 thalers a day besides, if they were allowed to dredge there for amber. That the contract proved not unprofitable to them may be inferred from the fact that, when the six years for which they had tendered expired, they offered 200 thalers per working day instead of the original 25. The take of amber at Schwarzort, where the dredging is carried on, was estimated at 75,000 pounds for the working year of about thirty weeks.

Amber fishing is no child's play, and the fishers of the Samland are an exceptionally vigorous and hardy lot of men, as they need to be, seeing that they work either shoulder deep in the water, when the salt spray dashing over them falls in chilling icicles upon their faces, or are obliged to spend hours in a constrained position on the sea bottom, in heavy diving armor, when the air temperature is often a good deal below freezing point! They are not Germans, but Samaites, of the Kurish race, who have given a good account of themselves in many a frontier fight with Cossacks and Russ.

Stormy weather is the time to see the village fishers at work, for then wind and wave do what man's hands cannot accomplish. The sea, lashed into fury, loosens the bowlders that press upon the amber masses underneath, disentangles them from the weeds and "sea tang," by which they are attached to the bottom, and sets them rolling inshore. Scouts are always on the look-out for approaching bad weather, and when a fierce northeaster comes roaring down the Baltic, sending the surf surging over the sand dunes, and strewing the sand with wrack, the fisher villages are warned that their harvest is a-ripening. Soon all are gathered near the water's edge ready for work. The fishermen, armed with long hooked forks and hand nets, wade shoulder deep into the sea, careless of the waves that buffet them to and fro, and seem almost to take them off their feet at times. With their forks some poke at the masses of seaweed and "tang" driven toward them by the crested surf, and catch as much as they can, and drag it landward, while others try to gather in their nets any stray pieces of amber tossed about by the surging waves.

As fast as the masses of weed or single pieces can be got ashore, they are passed on to women who stand as near as they can to the water, and who quickly loosen from them the fragments of amber, large or small, that may be attached. These are then put into bags, sorted, and sold to the dealers, who not unfrequently accompany the fishermen on such occasions, in the hope of picking up a fine specimen before any rivals have the chance of seeing it. As it happens, though, it is the smaller pieces of amber that are cast ashore by the sea. The larger and finer blocks are rolled about on the sea floor and remain behind, the ceaseless play of wind and wave helping to cover as well as to uncover them. To get at these, the amber seekers wait a day or two until the wind goes down and the storm abates. Then, when the sea is smooth enough to see the bottom, they row out into the shallows, where there is not more than five to fifteen feet of water, and look for any amber blocks the waves may have uncovered or rolled in during the gale. When such are found they are raised by means of long pronged forks, and nets held out as before. On a fine morning, after a stiff hurricane has been blowing in the Baltic, scores of little boats may be seen off the shores of the Samland peninsula, the occupants bending over the sides, and eagerly peering into the sea in search of any amber treasures left by the departed storm. But the village fisherfolk only get the gleanings. The harvest proper is gathered by those at work on the amber reefs in deeper water.

For reef fishing, which is carried on off the coast of Brüster-ort, divers, specially trained to the work, are employed. The reef, a little to the northeast of the Samland promontory, is the most valuable in existence. It is over six hundred feet long, and more than four hundred feet broad, and consists of solid pieces of amber, deposited by the currents that meet just there, and embedded in the sand and seaweed that accumulate about it, and covered, in some parts, by huge bowlders and blocks of stone. The barrier has been formed in the course of many centuries, and is now worked ten months out of the year, by the little flotilla of black boats that lie about three-quarters of a mile out, off the Brüster-ort lighthouse. Seen at a distance, the occupants of the boats seem idle enough as they sit in the stern, silent and preoccupied; but, rowing out to the fleet, one finds the men to be busy enough. Each of the half score boats at anchor here has six hands on board, besides the divers, who are at work below. Two pairs take charge alternately at the air pumps, which must be kept going without an instant's stoppage. One holds the life lines in his fingers, watching for the least pull, which is the signal to haul up, and the last is the overseer, who keeps an eye on everything.

The pumpers fix their gaze steadily upon a little dial plate placed amidships, and do not even turn as we row close up to them. They are watching the air pressure gauge, for too much air would prove as fatal to their mates below as too little, so their eyes never wander from the register in front of them. Every now and then strange and uncouth-looking figures are drawn out of the depths and rise to the surface, dripping wet, and are hauled into the boats—divers, evidently, and yet unlike ordinary divers—monsters, whose heads appear to hang down in front and wobble as they rise, and with curious humps on their backs. The amber reef fisher has to work in a lying and recumbent posture, so that the ordinary diver's equipment has had to be modified to suit him. Instead of the helmet, with its barred goggle eyes, being screwed on to his shoulders in an upright position, it projects forward, to relieve the neck and collar of the strain, and hangs down in front, so that his appearance as he rises from the deep, with the water dripping from his pendent top covering, is ludicrously like some sea animal with a snoutless head that waggles solemnly from side to side. To the back of each is strapped what looks, at a first glance, like a soldier's knapsack, but is really a metal box, with an upper cylinder, constituting an air reserve, so arranged as to supply the diver at each inspiration with exactly the quantum of air he needs, and no more; while the expired carbonic acid gas rises through another passage to the upper atmosphere.

As the divers are hauled into the boats, the overseer takes from a receptacle round the waist any amber blocks that have been attached to it. After a few minutes' rest, the fisher descends, and resumes his work below. With stout crowbar and pronged iron he pokes about among the masses of weed, and sand, and stone that form the sea bottom, until he detects the presence of an amber mass. Or, crawling about on hands and knees, he loosens from the sea floor any blocks recent storms may have partially dislodged. Often these pieces require two, or even three, divers to move them, and gigantic slabs have, now and again, been found that resisted even the united strength of three pairs of hands to disentangle from the masses of stone and weed encumbering them. The fishers remain down five hours a day, and though in autumn the sea is icy cold, so severe is the strain of working under water that they rise to the surface bathed in perspiration.

When gathered, the amber is sorted according to color and size. Pale, straw-tinted pieces go to the pipe makers of Constantinople, North Africa, and the Levant, and are made into mouthpieces; the light, bone-colored, and veined slabs are sent to grace the classic busts of the peasant women of central Italy; while the full yellow, sherry-tinted specimens find their way to the South Sea Islands and inner Africa, where, worked up into necklets and beads, they are destined to adorn the ebony necks of the dusky beauties of Otaheite or Timbuctoo. Water amber is nearly all transparent and glasslike. Earth amber—that is to say, amber obtained by digging—is of the smoky kind, more white than yellow, and quite opaque. Only the finer sorts are obtained from the "reef" off Brüster-ort, and these fetch on an average about five thalers, that is fifteen shillings, per pound. Large blocks fetch proportionally higher prices than smaller slabs, while exceptional specimens, of unusual size, run to fancy prices altogether—fifteen, and even thirty, pounds sterling, it is said, having been paid for such samples. Most of the ordinary qualities of amber go to Leghorn and Venice. In return, northeast Prussia takes coral gathered from the reefs of the Adriatic.

This is due to the fact that in the Baltic provinces of Germany and the neighborhood custom ordains that brides and young married women shall appear in a curious ornament of red coral. It is made by stringing coral beads on a stout silken cord, the smallest beads procurable coming first, larger next, then still larger ones, until the largest of all are reached. This ornament is worn in such a way that the smaller beads are round the neck, the next in size round the shoulders, while the largest cover the bust, and depend down the back. The cost of a perfect string of coral like this is over fifty pounds sterling, and all well-to-do Polish families consider it an indispensable item of a bride's outfit. Hence the demand for coral is pretty regular and constant in the North; and in this way it comes that, practically speaking, the produce of the Italian coral reefs is exchanged for the yield of the Baltic amber fishery.—*London Standard.*

[MANUFACTURERS' GAZETTE.]

The Draftsman.

The most approachable men among the mechanical fraternity are the draftsmen. Why it is that they always maintain that serene suavity that characterizes them as a body, it is impossible to divine.

Perhaps this comes from the fact that their calling isolates them, to a certain extent, and when you do meet them, their good nature is all the more impressive.

Many people suppose that a draftsman only draws.

This is only partly true. Strange as it may seem to these good people, a draftsman has brains.

If such was not the case, many crude sketches of "what I want" would lie buried in the rubbish, and many meritorious inventions never see the light.

Do manufacturers appreciate the services of their draftsman at his full worth?

Some do, many do not; the work he performs is of such a transitory nature that they never stop to think.

But the draftsman does; he thinks out many improvements in the design of the manufacturer, he points out errors in mechanical movements, and often saves it from becoming a total failure.

Then if you knew more about the knight of the drawing board, you would say that he was the brains of the inventor.

Precisely, and that is what he may be termed, for in many instances without him the inventor would be nonplussed. Therefore it must be concluded that the draftsman is one of the most useful members of the great mechanical and manufacturing industries, and an acquaintance worth cultivating, for it is due to his skill mainly that we are indebted for nearly all of the necessary, useful, and luxurious comforts that surround us, for the constant increase of labor-saving machinery, the construction of stupendous progressive enterprises in engineering, increased speed in locomotives and engines, simplicity of construction in many lines of mechanical utility, and in a thousand and one ways the draftsman helps the inventor to realize on human ingenuity.

The draftsman is also a teacher, in that his works are on file for the generation that follows him, and upon the basis of thought, or construction, more properly speaking, which he has outlined, are builded the improvements or more advanced methods of each succeeding venture in that particular line of manufacture. Give, therefore, the draftsman his due, and speak well of him. RICHARD B. WRIGHT.

Ink Rains.

Writing from Grahamstown, Cape Colony, Mr. L. A. Eddie gives an account of some extraordinary showers that fell there on August 14 last. A storm commenced near midday and lasted till late the next morning. At intervals during this period heavy showers of rain fell, after which large areas were found to be covered with water as black as ink. Two theories are put forward to account for the observed facts, one attributing it to dust in the air from a recent volcanic eruption, while the other considers the phenomena to be due to the passage of the earth through a dense meteoric stream, the dust of which suspended in the atmosphere was carried down by the rain, and being essentially iron, formed, on being mixed with the organic acids of the soil, a true ink.

Correspondence.

Discovery of Comet Brooks No. 1 of 1889.

To the Editor of the Scientific American:

While sweeping the eastern heavens this morning, in the vicinity of the sun, I discovered a new telescopic comet, and the first one of the year. Its position was right ascension 18 hours 4 minutes; declination south 21 degrees 20 minutes, with a rapid motion in a westerly course. Its appearance is that of a nearly round nebulosity, with slight central condensation.

WILLIAM R. BROOKS.

Smith Observatory,
Geneva, N. Y., Jan. 15, 1889.

Some Hints on Selecting a Trade Mark.

BY COL. F. A. SEELY.

It is almost a daily experience with me to be asked to look at some design, or oftener some word, and to express an opinion of it as a possible trade mark. Sometimes the comparison is instituted between the proposed trade mark and one already known and used for some similar merchandise, and the question takes the form "In view of that, would this be a good trade mark?" A good-natured person cannot be always refusing to express opinions on questions put to him on the assumption that his opinions are worth having. His natural self-complacency can scarcely resent such inquiries, and I commonly give a curbstone opinion, even when I had much rather not. Sometimes a mere word on the uncertain line which separates fanciful terms from those that are purely descriptive is shown to me, and I am asked to indicate whether it should be treated as a trade mark or as purely label matter. This is not always easy to decide. The nature of the merchandise, the rules of the trade, the particular circumstances of the case, a hundred things of one sort or another, may affect a proper judgment on such questions, and the person to whom they are put, whatever be his experience, may hesitate to answer.

I often mourn over what appears to me the great poverty of imagination among those who adopt trade marks. Certain familiar symbols appear over and over again, and applied to every variety of merchandise. The star, the cross, the anchor, the eagle, are found under various modifications everywhere. Words of a popular character like "Electric" and "Jumbo" are seized upon simultaneously for widely different goods, and there is no end to the persons who lay hold on such semi-descriptive adjectives as "perfect," "superb," "famous," "charming," "standard," "automatic," and the like.

There are a few simple notions on the selection of trade marks which might, perhaps, be called maxims, and the observation of which would save trouble and expense.

A trade mark right is in its nature perpetual. Patents expire with the term for which they are granted. Copyrights have a little longer term, and are renewable; but they exist only by virtue of statute law, and in the course of years they expire also. But a trade mark has no such limitation. The right it implies is not dependent on any statute, and has no term. Once secured, it goes on with the business, like the poet's brook, forever.

A man starts a small concern, identifying his products by his own trade mark. His sons grow up and are taken into partnership, while the business grows also, and the goods bearing the mark become more widely and favorably known. The style of the firm changes as well as in its personnel; it expands into a corporation or shrinks into a single individual, but the trade mark associated with the business and its product still belongs to the concern, and as long as the good character of the product is maintained, has a constantly increasing value. This is the history of many a reputable British house, like the great hosiery concern of Morley.

Many modern trade marks are adopted simply to attract trade by their own popular character. Such popularity is often most ephemeral, and the mark, having served its momentary purpose, is dropped for the next sensation. Technically, these are trade marks, while practically the part they perform is less to mark the merchandise as of a particular make than to attract customers by the sentiment they evoke. The persons who use them will not be guided by the maxims of trade mark law in adopting them. To those, however, who propose to adopt trade marks for permanent use in a business which they hope may long continue and outlast the ordinary business life of an individual, I suggest:

1. Let your trade mark have individuality; whether it be some pictorial symbol affecting the eye only, or a newly coined word, or some term used arbitrarily and fancifully, let it have a distinct character of its own. The world of fanciful words and designs is boundless. There is never any need of intruding on the ground some other has selected; and you should select for your trade mark something as far as possible unlike anything used by others on the same class of merchandise. The moment you begin to question in your mind whether you are safe in adopting a six-pointed star for use on your goods, while your neighbor is using already a five-pointed one, it is time to stop. If there is such doubt in your mind, always resolve it against yourself. You may be sure that if the faintest doubt comes to you, it will come to others also, and will becloud your title to that extent. The Irish coachman's rule was a good one; when asked how near he would drive to the edge of a precipice, while others were vaunting their skill and indicating the inches within which they would dare to approach, he scratched his head and said, "Faith, I'd kape as far off as I cud." I have never seen the rule laid down, but I had it as a fact from a recent Solicitor-General of Great Britain, that in the registry of trade marks the British office always resolves doubts of this kind against the applicant, holding that if the resemblance is so close as even to excite doubt, an honest man ought to select something else not liable to that objection.

It is not always easy to devise an absolutely unique trade mark, but that should be the objective point, and the nearer you can attain to it, the better.

2. A trade mark must be something to which the manufacturer has an exclusive right as a mark for his goods. Not an absolute right, since there can exist no such right to a symbol. But to say that there must exist an exclusive right as against any other person already making or selling similar merchandise is scarcely more than repeating what has been said already. More than this, there must be such a right as will exclude the general public now and in the future. If you are making gum-drops, you may call them *delicious*, may call them so whether they are so or not, but you can have no monopoly in the right to call them so. That is the privilege of every one. Consequently, you cannot take that word for your trade mark; and this is true of all words that describe merchandise, as adjectives of quality, those which define some quality or characteristic of the merchandise, or which assert its superiority, those which indicate geographically the place of origin, those which indicate ingredients, in short, all words which others may use with equal truth to describe their goods. You cannot shut out the public from any fraction of the right they already possess in the ordinary words of the language. Every man has a right to advertise his merchandise, to describe it, and to extol it as he will. So you cannot adopt as your trade mark that which is merely a picture of your merchandise. Any man may make a clothes wringer or an ore crusher, and use a cut of it connection with his advertisements. If you have any monopoly in a machine, it is by virtue of a patent; and when seventeen relentless years have passed, all your right lapses, and you cannot perpetuate it, or narrow the rights of any member of the public who may care to manufacture and sell it, by exclusively holding the right to use a picture of it.

3. Do not multiply your trade marks. One distinctive mark, well known in connection with your goods, may have great value. A dozen different marks will each tend to destroy the character and value of the other, and are a positive detriment. A trade mark has been neatly defined as "the commercial signature" of the manufacturer. Every body knows the value of a signature; but every body knows that if Jay Gould had a new signature for every day in the month, his checks would not pass very freely. Such signatures would authenticate nothing. The case is the same with the multitudinous trade marks fashionable in some branches of industry. Perhaps the conditions of trade make it necessary to constantly vary the brands of soap and cigars, as fashions in bonnets change, but the prudent manufacturer should see to it that each new label bears his distinctive trade mark in addition to the transient brand with which he captivates his customers. If the housewife finds quality guaranteed by the familiar trade mark, she will not object to the fascinating title that charms her cook and laundress.

These are some of the considerations which any one selecting a trade mark for permanent use, and intending to maintain a high character in the business it is to represent, should keep in mind.—*Trade Mark Record.*

The Satellite of Neptune.

M. Tisserand has presented a report to the Paris Academy of Sciences concerning some remarkable observations of the satellite of the planet Neptune, which was discovered in 1847. The angle which the plane of the orbit of this satellite made at that date with the ecliptic was about 30°, but this angle has now increased by at least 6°. The satellite moves round its principal in an opposite direction to that usually followed by other satellites, so that a question might be raised whether in the course of time this variation in the inclination of the plane of its orbit might not end in its movement around its principal becoming normal. M. Tisserand showed that this variation of inclination was due to the oblate or flattened condition of Neptune at its poles, and that it will complete its limit within a period of 500 years, at the end of which time it will again be as it was in 1847.

Electrical Dangers in New York.

An electric conduit at Maiden Lane and Nassau Street, a little after midnight recently, exploded with a report that shook the ground for a considerable distance. The iron cap of the manhole which covers the conduit was turned over and a huge volume of flame shot upward. As the iron cap weighs 200 pounds, the force of the explosion was sufficient to have caused much loss of life, remarks the New York *Tribune*, had the accident occurred in the busy part of the day. Not much damage was done to the buildings in the surrounding neighborhood, a few dislodged paving stones and a cracked window comprising the sum total of the mischief. The only trace of the accident to be seen the next day was the new cap which had been laid down in the early morning. Henry J. Smith, of the Edison Electric Illuminating Company, to whom the conduit belonged, was seen by a *Tribune* reporter, and expressed the opinion that the accident had been caused by the formation of an arc in the conduit box. The spark thus created communicated with the accumulations of gas in the manhole and brought about the explosion. The company had not yet made an examination of the conduit, but was satisfied that the explosion had happened in the way described.

President Lynch, of the United States Illuminating Company, said: "This is only another instance of the danger of running electric cables under the ground. The whole point of the difficulty lies in a nutshell. Whenever the electric insulator, from any cause, becomes impaired, the current must form a connection with the ground, and a spark is generated. If this should happen in any receptacle where gas, more or less mixed with air, has accumulated, and where such gas is within a narrow compass, such as a manhole, an explosion must follow. The business man or other pedestrian walking unsuspectingly over a conduit can never be sure that it will not explode and blow him to pieces."

Details for Working Chloride Paper.

The demonstration of chloride paper which I had the honor of giving at a recent meeting of the Society of Amateur Photographers of this city has elicited much favorable interest, and I have been requested to give the details of my method of working for the benefit of all. They are briefly as follows:

Exposure.—This is most easily done with magnesium ribbon held in a clip. A negative of good printing qualities requires but a quarter to half an inch burned at a distance of one foot from the negative.

Developer.—1. Make a solution of protosulphate of iron to test sixty by hydrometer, and acidify with acetic acid.

2. A solution of oxalate of potash to test forty by hydrometer, acidified with oxalic or acetic acid.

To develop, pour one ounce of 1 into six ounces of 2. Have ready a solution of acetic acid, about one drachm in twenty or thirty ounces of water.

After the exposure has been made, pour a few ounces of acetic acid solution into the developing tray, place the paper in it, and allow it to soak until quite limp, then pour off the acid and flow the developer over the paper evenly and quickly. If the exposure has been liberal, the positive will instantly appear, brilliant beyond comparison, all on the surface, not sunken in effect, and of a beautiful blue-black tone—a thing of rare artistic merit. The instant that sufficient detail is gained, the developer must be poured off, and, without washing, the acetic acid solution is flowed over the print. Let it soak in this a minute. Repeat twice, and, after a good rinsing, place in hypo. for twenty minutes. Avoid handling as much as possible until fixed. When it is necessary to handle the print, take it by the extreme edge.

Variations of Tone.—It will be noticed that I used no bromide in the developer. The bright blue-black tone, which is so much admired, is gotten by exposing at a short distance from the light, and using no bromide.

By increasing the exposure and distance, a gray tone is gotten with slow development.

By giving plenty of exposure at various distances from the light, and using a large amount of bromide of potash, brown, olive, and sepia tones are gained.

A glace finish may easily be obtained by squeegeeing the washed print on a polished plate of hard rubber. The print gains in depth and detail by the operation, as it gives great transparency to the whites. Still the flat finish is preferred by the majority. Although the chloride paper prints very quickly, it can be worked in abundant light. At the demonstration I only turned the *nearest* gas jets down, leaving two burning at the end of the room, and worked by a light which was hastily constructed, being, in fact, a cylinder of post paper and a candle. Yet the paper showed not the slightest trace of fog.

If these simple directions are followed, no one can have the least difficulty in producing exquisite results, as the chloride paper works with remarkable ease and certainty.—*Edward W. Newcomb, in Photo. Times and American Photographer.*

MLLE. SCHULTZE, DOCTOR OF MEDICINE OF THE FACULTY OF PARIS.

"Mademoiselle, you are beautiful, you are young, you are well informed, you are courageous, you have everything in your favor. Although I do not share all the ideas which you advocate, I render justice to the talent with which you have defended them."

Prof. Charcot spoke thus at the reception of Mlle. Caroline Schultze to the grade of Doctor of Medicine, and we who were present were of the opinion of the learned professor of the Salpetriere. Nothing could be more charming, by contrast, than the sight of this beautiful young woman with black eyes and a brilliant complexion, who, wearing the black robe of the candidates and surrounded by her bearded colleagues, argued before a jury composed of men eminent in science, but rather less dignified than usual in spite of the pomp and display of red robes and robes laced with gold.

Ordinarily, in the case of common mortals, students, the members of the jury are content to question the candidate on the subject treated, which is always a question of medicine or the object of personal medical work; and finally, the discussion finished, and accompanied by the traditional congratulatory discourse, the future doctor is declared worthy or unworthy to enter the corporation. This time it was an entirely different affair.

The candidate was a woman of 22 years, a person young and pretty, who not only discussed a medical subject, but supported a theory which still divides the learned faculty into two camps.

The subject of Mlle. Schultze's thesis was "The Female Physician of the Nineteenth Century," a subject which the candidate, it must be acknowledged, supported in a brilliant manner, demonstrating perfectly that, in the near future, woman would have an important place in the medical world, and that the female practitioners would take their stand with the male practitioners. "The second half of the nineteenth century," she said, "has been marked by a general movement of intellectual and professional emancipation for women. All civilized nations have formed their feminine contingent in the study and practice of medical sciences. Everywhere women, who have fought in the advance guard for their intellectual and professional emancipation, have had difficulties of all kinds to overcome; but everywhere, up to the present at least, they have been victorious."

We have said that Mlle. Schultze is 22 years old. She was born at Varsovie, Russia, belongs to a family of musicians, and at the age of 17 desired to give herself up completely to scientific studies. Finding herself under the Russian law which does not allow women access to any school of medicine, she went to Paris to pursue her medical studies. Less than five years have been sufficient for her to finish her task well and obtain the diploma of "Doctor." Armed with this title, she will establish herself in Paris (in her thesis she thanked France for the hospitality extended her and called it her adopted country), with the intention of devoting herself exclusively to the diseases of women and children.

"You have been my pupil, and I appreciate, not only your instruction, but the rapidity and surety of your diagnoses." Prof. Landouzy finished with these words. The assertion of the learned professor is a sure guarantee of the success of the young physician.—*L'Illustration.*

MLLE. SCHULTZE, DOCTOR OF MEDICINE OF THE FACULTY OF PARIS.

The Ways of Lawyers.

The *Boston Journal* relates a good story of a prominent legal firm in that city, which does a great deal of business for a rich mercantile concern. It lately rendered a bill which the senior partner of the mercantile establishment (who was accustomed to liberal charges) thought was too high. He, therefore, took the bill to the law firm and asked the chief to look it over and see if it was all right. The account was subsequently returned with $10 added for "advice as to the reasonableness of the bill."

SIMPLE EXPERIMENTS IN PHYSICS.

BY GEO. M. HOPKINS.

Color is a sensation due to the excitation of the retina by light waves having a certain rate of vibration. Those having the highest rate capable of affecting the eye are perceived as violet, while those of the lowest rate are perceived as red. According to Ogden Rood's "Modern Chromatics," the rate of the former is 757 billions of waves per second, that of the latter is 395 billions of waves per second, and between these extremes are ranged waves of every possible rate, representing as many colors. When light waves of all periods are united there is no color—the light is white. Newton discovered a way of resolving white light into its constituent colors. He made exhaustive experiments with prisms, first producing the gorgeous array of colors known as the spectrum, then recombining the colored rays by means of another prism producing white light. He found that the colors of the spectrum were simple, *i. e.*, they could not be further decomposed, and he also demonstrated that the red rays were the least and the violet rays the most refrangible.

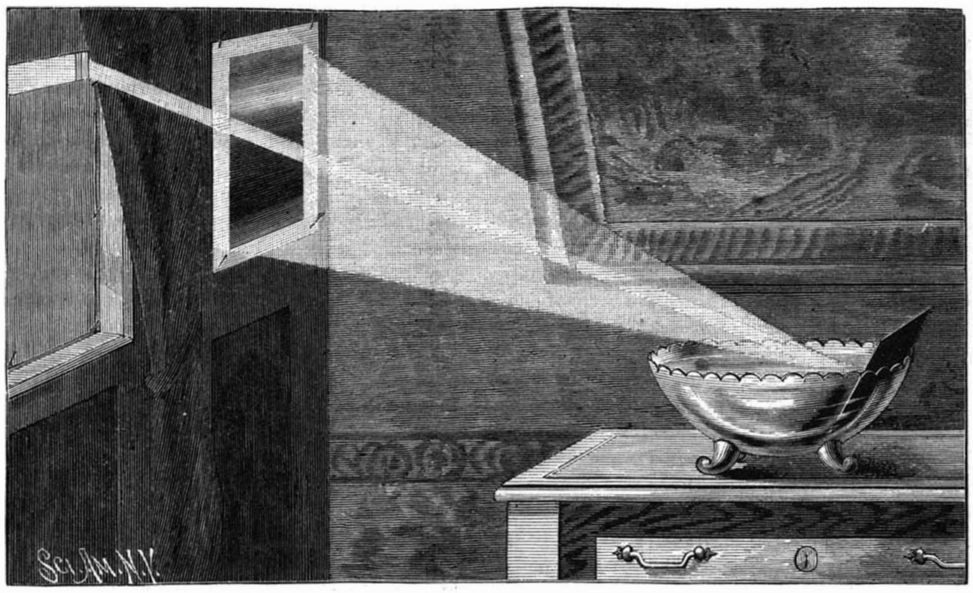


Fig. 1.—SIMPLE APPARATUS FOR PRODUCING THE SPECTRUM.

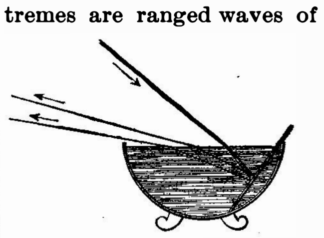


Fig. 2.—DIAGRAM OF SPECTRUM APPARATUS.

The solar spectrum is always a delight to the eyes of every person having normal eyesight, and it is a simple matter to produce it by means of a prism. When a prism is not available, it may be produced in the manner illustrated by Figs. 1 and 2. This method is inexpensive, and yields a large spectrum. The materials required are a piece of mirror, five or six inches square, a dish of water, and a sheet of white paper or a white wall. The mirror is immersed in the water and arranged at an angle of about 60°; this angle, however, may be varied to suit the direction of the light. The incident beam received on the mirror is refracted on entering the water and dispersed. It is further dispersed on leaving the mirror, and still further upon emerging from the water. By causing the reflected beam to strike obliquely upon the white paper or wall, the spectrum thus produced may be made to cover a large surface.

Should the sun be too high or too low, the proper direction may be given to the incident beam by means of a second mirror held in the hand. The diagram, Fig. 2, shows the direction of the rays.

Some very interesting absorption experiments may be made in connection with this simple apparatus. For example, colored glass, or sheets of colored gelatine, may be placed in the reflected beam. If red be placed in the path of the beam, red light, with perhaps some yellow, will pass through, while the other colors will be absorbed, and will not, therefore, appear on the wall. With the other colors the same phenomenon is observed. Each colored glass or gelatine is transparent to its own color, but opaque to other colors.

In a similar manner a piece of red paper or ribbon placed in the red portion of the spectrum will reflect that color, but if placed in some other part of the spectrum it will appear dark, the other colors being absorbed or quenched by the colored surface. It is seen by these experiments that when light passes through a colored glass or film, it is not all colored. It is simply a matter of straining out every color except that to which the glass or film is transparent. In reality only a small part of all the light striking the colored glass passes through it. In the above experiment it is essential to avoid all jarring of the water, as ripples upon its surface defeat the experiment. If it is impossible to so place the dish as to avoid jarring, the ripples may be prevented by suspending a transparent plane glass horizontally, so that its under side will just make contact with the surface of the water.

Experiments with Tempered Steel.

B. Pensky, after experimenting with two steel rods 100 mm. in length, observed, says *Industries*, that they exhibited an increase in volume after they had been tempered by heating to redness and plunging in water. This he attributes to the fact that the external layers solidify first, and consequently prevent, to a certain extent, the contraction of the interior mass during cooling. The length of the rods under these circumstances showed a variable behavior, inasmuch as one of the rods, 27 mm. thick, increased in length 0·083 mm.; while the other, 13·5 mm. thick, decreased in length 0·030 mm. It would thus seem that a rod when tempered becomes longer or shorter according as the proportion of surface to volume is either below or above a certain limit. Subsequent to the tempering, both rods became gradually shorter at the ordinary temperature, the decrease in length amounting to 0·032 mm. and 0·021 mm. respectively. When they were now heated to 120°, they underwent a further diminution in length amounting to 0·015 mm. and 0·021 mm.; but further exposure to the same temperature produced no alteration in the length. On the other hand, by subjecting the rods to successively rising temperatures, continued shortening was observed. Very hard steel disks suffered similiar decrease in the length of their diameter, gradually at ordinary temperature, but more rapidly after being heated.

THE LEANDER McCORMICK OBSERVATORY OF THE UNIVERSITY OF VIRGINIA.

BY H. C. HOVEY.

Jefferson's last request was that no other memorial should be erected to his fame than a simple column, signifying his having been the author of the Declaration of Independence and the founder of the Virginia University. But he has still another memorial in Mount Jefferson, located on the grounds of the university, an eminence which he himself selected as a suitable site for an observatory. It is a beautiful elevation, 850 feet higher than Charlottesville, and 1,350 feet above the level of the sea. Monticello is in full view, six miles distant, as well as many another spot known in history. The Blue Mountains are about twenty miles distant, and toward the south are visible the Peaks of Otter at the distance of fully eighty miles, while in every direction may be traced the faint outlines of receding hills. Thus there is commanded a complete and wide horizon on every side. Geologically, Mount Jefferson is composed of rocks belonging to the Huronian age of the Archæan era.

The McCormick family, inventors of the well-known reaper, originated in Rockbridge County, Virginia. Leander, the younger of the three brothers bearing that name, residing in the city of Chicago, desired to do something to prove his affection for his native State; therefore contracted with Alvan Clark & Sons, of Cambridge, Mass., for a mate to the splendid telescope they were then making for the National Observatory at Washington, D. C., with certain noted improvements, and offered, on specified conditions, to present it to the Washington and Lee University, at Lexington, in the county where he had been born. As those conditions were not met, he next offered it to the University of Virginia, through Col. Venable, the professor of mathematics in the latter institution, who immediately took steps toward raising the necessary endowment. In answer to an appeal to the State legislature, that body passed resolutions recognizing the generosity of the donor and the importance of securing such a telescope, but did not deem it wise, in the condition of the State finances at that time (1878), to make the appropriation asked for. Gen. Johnston, now of the South Carolina Military Academy, at Charleston, then visited the alumni of the University, pursuant to an appeal made by the executive committee, and raised over $50,000, to secure the $3,000 salary of the astronomer in charge. Mr. Wm. H. Vanderbilt, of New York, added $25,000 as the beginning of a working fund. The university gave the ample grounds on the summit of Mount Jefferson, and also built the astronomer's residence, at a cost of $8,000. Mr. McCormick then gave the telescope, costing $46,000, and the building in which it is housed, costing $18,000; thus making a sum total, including the smaller buildings, etc., of $150,000. The observatory was completed in 1884.

The great cost of refracting telescopes is due to the difficulty of obtaining masses of glass sufficiently uniform in structure to secure accuracy of definition. The object glass, made by Alvan Clark & Sons, is 26 inches in clear dimensions and 33 feet in focal length. The inner surfaces of the lenses are made with slightly different radii, in order to avoid what is called "an object-glass ghost," which has been found an annoyance in the telescopes of the Washington and other great observatories. The tube is of steel, in three sections firmly bolted together. The micrometer wires, and the reading circles, are lighted by small incandescent lamps fed by an ordinary bichromate battery. An incandescent hand lamp is also used. No oil lamps are used for any purpose in the observatory. The driving clock is electrically connected with a Seth Thomas clock in the computing room. The magnifying power depends on the eye-glasses used with the great objective. The highest power that can be usefully employed is stated to be 2,500 diameters; which, if applied to the moon, would bring it to within 96 miles of the observer. "The space-penetrating power of the McCormick telescope, estimated by the ordinary rule, is 131. That is to say, the faintest star visible to the naked eye would still be visible through this telescope if the star were removed to 131 times its present distance."

The dome is 45 feet in diameter, and weighs 25,000 pounds above the wheels on which it revolves. The running gear consists of a live ring of wheels in sets of three; the center ones of which support the dome, while the two outer ones rest on circular tracks. They are portions of exact cones, having their apexes at the center of the dome. Connected with each set of wheels are two guide wheels, one in front and one behind, which run between the tracks of the wall plate. These guide wheels are so adjusted as to keep the axis of the conical wheels at right angles to the track at that point. In this way sliding friction is changed to rolling friction. In the older forms of domes the effort was to make the live ring exactly circular; and the wheels were kept in place by the aid of flanges, and the connections between the sets of wheels were rigid. But atmospheric changes must necessarily change the shape of the dome, live ring, and tracks; the result being sliding friction. With the present arrangement each additional ton weight of the dome requires an additional starting pressure of less than two pounds; and with the gearing, about nine pounds pull on the rope will move the dome. Another important result is that the dome revolves more rapidly than any other of its size in the world. I timed Prof. Stone as he accomplished a complete revolution of it in exactly one minute and eight seconds.

The dome has three apertures, six feet wide, with closures six feet square between; the center of each closure being the same altitude as the center of an aperture opposite. This arrangement permits a very rapid and thorough ventilation of the dome, so as to get the same temperature inside as outside. Warner & Swasey, of Cleveland, Ohio, makers of the dome, conceived the idea, for the first time worked out in this apparatus, and took out a patent for it while the work was being done.

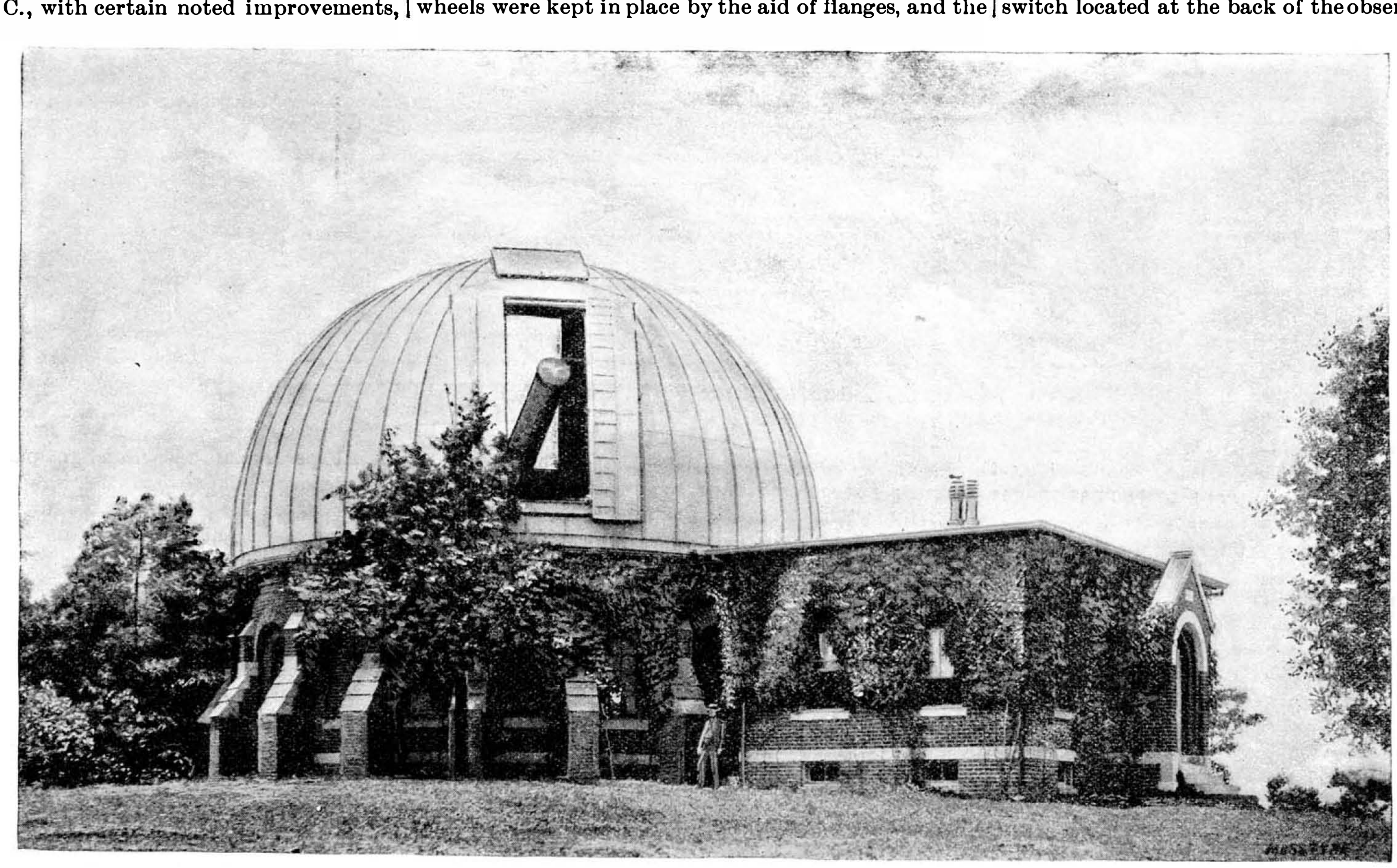
Attached to the circular building surmounted by the dome are computing rooms, containing the library, clocks, chronographs, seismographs for registering earthquakes, and various other apparatus. And in a smaller building near by are the transit and equatorial.

Three annual reports have been issued, showing what has been accomplished since the completion of the McCormick Observatory. From these we learn that numerous observations have been made of stellar pairs, nearly all of which are close and difficult, requiring 439 micrometrical measurements of angles and distances. A few cometic observations have been made. The catalogue of stars for the 23° zone has been completely revised. Lunar occultations have been observed, and the paths of numerous meteors noted. The nebula in Orion has received careful attention. The conclusion reached is that its figure has remained unchanged from 1758 to the present time, although variations have been and still are going on as to the brightness of its parts. Differences in this respect have been estimated in "steps," each being compared on the same night with brighter and fainter condensations. Estimates have also been made of the relative brightness of the stars in the brighter portion of the nebula, in order to trace, if possible, any existing connection between them and the nebula.

The director reports that 351 observations of miscellaneous nebulæ have been made, resulting in a large number of sketches and in the discovery of 270 nebulæ not hitherto detected. He says: "Our knowledge of the motions of the so-called fixed stars is steadily increasing; but astronomers have practically no knowledge of the motions of the nebulæ." This problem he has undertaken to solve. These bodies are so faint and diffused as to make meridian observations possible of only a few of them; and the positions of the remainder must be determined by comparison with neighboring stars. He has prepared a working list of all known nebulæ north of 30° south declination, and which are as bright as the 14th magnitude and condensed at the center. The filar micrometer is used in making comparisons of right ascension and declination, the wires being illuminated with red light regulated by a switch located at the back of the observing chair. This peculiarly delicate and important work is still continued, and will have to be carried on for several years to come; the results being published from time to time in various astronomical periodicals. The comparison stars needed for making the catalogue of nebulæ in course of preparation are being observed by Dr. H. C. Wilson, at the Carleton Observatory, in Minnesota.

The sole director, under whose superintendency the McCormick Observatory was built, and by whom it is now controlled, is Prof. Ormond Stone, who proved his enthusiasm by sharing almost daily in the manual labor necessary for the proper construction of the buildings required to house the great telescope and its accompanying apparatus. Prof. Stone was born in Illinois, January 11, 1847, and received his astronomical education under Prof. Safford, at the Dearborn Observatory, in Chicago. He became, in 1870, the assistant at the Naval Observatory, at Washington, D. C., where he remained till 1875, when he was made the director of the Cincinnati Observatory, from which he was called to his present duties in 1884. He is also the vice-president of Section A (mathematics and astronomy) of the American Association for the Advancement of Science, and will make the opening address before that section at the Cleveland meeting.

Among the astronomers who have been trained for their work by Prof. Stone may be mentioned Prof. Wilson, of Carleton College; Prof. Upton, of Brown University; Prof. Howe, of Denver; Mr. Egbert, of Madison, Wis.; Mr. A. S. Flint, of the Naval Observatory at Washington, D. C.; and Prof. Leavenworth, of Haverford College. His present assistant is Mr. Frank Muller, and N. M. Parrish is also assisting, with special reference to seismographic observations. This latter work has just been begun, in accordance with an arrangement entered into by several observatories in



THE OBSERVATORY BUILDING, UNIVERSITY OF VIRGINIA.

different parts of the country. Prof. Stone also edits the *Annals of Mathematics*, one of the few mathematical journals published in this country.

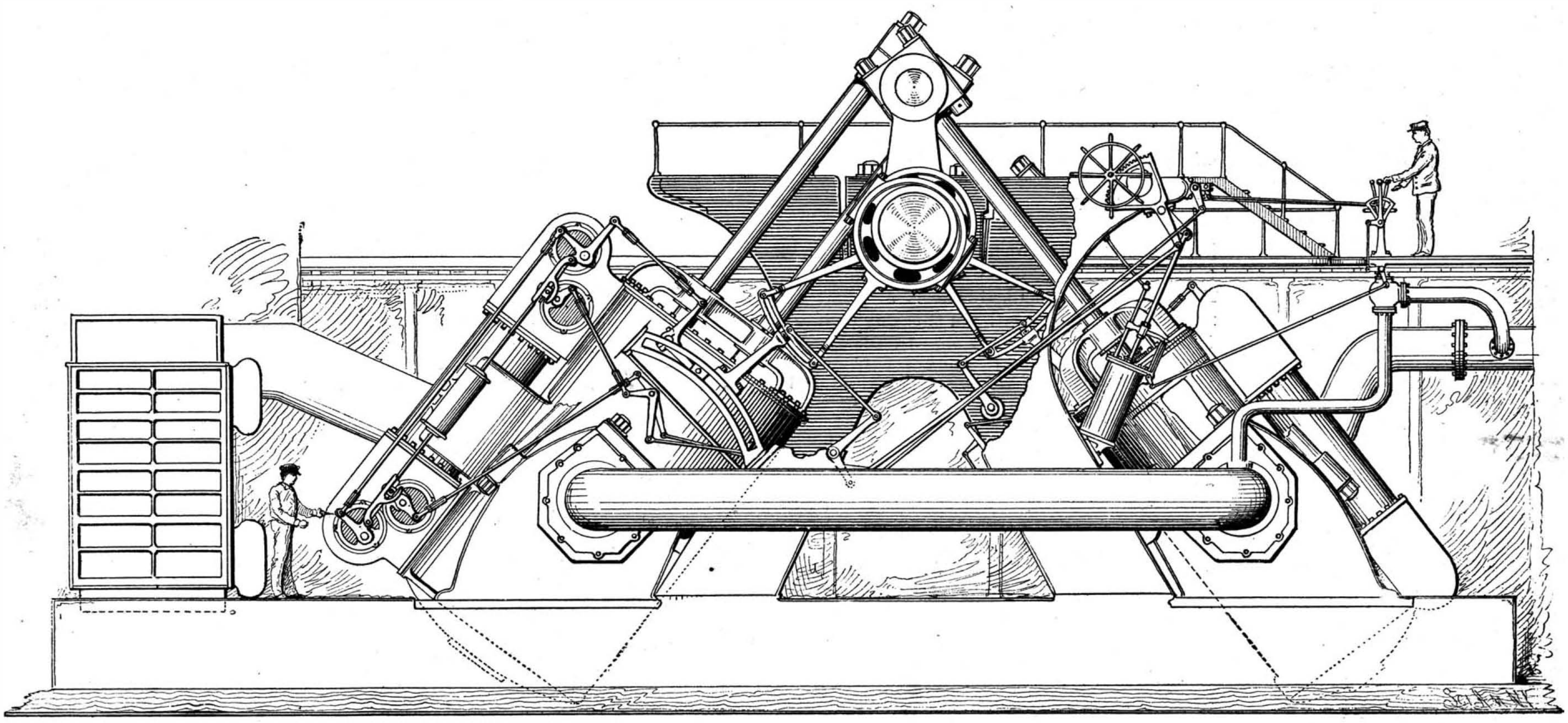
THE ENGINES OF THE STEAMER CONNECTICUT.

(*Continued from first page.*)

in the single cylinder construction. The wheels are of the feathering type.

The engine is carried by two parallel keelsons made of steel. These in their turn rest on yellow pine keelsons which rest upon the cross timber and are bolted to the hull timber. The surface condenser is carried on the after end of these steel keelsons. It contains 3,916 brass tubes ¾ inch in outside diameter. The distance between the tube sheets is 16 feet, giving a condensing surface of 12,150 square feet. A second condenser of 750 square feet is provided for use if necessary. The crank pin, whose bearings are 18 inches in diameter and 49 inches long, is shrunk into place, as are also the crank arms. Each of the shafts thus constituted is 33 feet 6 inches long, and has 23 and 25 inch journals. The steam is generated in six boilers 12 feet 6 inches in diameter and 20 feet 1¾ inches long, carrying 120 lb. pressure. They are of steel, with drilled rivet holes, and machine-riveted throughout. The engine will develop about 4,500 horse power, and may be driven 1,000 horse power higher. The steamer is 358 feet 6 inches in length over all, and 87 feet in width over the guards. Its width of hull is 48 feet 2 inches, and its depth of hold 17 feet 3 inches.

The engines were designed by Mr. George B. Mallory, of New York, and were constructed by the William Cramp & Sons Co., of Philadelphia, Pa. The steamer is of wood, and was built by Robert Palmer & Co. at Noank, Conn.



VALVE MOTION AND GENERAL CONNECTIONS OF THE ENGINES OF THE CONNECTICUT.

TRIAL TRIP OF THE VESUVIUS.

The new dynamite gun cruiser Vesuvius, built by Wm. Cramp & Sons, Philadelphia, was put to a trial test on January 11, off the Delaware Breakwater, and she proved herself fully equal to the government requirement, developing a speed exceeding that of any war vessel of or above her size in the world.

The Vesuvius is 252 ft. long, 26½ ft. beam, 9 ft. draught, with displacement of 725 tons. She has a four-cylinder triple-expansion engine, and developed 4,295 I. H. P. on her trial trip, or nearly 6 horse power to a ton of displacement, and not 17 H. P. per ton, as stated by some of the city papers. This ratio of power to tonnage far exceeds the power of any vessel of over 200 tons that has yet been built for war purposes.

The run was made, commencing at 9 A. M. January 11, each way over a course of 2·543 knots, laid off outside the Delaware Breakwater, marked by two buoys placed by government officials, and the trial was made under inspection by U. S. naval officers.

The speed of 22·947 knots with wind and tide, and of 20·346 knots against wind and tide, was easily accomplished; the mean of the two runs being 21·646 knots per hour, or an excess of 1·646 knots over the government stipulation, which makes the Vesuvius acceptable to the government on her first trial test, something we think unheard of in American naval accomplishments.

The after run of 90 miles from the Breakwater to Philadelphia was easily made under low steam at a speed of 16 knots per hour, about all that could be attained in the shallow waters of the Delaware without causing a drag wave.

The speed attained by the Vesuvius has only been exceeded by the following small vessels: A twin-screw torpedo boat, built for the Italian government by Yarrow & Co., with a displacement of only 100 tons; length, 140 ft.; beam, 14 ft.; with which a trial speed of 25 knots was attained (the developed horse power not being given). The Courier, a French torpedo boat, built by Thornycroft, of about 150 tons displacement; length, 147½ ft.; beam, 14½ ft.; draught, 5 ft.; which in a trial trip developed 1,550 I. H. P., or 10 horse power to a ton of displacement; attained a speed of 26 knots per hour. And also a small torpedo boat for the Dutch government, for which a speed of 27 knots per hour is claimed.

The relative horse power per ton of displacement plays so important a part in the performance of all vessels propelled by steam that we give the proportions in a number of war vessels of exceptional speed, as far as known: The Wattignies, a French cruiser of 1,273 tons displacement, having engines of 4,000 I. H. P., or 3·2 H. P. per ton. Just finished. Speed not yet tested.

A twin-screw naval steamer (English); length, 220 ft.: beam, 34 ft.; draught, 15 ft.; 1,560 tons and 3,115 I. H. P., or 1·99 H. P. per ton displacement. Speed on trial, 16·91 knots per hour.

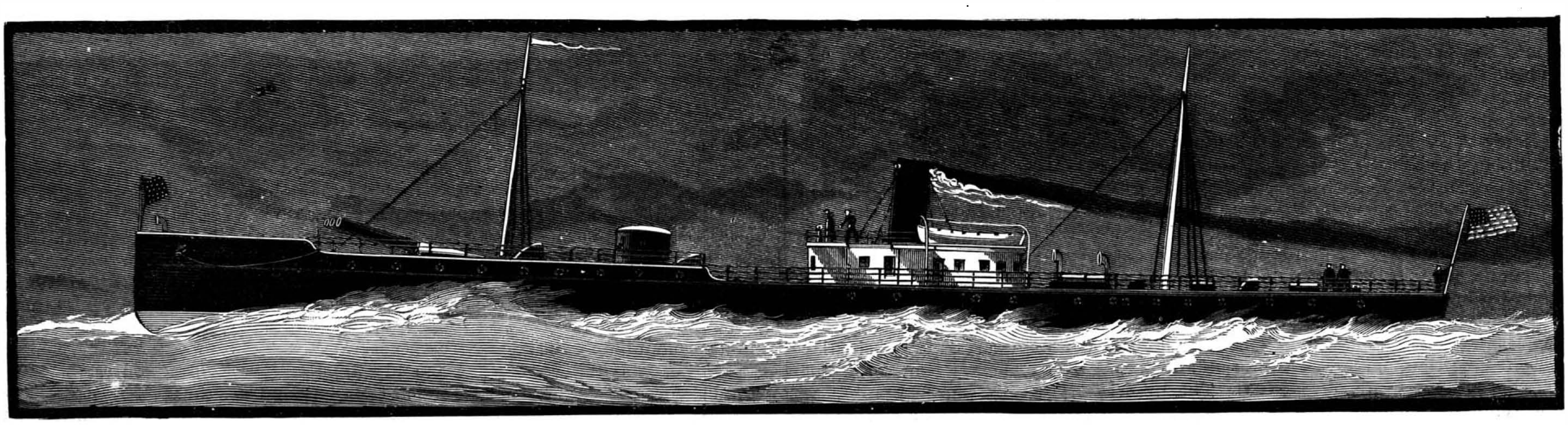
A twin-screw naval steamer (English); length, 300 ft.; beam, 46 ft.; draught, 19½ ft.; 3,584 tons displacement and 6,160 I. H. P., or 1·71 H. P. to a ton. Speed on trial, 18·18 knots per hour.

A twin-screw naval steamer (English); length, 315 ft.; beam, 61 ft.; draught, 25½ ft.; 7,645 tons, with 10,180 I. H. P., or 1·33 H. P. to a ton. Speed, 17·21 knots per hour.

A twin-screw naval steamer (English); length, 325 ft.; beam, 68 ft.: draught, 27½ ft.; 9,690 tons, with 11,610 I. H. P., or 1·2 H. P. to a ton. Speed, 16·52 knots per hour.

The Italia, an armorclad ship, built by the Italian government, probably the largest war ship afloat; length, 400 ft. 6 in.; beam, 73¾ ft.; draught, 30½ ft.; having a displacement of 13,480 tons; has developed 18,000 horse power, with the extraordinary speed of 17·8 knots per hour. Considering that the ratio shows but 1·33 I. H. P. to a ton of displacement, this is an extraordinary speed for an armored cruiser.

Although none of the new unarmored cruisers has developed a speed equal to that of most of the vessels mentioned in the above list, it is expected that most of the cruisers, both armored and unarmored, that are as yet uncompleted will attain speeds that will compare favorably with the European standard. The Vesuvius has taken a long step forward, and marks a well defined line between the slow coaches of the old navy and the long hoped for high speed vessel of the new *regime*. That our American engineers are capable of rising to the emergency of the case has been pretty satisfactorily demonstrated; and that our marine architects have succeeded, with so little experiment and so few failures, in producing a vessel that can compare favorably with such veteran builders of high speed vessels and torpedo boats as the Yarrows and the Thornycrofts is a matter of congratulation.



THE DYNAMITE CRUISER VESUVIUS.

IN a paper lately read before the Academy of Sciences, Paris, on various methods of treating rabies, by M. Odo Bujwid, he said that, since his visit to M. Pasteur's establishment in 1886, he had been treating persons bitten by dogs, either mad or suspected of being mad, in his laboratory at Warsaw. At first he followed the simple processes of inoculation of M. Pasteur, and of M. Frisch, of Vienna, with some failures in both cases. But during the last sixteen months he has adhered exclusively to the intensive or severe treatment, which has been applied to 370 patients without a single fatality.

RECENTLY PATENTED INVENTIONS.

Railroad Appliances.

CAR COUPLING.—Edward P. Eastwick, Jr., New York City. This coupler is of the class having knuckle connecting links, and provides means whereby the strain on the drawhead caused by a buffing blow is made much less than usual, from the special construction of the knuckles and drawhead, and whereby the locking pin may be readily raised from the side of the car.

CAR TRUCK CONNECTION. — Aaron Twyman, Pullman, Ill. This invention provides for attaching a car body to a truck by parallel or jointed bars around the pivotal center of motion of the truck, leaving an open space at the center of or within the attachment which may be utilized for the convenient placing of a motor or grip, or other purpose, the king bolt and center plates being dispensed with.

CAR DOOR.—Henry Alsop, Chicago, Ill. This door is intended for stock and general freight cars, etc., and is formed with a bridge-like section or portion loosely or pivotally connected at its lower edge with the car, so that, when released, this section will be free to turn outward to and upon a platform or chute, forming a bridge for the passage of stock into or out of the car, or over which to roll hand trucks.

RAILWAY CAR. — Gerald P. Warren, San Antonio, Texas. In this car the ends or vestibule portions are constructed with their outer sides in movable sections, and bullet proof, with port holes, the arrangement being such that these portions can be quickly closed to make a fortified chamber wherein passengers will be protected against train robbers.

BELL CORD ATTACHMENT.—George A. La Fever, Selkirk, N. Y. It consists in a carriage mounted on a guiding bar supported in a horizontal position in the car above the bell cord, and provided with a device for clamping the cord and severing it in case of an unusual movement of the cord, preventing it from being drawn rapidly through the car and endangering passengers.

HOT AIR GENERATOR. — Emmet M. Crandall and Thomas H. Turner, St. Joseph, Mo. It is especially adapted for locomotives, to furnish hot air for heating the cars of a train, the generator being fitted in the smoke arch, and consisting of a ring-shaped hollow casing perforated by short pipes for the passage of heat and smoke, while the casing has an outwardly opening funnel for the entrance of air, and a pipe connected with the cars of the train.

Engineering.

MINING DRILL. — John P. Paynter, Pomona, Kansas. A frame carrying an engine is mounted to travel on a track, the engine operating a transverse cutter shaft, with a drill of novel construction, especially adapted for undercutting coal in small seams, cheapening the cost of mining, and relieving the miner from his most difficult work.

VACUUM ENGINE.—John R. Cameron, Pittsburg, Pa. This invention covers a novel construction, whereby a given body of air is rarefied by heat and allowed to escape as it expands, while the remaining body of air is then suddenly cooled to create a partial vacuum, the device giving continuous automatic action, affording means for operating a piston within a cylinder.

Mechanical.

LATHE. — Joseph K. Koons, Montgomery, Pa. This lathe is made with movable supports for the centers or work holders, whereby the work in the operation of the lathe will be moved as it is rotated toward and from the tool, making a convenient means for turning ovals and oval shafting, or for turning bodies having elliptical cross sections.

DRILLING AND CENTERING TOOL.—John E. Ketchem, Morrillton, Ark. This is a tool intended especially for watchmakers' use, and has a spring by which a steady feed pressure may be exerted on either the center marker or the drill, either of which may be conveniently applied to the machine, and the pressure can be regulated and adjusted to properly feed the tool in working in different materials.

SAW MILL FEED.—Alois Lang, Atlanta, Ga. This construction has a combination of disks secured edgewise to each other and upon shafts driven from the saw shaft wheel, a shifting lever engaging a wheel sliding upon a shaft, while there is a lever having a cam-shaped pivoted end for moving the wheel to and from the disks, with other novel features, designed to overcome certain objections in this class of mechanism.

Miscellaneous.

CUTTING HAIR. — Marcus Klein, Chicago, Ill. This invention relates to an apparatus combining a comb and a pair of scissors so connected and arranged together as to be adjusted for scissors of different sizes, and also for regulating the length of the hair cut.

ORNAMENTAL BOX.—Mendel Baskam, New York City. It is composed of united panels forming the side and end walls of the box, each being made of slotted tubes holding an inner plate, an outer glass plate, and an interposed ornament, the panels being secured to a bottom, making a cheap box with the ornamentation fully protected.

MUSIC BOXES.—Gustave J. Jaccard, New York City. This invention relates to mechanism for stopping and starting and governing music boxes, and consists principally of a duplex stop acting upon the countershaft, so that there will be less strain and less wear upon the vertical shafts which carry the stop arms.

OIL FEED FOR LAMPS. — Christian Sieghold, Salinas, Cal. The lamp is provided with a valve in its bottom, connected with a float contained by the body of the lamp and a pipe leading from the valve opening to an oil reservoir, making a simple and effectual device for uniformly supplying lamps with oil.

CARPET STRETCHER AND TACKER.—Austin F. Lamb, Stockbridge, Vt. It has a stationary bar and a sliding bar with forked and serrated end, a pivoted frame on the end of the sliding bar, a bar adjustably secured in the frame, and a tacker carried on the end of the latter bar, whereby carpets may be easily stretched and fastened down.

OIL TANK.—John C. Dilworth, Pittsburg, Pa. This invention relates to metallic oil tanks used by dealers, provided with a pump, and an opening through which waste oil is passed back into the oil chamber, and provides a strainer cup therefor, with filtering material, and a strainer pocket, with which it will be impossible for even the finest particles of dirt to enter the oil, while the strainer can be easily cleaned.

ALBUM CLASP. — Louis B. Prahar, Brooklyn, N. Y. A spring pawl is held within a pocket, which has a button extending outward, a plate being adapted to slide within the pocket, and having ratchet teeth engaging the pawl, with a stop for the plate, making a clasp designed to be ornamental as well as useful.

CHEWING GUM LOCKET.—Christopher W. Robertson, Somerville, Tenn. This is a locket having hinged sections and anti-corrosive linings, for holding, with safety and convenience, chewing gum, confections, or medicines, etc.

TOBACCO PIPE AND CANE. — George H. Coursen, Baltimore, Md. This invention provides a pipe that will be of the usual shape, either ornamental or plain, but forming the upper portion of a walking cane, from which it is detachable, the bowl constituting the handle of the cane and the stem a portion of the stick.

TOBACCO PIPE.—George F. Colquitt, Purcell, Indian Ter. This invention consists of a pipe provided with a storage chamber having an opening leading into the bowl, and with a valve for closing said opening, the design being to prevent the nicotine and other unhealthy substances from entering the smoker's system.

Business and Personal.

The charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

Notes & Queries

HINTS TO CORRESPONDENTS.

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

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

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

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

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

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(192) T. K., New South Wales, asks information for grinding and setting a hollow ground razor. A. Razors that have been in use until the edge is rounded by strapping can be brought to a flat bevel on the edge by placing them on a perfectly flat hone or other fine-grained stone, with a little thin oil, as lard oil or fine machine oil, letting the back always rest upon the stone, and with small circular motions of the hand without pressure grinding down the bevel until the stone marks meet on both sides in a thin feather edge. The regular razor hone as imported through your cutlery trade from England is the best. The finest washed flour emery laid on a flat piece of wood with glue and pressed down with a flat piece of iron or plate glass, or a strip of flour of emery paper glued to a strip of wood and pressed upon a flat iron or piece of glass, will answer the purpose. In using the emery stick always draw the razor backward from the cutting edge to prevent catching and hacking the edge against any uneven particles of emery. For a strap use a strip of fine, even calf skin, glued to a piece of wood, on which rub a little paste made of oxide of iron (rouge) mixed with olive oil. Draw backward and keep the heel or back of the razor in contact, so as not to round the edge. Oxide of tin or putty powder mixed with oil also makes a good razor strap paste. The skin of a horse's tail is very highly recommended for razor straps.

(193) G. P. asks how chimney stacks (factory, etc.) are built so as to gradually taper toward the top (and how everything is kept plumb). Also how the gradual lessening of the bricks is managed. A. The insides of nearly all tall chimneys are parallel and vertical. They are carried up by plumb bob and long plumb line for correction in the usual way of mason's practice. The outside batter is carried up in detail by a plumb bob set for the angle, which is verified by actual measurement of the diameter every section of a few feet. The batter is brought in by cutting a brick on each second, third, or fourth outside course, the joints usually allowing for considerable drawing in of the batter for several courses. The same practice is also used for thinning the wall, with rule measurement for regulating the thickness all around. The boss mason or architect usually furnishes the computation for batter diameters by sections. If there is any doubt as to the vertical lines of the chimney during the progress of the work, a plumb line is let down the center and measures taken at top and bottom in each direction of its sides.

(194) E. D. F. writes: Can you give instructions through your valuable paper for painting photographic pictures on convex glass, also on plane glass? Also, how can the original photo. be preserved? A. Soak the pictures in water and attach with starch paste to a concave glass such as can be bought at the art stores. Afterthey are dry, rub down with pumice stone until nearly transparent, hold against the light, and paint them. Soak with castor oil when they are dry; pour off excess of oil and place a second glass against the back, and bind edges securely with paper or cloth, using gum tragacanth. Or you may flow dammar varnish on the glass, and after soaking the picture stick it to the glass while the varnish is still tacky. When all is perfectly dry the paper can be almost completely rubbed off with a wet finger, leaving the picture. Paint, and flow a second time with dammar varnish. In both cases attach the picture to the convex surface. Practice on flat glass with valueless pictures first. The original photograph is destroyed.

C. J. C. is referred to latter process, in answer to his query.

(195) J. W. asks (1) the difference between the working of a high pressure and low pressure engine. A. The main difference between a high pressure and a low pressure engine is that the latter works with a partial vacuum on the preceding side of the piston, made by condensing the steam and thus adding about 13 pounds to its effective work for every square inch of the cylinder area. We recommend you to read the "Practical Steam Engineer's Guide," by Edwards, $2.50, which we can mail for the price. It contains a full description of all kinds of steam engines. 2. The largest engine in the United States. A. The largest single cylinder engine is near Bethlehem, Pa., at the Lehigh zinc mines, used for pumping.

(196) G. C. H.—We have no further information in regard to clover hullers than that contained in articles quoted. Prof. Sweet, of Cornell, now in Syracuse, N. Y., designed the straight line engine. It takes its name from its outward appearance. Automatic engines are so called because the ordinary governor valve is dispensed with, and the governor so arranged as to act directly upon the motion of the slide valves. The slide valve moves upon a flat surface, while a rocking valve (Corliss and similar) makes a partial revolution in a cylindrical steam chamber. The variation in prices of engines mostly corresponds with peculiarities and complexity in construction, also in finish. Some engines of the same size cylinders vary very much in the weight and value of the material. Your 1¼ inch belt at 200 feet per minute represents 3 horse power.

(197) B. F. C. asks: How is a piano case polished or finished or smoothed before it is put together, or rather how is it prepared to varnish? Is it not done with emery belts or belts of some kind? A. The polish finishing of piano cases requires experience to assure success. The cases are first smoothed with a planing machine or hand planes, and then are scraped and smoothly sandpapered. They are then stained, and a "filler"—a rosewood paste for instance—is carefully rubbed in, to completely fill the pores of the wood. A rubbing coat of varnish is then applied, this coat really being four or five coats applied four or five days apart. When thoroughly dry this rubbing coat is rubbed down perfectly smooth with ground pumice and felt rubbers and water. Then a flowing or finishing coat of varnish is skillfully applied, and when dry it is fine-rubbed and rottenstoned, using water and the palms of the hands in this operation, which removes all scratches and leaves a bright polish, which is completely finished by rubbing off with oil. In finer classes of work a "scraping" coat is applied after the filler is rubbed into the pores, and when dry this scraping coat (which is really four or five coats of varnish applied four or five days apart) is carefully scraped off by steel plate scrapers, a delicate operation, then the rubbing coat above named is applied, and later the flowing coat and oil finish. The original smoothing is not done by emery belts, but by machine or hand smoothing planes, scraping and sandpapering. It requires about three months' time to polish a piano case, and the work should be intrusted to skillful, experienced hands.

(198) J. S. asks: 1. Will you describe the method usually employed of manufacturing plaster of Paris? A. It is made by grinding and heating gypsum. 2. Can it be made in any other way than by burning gypsum? A. It is made by no other method. 3. What books describe "burning lime" or "burning alum," or making plaster of Paris? A. Spons' Encyclopedia, which we can supply for 75 cents in parts, contains treatises on plaster of Paris and lime. The burning of alum is described in the United States Pharmacopœia, which you can consult in any drug store.

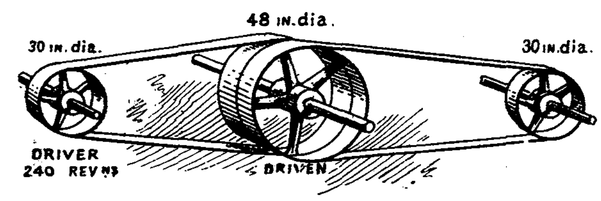
(199) W. A. S. writes: I am in want of an electro-magnet which will lift, say 4 pounds, a distance of about ⅝ inch. Can you give me any information as to where I can get a description of such a magnet, giving the dimensions of the different parts? I would also like to know if a Leclanche battery of two cells would operate such a magnet in good shape. A. Your battery is rather weak. The larger the magnet core for the same number of ampere turns, the more powerful will your magnet be. A ¾ bar of iron wound with No. 18 wire until 1 inch to 1¼ inch thick should give good results.

(200) J. W. K. asks for a cement to fasten rubber to iron. A. Soak pulverized shellac in ten times its bulk of strong aqua ammonia for three weeks, when it will become a transparent mass. Spread upon both surfaces to be cemented, and press together and allow to dry. First clean the iron by immersion in hydrochloric acid 1 part, water 4 parts, for two or three hours, and wash free from acid in hot water.

(201) M. E. S. asks: 1. Will the fluctuating motion of a windmill answer well to drive the eight light dynamo of SUPPLEMENT, No. 600? A. It will not. 2. What sized storage battery will be required

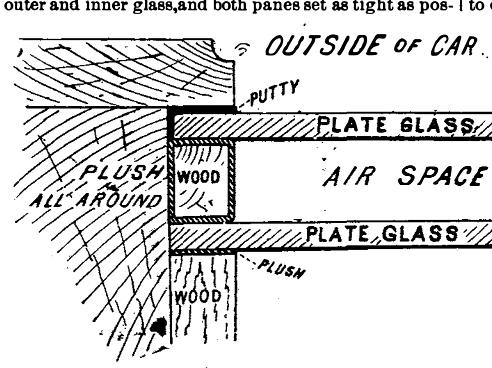
to operate the eight 16 candle power lights for six hours when there is no wind to drive dynamo, or how much battery per light per hour? A. Twenty-five cells will be required for fifty volt lamps. 3. How much wastage to storage battery when not in use, charged and uncharged? A. It should be kept charged, when there will not be much loss. If uncharged, it deteriorates.

(202) G. W. C. asks whether there is any lost power in belting as per sketch over the ordinary friction, or if there is any power gained by so belting.



A. As you have failed to note particularly in regard to distances between the centers of transmission, we must assume several conditions to satisfy a general answer. If the central pulleys and shaft do no work, or are only means of transfer, there is nothing gained by their use for distances of less than 40 feet between extreme points or shafts. There is a little friction from the bending of the belts, the journals, and also a slight loss of contact on the extreme driving and receiving pulleys. The sag of the belt made by dispensing with the transfer pulleys enables a more perfect economy by increased belt lap with decreased tension, for lap and tension are equivalent factors in this problem. Within reasonable limits, the more lap, the less tension is a maxim, and the sag of a moderately long belt is the best means of regulating the tension to the required work. For long distances, say 80 to 100 feet, the intermediate or transfer pulleys become in most cases a necessity, although long belts running upon idlers are admissible, and are part of the regular scheme in wire rope transmission where the weight and momentum of the rope gives it uniformity of motion. The only objection to the use of very long belts arises from their elasticity and vibration. In many kinds of machines the work or motion sets up a synchronous vibration in the belt that becomes destructive. In such cases a very light idler may obviate the difficulty. We can only say in answer to your direct question, that in no case is there a gain in power over the absolute power of the driving pulley. The only gain is in a saving of otherwise lost power by steadiness of transmission in long distances.

(203) A. T. S. writes: In several of our railway office cars, observation room end windows are glazed with double glass in order to keep out the cold while running. A space of ½ inch is left between the outer and inner glass, and both panes set as tight as possible to prevent dust between them, but now, as cold weather sets in, the inside of the outer pane sweats, obstructing the view. Do you know of any way to keep the space between the two glasses dry and clean? A. As the half inch space contains an objectionable amount of moisture when condensed by cold, we suggest, as the less air between the glasses, the less moisture will be condensed upon the outer glass, that the glasses be set with only a one-eighth inch space between them, and that the inside glass be set in a hinged frame to allow of opening and wiping moisture from the outside glass. Another method, requiring more care, is to make an opening under the present air space and insert a sheet iron box (narrow and the length of the space), with a lid or door to close the space air tight. When the weather induces frost or condensation on the glass, put quicklime in the box. Its affinity for water will make the inclosed air dry enough to prevent condensation during any ordinary inspection trip. The old lime can be dehydrated in an iron pipe or pan in any common fire; one or two quarts of lime should be sufficient for an observation window. Chloride of calcium is used for the same purpose in some northern countries.



(204) J. S. writes: I made a motor like one described in March No. dated 17, and it runs to perfection; have five large batteries 12 inches square, 30 one-half inch carbon pencils, and porous cup with zinc in it, that is, each has that amount, but find it pretty expensive to keep running, so now I want to make an eight light dynamo and run it by a windmill and charge a storage battery to run motor, and also light my dwelling at same time. I would like to know how many storage batteries I am to get. There will be only four lights used most of the time, once in a while six or eight lights. A. Three or four storage battery standard cells would run your motor. To charge the battery it must be connected in series. For cells address some of our advertisers in electrical supplies. To run lamps you will need more battery, as you will require cells equal in number to one half the voltage of the lamp. Thus for a single fifty-volt lamp you would need twenty-five cells.

(205) F. M. E. writes: I wish you would give a list of the products of petroleum compared with products of coal tar, as it seems difficult to get the information any other way. A. The products of coal tar are so numerous that any account of them would fill a book. The products of petroleum are much less interesting, falling largely into the olefine and paraffine series. The benzole and allied series given in such quantity by coal tar are wonderfully prolific in their substitution products. We recommend Crewe's "Petroleum," $4.50, and Lunge's "Coal Tar and Ammonia," $12.

(206) J. L. S. asks how to succeed in casting small iron door bells. I have trouble in getting the right ring by the ordinary casting process and common metal. A. For small bells of cast iron it is necessary to have a very fluid iron that will run sharp on the edges and also be solid. This may be done by using good charcoal iron with fine-grained scrap for the cupola. When ready to tap, place in the ladle one ounce of tin that has been granulated by melting and pouring in water or through a sieve, for a tap of 50 pounds of iron. This may be varied a little to suit the requirements of tone or temper. By placing the finely disintegrated tin in the ladle, it becomes thoroughly mixed in drawing the iron upon it. The required tone of the bells depends upon the thickness and shape of the patterns, and is necessarily a matter of trial. Aluminum is also much used for making cast iron flow freely and solid. Address the Cowles Electric Co., Lockport, N. Y., who will send you their circular on this subject. If you find that the ring is not sharp enough, try a harder grade iron, say No. 3 or 4 pig. With the harder iron the bells will be brittle.

(207) A. B. asks information in regard to the utilization of tin scrap. A. Scrap tin is used in New York and vicinity by chemical manufacturers, who separate the tin and iron by chemical processes. The solution of tin is made into tin salts used in dyeing, and the iron scrap, if large enough, is rolled into tag iron, or made into rouge or the red oxide of iron, used for polishing or paint. The scrap tin is also used with pig or scrap iron in an ordinary cupola for casting sash weights or other iron articles not required to be cut with tools, as it is hard. Scrap tin is of very little value, and will hardly pay for its own transportation any considerable distance.

(208) S. T. C. asks how to keep boilers from rusting that are kept for reserve, only fired once or twice a year, three or four days at a time. A. You may keep them empty, provided you can withdraw the water perfectly, leaving openings above and below so that they shall be perfectly dried. Otherwise leave them full of water that has been boiled. A little caustic soda or potash may be added with advantage.

(209) Paul writes: 1. I contemplate lighting my residence with incandescent lamps, using storage batteries to supply the current. I have a dynamo whose capacity is said to be 70 volts and 15 amperes. The batteries are said to be 100 ampere hours and 2 volts each. I use a gas engine in my barn to cut up feed, etc., and have more power than I need. I want to burn about 20 lamps of 16 candle power during the whole day, say 10 hours. I have been told that if I use the storage batteries as regulators, charging them at one end and discharging them into the lamps at the other end, a smaller number of batteries will suffice. If that is the case, how many batteries of the above capacity will be necessary? How many horse power will it need to light the lamps as stated above, and how many if lighted direct from the dynamo? A. Your dynamo will supply 1,050 watts, enough for about 350 candle power or about 20 incandescent lamps. A storage battery is sometimes used as an auxiliary to a dynamo. It is then placed in a shunt directly across from lead to lead between the dynamo and lamps. Then any surplus of current charges it, and if there is a deficiency, it is supposed to be made up by the battery giving a current. It will take about 1½ H. P. (electrical) to light the lamps (or $\frac{1200}{746}$ H. P.) The practical power required will, for the dynamo, be not far from 2 H. P., and for the storage batteries twenty-five per cent more. 2. Is there a rule for determining the number of watts per candle power for incandescent and arc lamps? A. Allow from 3 to 4 watts to the candle power. 3. What would be the most economical voltage for lamps of 16 candle power lighted by storage batteries? A. For storage battery work, lamps of low voltage are required; in general terms, the lower the better. Thus for every 2 volts a cell is required, so that for 50 volt lamps 25 cells would be needed. The economy refers to the number of cells required, not to running expense, except as regards deterioration of battery plates from too rapid discharge.

(210) J. H. B. writes: There is a process, known to some sign painters on glass, of making a letter upon glass with half of the letter gold and the balance silver. A. Size one-half of the letter and gild it, then size the remaining portion, if necessary sizing part of the gold leaf, and apply silver leaf.

(211) C. G. W. writes: Will you please give description and how to use Nippoldt's telephone bridge, made by Hartmann & Braun, Bockenheim-Frankfurt a. M., which consists of galvanometer, resistance coils and bridge? Or give through SCIENTIFIC AMERICAN name of book which tells how to use this instrument. A. We would suggest Practical Electricity, by W. E. Ayrton. This gives many methods of bridge work, though it does not mention the particular bridge you speak of. We can send it free by mail for $2.50.

(212) P. P. S. writes: What combination of chemicals will produce fire without an explosion by applying water? A. Metallic sodium, potassium, and phosphide of calcium ignite when water is applied to them. All these must be handled with great care, as they are dangerous.

(213) J. J. W. writes: 1. How much water in pounds at 60° Fah. must be taken to saturate 100 cubic feet dry air at 160° Fah., and have no water left? A. 1·52 pounds; it will increase the volume of the air to about 137 cubic feet. 2. What will be the temperature of the saturated air formed from hot dry air at 160° and water at 60°? A. About 125° Fah. 3. Will the resultant saturated air be heavier or lighter than the dry air at 160°? A. It will be heavier, owing to the reduction in temperature. At the same temperature, wet air is lighter than dry air.

(214) F. C. T. asks (1) for a preparation that will take the place of oil for tapping cast iron and wrought iron. A. Use strong soap water. 2. Also the names of some good mechanical books. A. We recommend Spon's "Mechanic's Own Book," $2.50; "Engineer's and Mechanic's Pocket Book," by Haswell, $4; "507 Mechanical Movements," $1.00, which we can mail at above prices.

(215) E. E. S. asks: How can I bleach bromo-gelatine negatives to have them remain permanently white? A. Soak plate in water 15 minutes, then immerse in a solution of bichloride of mercury, strength 20 grains to the ounce, for five or ten minutes.

(216) A. J. D. asks how the so-called ivory type on glass is made? A. See full directions in No. 8, vol. 52, page 120, of the SCIENTIFIC AMERICAN.

(217) H. E. B. asks: 1. If a force of ten pounds is necessary to slide a piece of steel off another piece of steel, both pieces being unmagnetized, how much greater force will it take if the pieces of steel are magnetized, and unlike poles placed upon one another, or in other words, how much does magnetism increase the coefficient of friction? Of course your answer will have to be largely in the nature of a guess, as it will depend largely upon the quality of steel, strength of current, etc. A. The moving block of steel would weigh about 50 lb., and might easily develop 100 lb. resistance to sliding. It would be very largely affected by the condition of the surfaces as well as by the magnetic force. 2. How much water would waste from a boiler in an hour, if a hole $\frac{1}{16}$ of an inch was drilled in the boiler below the water line, with a steam pressure of 100 lb.? Also, how much would waste from a hole $\frac{1}{32}$ of an inch? A. The streams will emerge with a velocity of 95 feet per second. Multiplying this by the area gives as the quantity per second 0·29165 cubic inch and 1·16660 cubic inch, or per hour 1,050 and 4,200 cubic inches respectively. 3. In a neighboring city are several small water motors run by the water from the city water works. The motors are run by the simple impact of water against the outside of the wheel. About what per cent of the power of the water is utilized by the motors? A. They should utilize from 50 to 75 per cent. 4. Supposing that instead of the wheel running by the direct action of a jet of water, the wheel was made hollow, and from arms radiating from the wheel jets of water were made to discharge at right angles to the arms, all in one direction, and causing the wheel to run by reaction. Would not the wheel develop just as much power as the present style of motors described in my third question? A. Such motors are on the principle of Barker's mill, and have been made to give very good results in practice. 5. Does the turbine water wheel run by action or reaction? A. Reaction. 6. What are screw plates? Can they be used to cut threads on bolts, the same as dies? A. A screw plate is practically a collection of dies. They are used for the identical purposes as dies, generally on the lighter classes of work.

(218) B. writes: Will you inform me how to make jelly from non-gelatinous fruits, such as lemons? A. Two cupfuls of sugar, one of lemon juice, one quart boiling water, one cupful cold water, one box gelatine. Soak the gelatine in the cold water for two hours. Pour the boiling water on it, add the sugar and lemon juice, strain, mould, and harden. Other receipts are given in the cook books for various fruits.

(219) A. F. G. asks: What part of a boiler, when steam is up, sustains the greater pressure? My friend maintains the part containing the steam is under the greater strain, while I hold to the opinion that there is as much strain on the bottom as there is upon the top. A. All parts of a boiler are under the same strain from the pressure of the steam alone. The lower part has a slight additional strain, due to the hydrostatic pressure or weight of the water. This may amount to from 1 to 2 pounds per square inch in ordinary cylinder boilers.

(220) H. A. S. asks how the horizontal pressure exercised by a current in midstream is ascertained, for example: When a 24′ × 10′ surface is presented to a stream (say the Hudson) in its center, and at right angles to its course, what is the horizontal pressure, by a two knot stream, on the 240 square feet thus presented to the current? A. The formula for the resistance of plane surfaces at right angles to the flow of water is the weight of water per cubic foot multiplied by the surface of resistance in square feet, and this product multiplied by the square of the velocity of the stream in feet per second, and the last product divided by twice gravity, or twice the velocity that a body attains at the end of one second in falling without resistance, as in your case:

$$\frac{62{\cdot}5 \times 240 \times 3{\cdot}2^2}{64{\cdot}33} = 2{,}387 \text{ lb. pressure, or nearly 10 lb.}$$

per square foot. For tables and formula illustrating the motions of bodies in fluids and resistance of planes under various angles, see Haswell's "Mechanic's and Engineer's Pocket Book," which we can furnish to you for $4.

(221) L. H. L. writes: 1. Please give full directions for making a stereotype, using form of printer's type in chase as the intaglio, and using the paste described in query No. 5, SCIENTIFIC AMERICAN, December 15, 1888, for matrix. A. The paste is thinly spread on successive layers of tissue paper, enough to make mould of sufficient substance, the compound sheets thus formed being kept level by flat metal plates; these sheets are of a substance to admit readily beating them into the surface of the type with a brush, although they are likewise forced in by a press. Then the form with the sheet upon it is placed upon a steam table till the water is all drawn off, and the sheet, then readily removed from the type, constitutes a perfect mould to cast from. 2. Would *papier mache* be preferable to the above paste? If so, how can I make it, or where can I get it? A. *Papier mache* will not do for the purpose; it is not sufficiently fine and strong. 3. Will old type metal do for stereotype? A. Yes. 4. Give formula of cement used in forming letter sheets, note heads, etc., into tablets. A. Glue is made into very thin solution, after ten minutes' soaking in cold water. For every fifty pounds of dry glue nine pounds of glycerine are added to the mixture. It is colored with cochineal or with aniline dissolved in alcohol.

(222) W. L. P. writes: 1. Can a small wire be heated to a red heat between points in a battery circuit? A. Yes. 2. What is best battery to use, and how many cells? A. Use two cells of Grenet or simple plunge battery. 3. What is the best metal for wire? A. Use No. 30 to 35 platinum wire.

(223) P. E. M. asks. 1. What kind of metal contracts the most by cold and expands the most by heat? A. Of common metals, solid at ordinary temperatures, zinc. 2. How many cells of the Law battery will it take to run up strong the motors that you described in SUPPLEMENT, No. 641? A. The Law battery will not answer. Use ten to fifteen cells of a simple plunge battery. 3. Has a nut lock been invented that will prevent the nuts from coming off by the vibration of the train on the track, and leave the fish plates loose and the track loose? A. Yes; there are many patents on them.

(224) A. A. (Transvaal, South Africa) asks the value of crocodile, giraffe, hippopotamus, and sea cow skins, saying they have plenty of them in that locality. A. These skins only come to this country in very small lots or singly, so it would not be possible to name standard market value. Alligator skins, the product of our Southern coast, which we suppose quite similar to those of the crocodile, bring from 50 cents to $1 apiece, as taken off. Small giraffe skins from young animals are much of the nature of deer skins, and would probably command about same price per pound if in good condition. The hippopotamus would have no appreciable value for any regular use. There is a little leather made from skins of sea lions, for use in buffing wheels, but the skin is difficult to tan, and its value very uncertain, dependent upon size and condition. You should write to some of our hide dealers, stating number, size, and weight of skins you can supply.

(225) W. F. H. writes: Will you kindly let me know what mixture you would use to make 5 gals. of electropoion fluid for a carbon battery? A. Mix 1 gal. oil of vitriol and 3 gals. water carefully, and allow to cool. In a separate vessel dissolve 6 lb. bichromate of potash in 2 gals. boiling water. Mix both solutions carefully while the latter is still hot. This will make a little over 5 gals.

(226) Turner asks: What is electricity, or how is electricity produced in a Grove battery? A. Neither of these queries admits of an answer. Human knowledge has not gone far enough to solve the enigma. In a Grove battery chemical energy disappears, and its equivalent of electric energy is produced.

(227) G. M. G. writes: Will you let me know the mixture used for making mercury adhere to glass and metals? A. Place a piece of tin foil on a smooth surface, pour mercury over it, slide a piece of glass with its advancing edge just under the surface, then press and place on edge to drain. The same process will answer for smooth steel; most other metals will be attacked and injured by the mercury. Above all, do not let it touch gold jewelry, etc., as it will at once amalgamate with the gold and make it very brittle.

(228) I. R. B. writes: Will you please give me a receipt for a good stove polish in the form of a powder? A. Use good quality plumbago, applied with a stiff brush.

(229) J. W. H. asks: What is the simplest method to remove tobacco stains from fine blue kersey cloth, so that it will not injure the cloth, yet remove the stains permanently? A. Try lemon juice; oxalic acid followed by ammonia; weak muriatic acid followed by ammonia. Follow by sponging with soap and water.

(230) M. K. asks if there is any difference between Baume's hydrometer and that of Twaddell? If so, what is the difference, and how to calculate it? For example, suppose Baume's hydrometer showed 4°, what would that represent on Twaddell's? A. You will find the specific gravity scale of the Baume scale in works on chemistry. You can compute a Twaddell scale by multiplying the scale number by 5, add 1,000, and divide by 1,000. Thus: 1° = 1,005; 2° = 1,010; 3° = 1,015; 4° = 1,020; 5° = 1,025; which is within a fraction of 4° Baume = 1,027.

(231) F. E. asks: In a cannon of 6 inch bore, powder produces a pressure of, say, 30,000 lb. per square inch; what is the bursting strain the tube is subjected to at each point around the circumference, and by what rule is it calculated? If the cannon be made of material having an elastic limit in tensile strength of, say, 60,000 lb. per square inch, how thick must the walls of the tube be to stand this pressure of 30,000 lb. per square inch? The bore of cannon taken as 6 inches. A. The bursting strain around one lineal inch of the circumference of the bore is equal to 30,000 lb. × by the diameter = 180,000 lb. This product divided by 60,000 lb. tensile strain = 3 inches of metal, and this multiplied by 7 as a factor of safety makes 21 inches of metal, to which add the diameter of the bore, making the breech end of the gun 27 inches in diameter.

(232) H. R. K. asks for some article to use on leather belting to prevent slipping. Resin is not good, as it cakes and ruins a belt in a short time. Also, would like to have you name a good work on practical engineering, engines and boilers, exclusively. A. Use a piece of beeswax rubbed on the inside of the belt or on the pulleys as a temporary remedy in cases of emergency, though with proper size belts and pulleys, properly put in, there should not ordinarily be any slipping. We recommend you the "Practical Steam Engineer's Guide," by Edwards, $2.50.

(233) E. C. asks: Can you tell me the best preparation for cleaning copper boilers on outside so as to remove all tarnish? A. An excellent preparation, and the one most in use, is a solution of

oxalic acid in 6 parts water. It is a powerful poison, and requires care in its use. Slightly wet a cloth with the solution and rub the boiler. Wash clean with hot water.

(234) C. F. P. writes: I am about to erect a tobacco sweat house, 15 by 16, which must be completely steam tight. Can you tell me how many one-inch steam pipes it would require to heat this room, 15 by 16, 7 feet high, to a uniform heat of 90° day and night? I also need a moisture of 95°, which must be absolutely there day and night; would you recommend the heating by hot water or steam circulation? Is there any steam tight paper manufactured, which will stand moisture and heat any length of time? What will it cost me to get a hygrometer? A. You will require 75 feet of 1 inch pipe for your sweat room. If you have steam upon the premises, it is recommended. If not, a small greenhouse hot water stove is recommended. A galvanized water evaporator can be hung on the heating pipes for moisture. For ascertaining the amount of moisture in the room, we recommend a Mason hygrometer as the most reliable means, cost $2.50 to $3. They can be purchased through the optical trade. There is no paper lining that would stand the moisture and heat, unless thoroughly saturated with coal tar, which would impart a disagreeable odor to the tobacco. Many sweat rooms in New York are only lined with matched ceiling boards that have been well oiled with linseed oil and then painted with mineral paint (no lead). Some are only oiled.

(235) C. B. asks: I would like to know if the dynamo described in No. 600 could be made in half size by using exactly half the dimensions everywhere. Also if there would be any difference in the wire? A. To make a dynamo of one-half the capacity of the one referred to, reduce every dimension twenty-five per cent. If you make it one-half size linear measurement, the machine will have approximately one-fourth the power.

(236) H. M. C. writes: Please give definition and value of following terms: 1. Electro-motive force? A. The force directly producing an electric current. What it is, is unknown. 2. Ohm? A. The resistance offered to a current of electricity by a conductor through which a unit of electromotive force (one volt) will produce a current of one ampere. A cylindrical column of mercury one meter long and one millimeter in diameter has a resistance of 1·2247 ohms. 3. Megohm? A. One million ohms. 4. Microfarad? A. One millionth of a farad. A condenser of one microfarad capacity, charged at a potential of one volt, will contain one microcoulomb of electricity, enough to mantain a current of one ampere for $\frac{1}{1000000}$ second. 5. Volt? A. The unit of electromotive force. A gravity battery gives about 1·07 volt. 6. Ampere? A. The current produced by one volt through a resistance of one ohm. 7. Series? A. One succeeding the other. 8. Parallel? A. One by the side of the other, so as to be in action simultaneously. 9. Multiple? A. Several at once. 10. Multiple arc? A. Several voltaic arcs arranged in parallel between two conductors. This is the proper meaning, but it is applied to incandescent lamps, and means several disposed in parallel as just described. 11. Ampere hour? A. A current of one ampere maintained for one hour. 12. Compound wound? A. In a dynamo, having separately arranged windings on the electro-magnets.

(237) F. W. asks if men and women have been scalped and have recovered from it? A. Yes; there have been such cases, though they have occurred but rarely. One of the veterans in our office well remembers having seen, when a boy, an entirely recovered and healthy man who had been a subject of an Indian scalping knife. Possibly such survival has been due in some instances to the fact that the Indians, in hurriedly performing the work, removed only a portion and not the whole of the scalp. An instance was also reported, some years since, of an operative in an Eastern factory being scalped, from her hair having caught in the machinery, and of her recovery from the effects of the accident.

(238) H. L. W. asks (1) for a process of making soft water for the purpose of manufacturing liquid blueing with oxalic acid, without distilling. A. If the lime is present as bicarbonate, it can be precipitated by boiling. If it is present as sulphate, it should not cause you much trouble. 2. How to make a cheap electrophorus powerful enough to ignite gas or gasoline. A. Cast a cake of resin six inches in diameter and one inch thick. Provide for it a wooden box lined with tin foil. A tin disk four inches in diameter is provided with a central glass handle. To exciteit, stroke the resin with a cat-skin, put the disk upon it as nearly central as possible, touch the disk with the finger, and then remove the finger. The disk, lifted by the glass handle, brought near a gas fixture, will give a spark.

Enquiries to be Answered.

The following enquiries have been sent in by some of our subscribers, and doubtless others of our readers will take pleasure in answering them. The *number* of the enquiry should head the reply.

(239) W. H. M. asks: Please describe the method of firing red hot shot. We know it has been done, but it seems impossible to gain any personal information.

(240) F. C. L. asks: Can you inform me about how deep the water is in Niagara river, from one to two hundred feet back of the great falls? Is the rock in river bottom here comparatively level? Also state the rapidity of current at this point. Does the city of Buffalo offer $100,000 premium to the party furnishing the most feasible scheme to utilize the power of the falls?

(241) H. C. W. asks whether it is easier for a fireman to keep steam on an 80 h. p. boiler to run a 50 h. p. engine (14 × 20, 180 revolutions) or a 75 h. p. engine doing the same amount of work as the 50 h. p. engine, it requiring 80 lb. of steam to run the 50 h. p. engine, and do the work. We fire with the refuse from rotary veneer machines and poplar bark, and sawdust from a heading saw. We find it pretty hard work to keep 80 lb. of steam on our 80 h. p. boiler to run 50 h. p. engine. Would we find it any better to put in a larger engine? Would we find it any more work to keep steam?

Replies to Enquiries.

The following replies relate to enquiries recently published in SCIENTIFIC AMERICAN, and to the numbers therein given:

(35) Circular Saw, Connections, etc., for same.—Your saw, 36 inches, should travel 1,000 revolutions per minute. You cannot obtain this speed without using a belt or multiple gearing. Better use a belt. If you have a fly wheel 5 feet in diameter on your engine shaft, you will need a pulley 1 foot in diameter on your saw arbor, providing your engine travels 200 revolutions per minute, which it should, with a boiler pressure of 150 pounds. It would then indicate 27·6 horse power if the stroke is 8 inches. This arrangement will allow of your cutting 5,000 feet of lumber per day, if your boiler is of sufficient size. But I do not think it is. Your description is too meager to permit of an estimate being made of its power. You should give number and size of tubes and size of fire box.—S. H. PRATT, M. E.

(56) I. S.—With the velocity of the air in the pipe at 14 miles per hour, with pressure of 100 lb. less the friction and other losses, we compute that you may realize 8,000 horse power, and for 200 lb. pressure nearly double, or say 15,000 horse power.

(58) W. H. C.—White porcelain clay or kaolin is a silicate of alumina, known by its soft, greasy feel and absorbent nature when touched to the tongue. Address L. A. Solomon & Bro., 216 Pearl Street, New York, importers of clays, for prices.

(59) F. H. G.—For coal, the grate should be 24 inches from the boiler; and for the small power you intend to use, you may make the grate surface only 3 ft. wide, if the grates are 4 ft. long. This can be done by false sides upon the grate, of fire brick; or an independent wall from the ash pit on each side.

(60) H. B.—For computing the indicated horse power of an engine: Multiply the area of the cylinder ($D^2 \times 0·7854$) by the mean engine pressure, taken from tables, for mean pressure due to cut-off, and this product by the travel of the piston in feet per minute, and divide by 33,000. The mean engine pressure for ¼ cut-off = 0·637 of boiler pressure; for ⅜ cut-off = 0·766; for ½ cut-off = 0·86. For computing the distance of the weight on the safety valve lever: Multiply the area of the safety valve ($D^2 \times 0·7854$) by the required pressure for blowing off. Divide this product by the weight of the ball. Multiply the quotient by the length of the fulcrum in inches and decimals; the product will be the distance in inches and decimals from the fulcrum to the center of the ball. Thus for a 3 in. safety valve, 100 lb. pressure, 60 lb. ball, fulcrum 2 in.: 3^2 in. = 9 in. × 0·7854 = 7·06 × 100 lb. = 706 lb., and 706 ÷ 60 = 11·76 × 2 in. = 23·52 in., 23½ in. from the fulcrum to the center of ball.

(73) 1. Resistance of accumulator and lamp.—Watts = 250 per unit of time. Amperes × volts = number of watts. 2. Resistance of lamp, 183·3 ohms. 3. The resistance of carbon is about 6-10 as much at a white heat as cold. 4. You cannot unless you allow one or more of the arc lamps to go out, without reducing greatly their brightness. 5. The batteries should be connected in series with the lights. —C. A. C.

(74) E. A. B.—Bromide Prints.—See SCIENTIFIC AMERICAN SUPPLEMENT, No. 330, practical hints on the making of bromide and gelatine prints.

(75) L. M. C.—For your thermostatic bar, cut a strip of sheet iron and a strip of sheet zinc 1 inch wide and long enough to reach across the incubator box. Rivet or solder the ends together, and wind twine tightly around for the whole length to hold the pieces close together, or if convenient, the strips can be soldered together. Fasten one end to the inside of the incubator. The other end will swing with the variation in temperature, to regulate a damper or the heat in any way that you may devise.

(77) Recovery of Silver from Waste.—The waste papers are thoroughly washed in water and this added to any first washings of silver prints. Sodium chloride (salt) is added till precipitation is complete, decant the solution, wash the precipitate with water, and again decant. The remaining precipitate is dried and then ready to reduce to metallic state. The silver chloride is mixed with about an equal portion of a mixture of sodium and potassium carbonates and fused in a clay crucible. A few minutes after fusion pour the contents of the crucible into some clay dish and allow to cool, when the silver button is easily separated from the mass. The cotton filters should be burned and the ashes treated with nitric acid. Dilute and precipitate with salt and proceed as above.—E. W., Jr.

(77) Recovering Silver Waste.—1. Burn the material, and treat ashes with nitric acid and water, 50 per cent solution. Then filter and evaporate, leaving silver nitrate. 2. Know of no method for reproducing negatives directly. You may make a positive on glass first, and then copy another negative from it. —C. A. C.

(78) Red gas flame.—Suspend in the flame a fine wire gauze basket containing strontium nitrate.—C. A. C.

(82) Raising a weight.—The power required would be the same in each case.—C. A. C.

(83) Who invented the telephone?—The telephone was invented by Philip Reis in 1861. Bell's patent is dated 1876.—C. A. C.

(84) Lapidaries' wheels.—The wheel used by lapidaries is a flat copper disk, charged on the edge with powdered emery, or a steel disk charged with diamond dust. It is used in the same manner as a circular saw.—C. A. C.

(86) M. C. H.—Matches.—Clear white pine is used for matches. We can mail an excellent work on the fabrication of matches by Dussauce, for $3, its price.—Address Paul Pryibil, 463 West 40th St., New York, for splitting machines.

(87) F. S. W.—Hot Water Heating Apparatus.—The hydrogen which you ignited at the air cock is not explosive; it requires to be mixed with a proper proportion of air to become so. There may be a possibility of vegetable matter in the water of your hot water apparatus disengaging a small portion of gas, which may accumulate in a radiator. In steam boilers, the flow of steam carries any gases of decomposition with it, and also all air that might make an explosive mixture.

(90) T. G. A.—Granite ware is glazed with porcelain enamel in the same manner as other kinds of enamel ware. The difference being in glazing both inside and outside, and in the color and quality of the glaze. Any colors can be utilized that are available for chinaware. See SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 248, 314, enamels and enameling.

(91) W. H. B.—Wire Netting for Drying. —Nothing that you can put on the wire netting in the frames will resist disintegration by the glue. Regalvanizing is the only remedy.

(94) 2. Battery for Heating Wires.—1 think you will find the Grenet or simple bichromate of potash battery the best for heating wires. One cell, with a zinc plate 2¼ in. × 1½ in. between two carbon plates of the same size, heats ⅛ in. of No. 30 platinum wire to a white heat in two or three seconds. For greater length of platinum wire, connect more cells in series. With greater battery power, you can probably obtain white heat in a second. The battery fluid soon becomes exhausted with this work.—L. B.

(94) Telephone call bell.—1. The bell would be rung over the wire by the magneto call bell, but the resistance of the wire is too great to operate by a battery. 2. You do not mention the length of wire to be heated.—C. A. C.

(95) Movements of the ocean.—Two. The tidal movement caused by the attractions of the sun and moon, and the ocean currents, as the Gulf stream, caused by the rotation of the earth and the unequal heating of the waters at the equator and the poles.—C. A. C.

(96) Horse power of waterfall.—1. Over the 25 foot fall, 1·527 H. P. 2. Over the 50 foot fall, 3·054 H. P.—C. A. C.

(97) Leather belt.—Always turn the grain or hair side of the belt to the pulley.—C. A. C.

☞ Books or other publications referred to above can, in most cases, be promptly obtained through the SCIENTIFIC AMERICAN office, Munn & Co., 361 Broadway, New York.

INDEX OF INVENTIONS

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January 8, 1889,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

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Advertising device, T. Clark 395,953
Agricultural boiler or barrel heater, T. Tvedler... 395,762
Air, apparatus for moistening and cooling, Gumtow & Lutzner 395,896
Alarm. See Overflow alarm.
Anæsthetics, apparatus for combining, J. S. Ammon 395,683
Axle box and bearing, car, Fulmer & Fry 395,777
Axle, car, W. Hayes 395,901
Axle lubricator, car, T. F. N. Finch 395,887
Axle lubricator, car, T. Saunders 395,758
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Basket cover, T. W. Lankford 395,708
Batteries, apparatus for charging and discharging secondary, W. P. Kookogey 395,836
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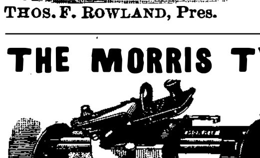

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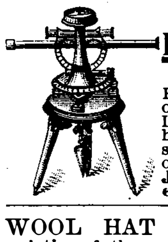

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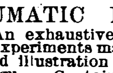

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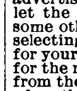

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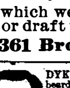

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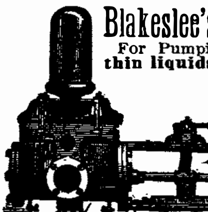

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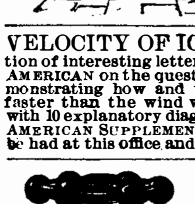

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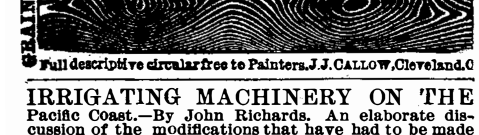

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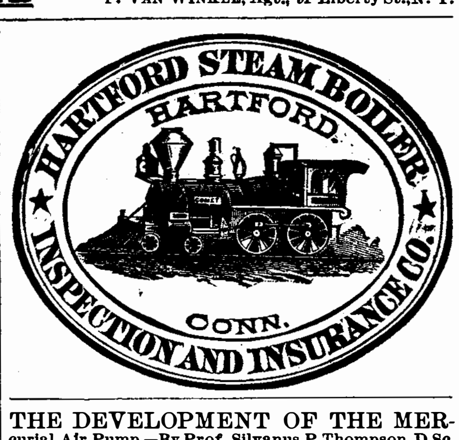

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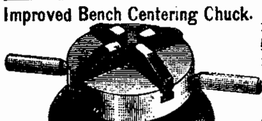

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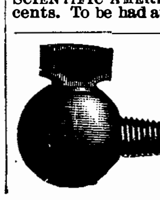

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