SCIENTIFIC AMERICAN

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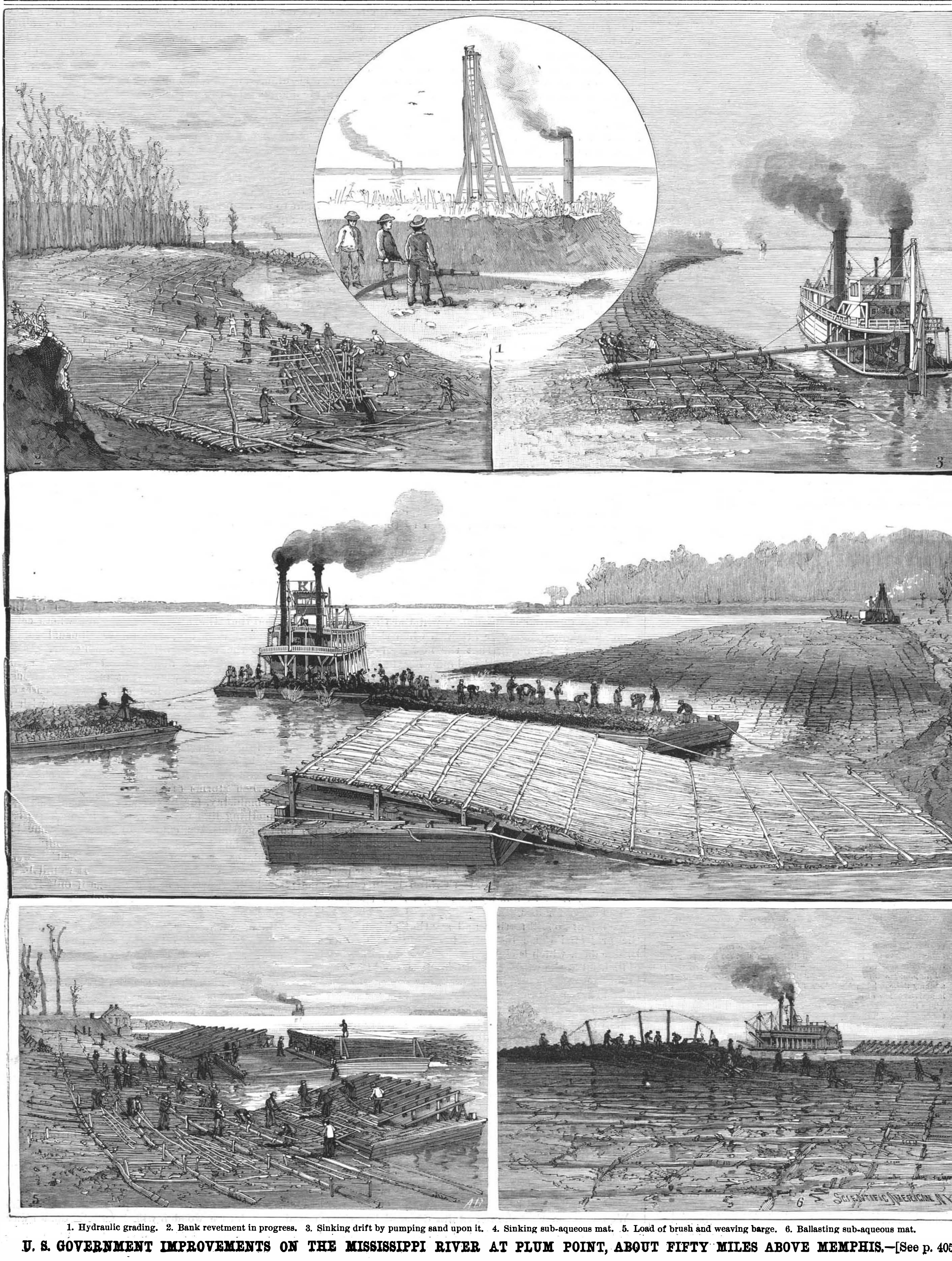

1. Hydraulic grading. 2. Bank revetment in progress. 3. Sinking drift by pumping sand upon it. 4. Sinking sub-aqueous mat. 5. Load of brush and weaving barge. 6. Ballasting sub-aqueous mat.

U. S. GOVERNMENT IMPROVEMENTS ON THE MISSISSIPPI RIVER AT PLUM POINT, ABOUT FIFTY MILES ABOVE MEMPHIS.—[See p. 405.]

Scientific American.

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NEW YORK, SATURDAY, JUNE 29, 1889.

Contents.

(Illustrated articles are marked with an asterisk.)

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For the Week Ending June 29, 1889.

Price 10 cents. For sale by all newsdealers.

THE WATER SUPPLY OF NEW YORK.

A record of draught is of interest to show what has taken place and of importance to show what is going to take place. When represented graphically, the record would take the form of a plane curve, that is to say, if at given intervals of time an enumeration of the people was made and the volume of water required by them was ascertained, the succeeding changes in draught would be clearly indicated by a line drawn through the points of intersection of the variable and the variant. It is practicable to calculate the data as to population which would form the values of the variable quantity, and the record of consumption would form the values of the variant; but the failure of the supply has imposed a condition in the equation, and hence the utility of the prolonged curve for determining the deficiency of supply at any time and in showing the wayward course of the true curve, which changes with abruptness as the storage is occasionally replenished, but which fails ever to assume its proper position.

In 1875 the per capita demand was *ninety-five* gallons and the draught by the city had reached the maximum delivery of the aqueduct. Since this time, therefore, the antecedent condition of the variable has alone been maintained, that is, the population has continued to increase, while the extent of this increase as exhibited by a greater draught has been relegated to the mercies of a prolonged curve.

In 1880 the indicated requirement was *ninety-seven* gallons per capita, equivalent to a daily delivery of 115 million gallons; but the actual delivery was only 99 million gallons, and hence the allotment was only *eighty-two* gallons, showing a deficiency of fifteen gallons to each person, or a total of 16 million gallons in the delivery.

In 1888 the indicated requirement was *one hundred* gallons, equivalent to a daily delivery of 161 million gallons. Prior to this date an additional supply of 10 million gallons had been received from the Bronx River, so that the actual delivery was 110 million gallons per day, making the allotment *seventy* gallons per capita, showing a deficiency of *thirty* gallons to each person, or a total of more than 50 million gallons in the delivery.

When the new aqueduct is completed, the deficiency will be partially made up, inasmuch as during the winter months the customary flow-off from the Croton basin can be utilized. Until such time, however, as the storage is increased by the completion of the Sodom dam, there will be no addition to the delivery during the summer months above what it is at present, and hence a calculation for the dry season of 1889 must be based on the prolonged curve. The indicated requirement for this and the following year is *one hundred and one* gallons, but the allotment will only be *sixty-six* and *sixty-two* gallons respectively.

Now the question is suggested, will the theoretical maximum daily delivery be attained when the Sodom dam is built? Assuming that the new reservoir thus formed will be in use in 1893, and allowing that the storage is thereby increased 5,000 million gallons, then the total storage of the Croton basin will be 14,700 million gallons. In this year the population will be two million and the daily theoretical consumption 200 million gallons.

But in order to provide for this volume daily, the estimated storage is 30,857 million gallons, showing a deficiency of storage provided of 16,157 million gallons. In other words, the capacity of the Croton watershed in the summer of 1893 will be approximately 135 million gallons per day, so that the demand will still exceed the supply, and the allotment, instead of being more than one hundred gallons, will be *sixty-six* gallons.

There are no projects on foot to restore the supply to its former volume, and it may be said that no part of the work contemplated in the Croton basin can be finished in time to modify this "say so" of the prolonged curve for 1893.

We might go still farther and say that although all the projected dams be built, including the Quaker Bridge dam, which is claimed to be "the largest work of its kind in the world," still the delivery could not be brought up to one hundred gallons per capita, for the reason that the population is increasing at such a high rate that it will reach the point where the demand is equal to the maximum capacity of the drainage area in 1897, while to complete all the necessary impounding reservoirs before this date is a physical impossibility.

In the following table is given the calculated requirement of each inhabitant, based on the records of past years, together with the allotment that has been furnished and will be furnished during the summer months of the years noted.

Date.	Per capita demand, gallons.	Allotment, gallons.
1840	20	20
1875	95	95
1880	98	82
1889	100	62
1893	101	66
1897	102	56

We have seen that the per capita demand has risen from *twenty* gallons in 1840 to *one hundred* at the present time. Whether this latter rate is high or low in comparison with that of other cities is immaterial—it is plainly not due to domestic use, but to features of an industrial and commercial character and therefore intimately connected with the prosperity of the city. To limit the consumption to *one hundred* gallons per day could not be taken exception to, provided there was any occasion for such limitation; but to allow the supply to be reduced to *seventy* gallons and less is to curtail enterprise, if not to defeat manifold industries that are already established.

To recite here the lines of manufacture and shipping that are dependent on a free and abundant use of water would be substituting a pleading from the people for emphatic criticism and give an entirely false aspect to the question. There is no benefit in dealing with hypotheses as to what business advantages this diminishing of the supply has deprived the city of, or in speculating on the dangers of a scant delivery in mid-summer, when it can be shown in an incontrovertible manner that the means adopted for procuring the additional water are not going to accomplish the end. What the people want next is evidence of abundance of water coming from somewhere—the testimony as to the need of such abundance was taken many years ago. The citizen gets no comfort in learning from the prolonged curve that his quota of water is to-day 30 per cent short of what he is entitled to. Has he not a right to be astonished that after the construction of the aqueduct and the Sodom dam, his allotment will be 35 per cent less than he is bargaining for? The choice of the Croton basin, with its "dry seasons," low cycle years, and untimely flow-off, has so occupied the authorities in its defense that the city has obtained a lead by growth which, according to the prolonged curve, it is going to maintain.

DYNAMO AND COMPASS.

The recent studies of Sir William Thomson of the effects of electricity upon the compass, as described in his recent paper, though not discovering a means of wholly protecting the needle from electrical influence, serves to point out at least one of the principal causes of it, and to indicate, with hopeful distinctness, the direction in which others may perhaps not unprofitably be sought for. War ships and passenger steamers—the only ones having electrical fittings—have not heretofore been able to protect their compasses from induced currents from the charged wires or from the magnetism of the dynamos.

At times the one or the other appears to exert an influence almost directly opposed to that of the mysterious something in the polar north to which the needle owes its allegiance. Sir William Thomson says that he has discovered, beyond peradventure, that, when single wires are employed—the ship's iron hull being used for the return conductor to the dynamo—there is the greatest disturbance, the widest deflection of the needle, and that the alternating system, where carefully installed, does not, save under unusual conditions, affect the true pointing of the needle. As to the effect of constant and vagrant currents upon the ship's chronometer, we do not propose to discuss that at this time, because in most, if not all, cases of complaint, the master has not been provided with a non-magnetic chronometer.

Only those used to the sea and familiar with navigation can fully appreciate the value of the investigations now being conducted by Sir William Thomson and other equally skillful electricians. When skies are clouded, when storms are come, the compass is the mariner's mainstay, for, by "dead reckoning," he may, with something like certainty, mark his way and hit his port; getting his course by compass, time by chronometer, and speed by log. When iron ships were first floated, the card compasses in use at the time were found wholly unfit to guide them by. It would have mattered little what the deflection was if only it had been constant, but it deviated. Ritchie came to the rescue with his liquid compass, immersing the needle in a bath of spirits of wine or alcohol, and by means of compasses in series, binnacle, bow, and tops, the mean local error is easily computed. Now come electric fittings, lights, and steering gear for passenger steamers and search lights, motors, firing apparatus, and other ingenious mechanisms for battery and pilot-house of men-of-war; admirable contrivances all, yet, if no way were found for encountering the mal-influence of those currents and their generator, it is hard to see how their presence could have been tolerated afloat. The careful mariner "swings" his ship before quitting port, to adjust his compasses, and while afloat is able to mark the deviation of their needles from true north by means of tables marked on his ocean chart. But, let such interferences as the dynamo and its currents interpose, and ship and crew are in imminent danger of destruction. The nautical as well as the scientific world has, then, cause for congratulation at the discoveries made by Thomson and others.

CARRIAGE manufacturers are predicting that in the not distant future wooden wheels will be done away with, and steel wheels substituted on account of the increasing scarcity of lumber for wheels.

POSITION OF THE PLANETS IN JULY.

JUPITER

is evening star, and, as usual, during the month after opposition, is most favorably situated for observation. He rises before sunset on the 1st, and a glance at the southeastern sky will reveal his presence as soon as the twilight begins to fade. At the close of the month, he has so far advanced on his course toward the sun that he is on the meridian soon after 9 o'clock. He is very brilliant in spite of his great southern declination. Jupiter sets on the 1st at 4 h. A. M. On the 31st he sets at 1 h. 47 m. A. M. His diameter on the 1st is 44".6, and he is in the constellation Sagittarius.

VENUS

is morning star. She reaches her greatest western elongation, or greatest distance west of the sun, on the 10th, at 4 h. A. M., being then 45° 44' west of the sun. After elongation, she retraces her steps toward the sun, her brilliancy slowly decreasing as she recedes from the earth. She will be a charming object in the morning sky throughout the midsummer month, especially on the morning of the 23d, when approaching conjunction with the waning moon. Venus rises on the 1st at 1 h. 50 m. A. M. On the 31st she rises at 1 h. 37 m. A. M. Her diameter on the 1st is 26".4, and she is in the constellation Taurus.

MERCURY

is morning star. He reaches his greatest western elongation on the 12th, at 5 h. A. M., and then, like his more brilliant neighbor Venus, begins to retrace his steps toward the sun. At elongation he is 20° 47' west of the sun, and favorably situated for observation with the unaided eye, on account of his high northern declination. Mercury rises on the 1st at 3 h. 39 m. A. M. On the 31st he rises at 4 h. 17 m. A. M. His diameter on the 1st is 10".0, and he is in the constellation Taurus.

SATURN

is evening star. He is so near the sun as he approaches conjunction, that he will soon be hidden in the sunlight, setting less than an hour after the sun on the last day of the month. He is visible in the early part of the month in the northwest, moving eastward and slowly approaching Regulus. Saturn sets on the 1st at 9 h. 41 m. P. M. On the 31st he sets at 7 h. 52 m. His diameter on the 1st is 15".4, and he is in the constellation Leo.

MARS

is morning star, and makes seemingly little progress in his approach toward our planet. He rises on the 1st at 4 h. 11 m. A. M. On the 31st he rises at 3 h. 47 m. A. M. His diameter on the 1st is 4".0, and he is in the constellation Gemini.

URANUS

is evening star. He is in quadrature with the sun on the 9th at 8 h. P. M. He is in good position for telescopic observation, and may be easily found on account of his near approach to Spica. Uranus sets on the 1st at midnight. On the 31st he sets at 10 h. 3 m. P. M. His diameter on the 1st is 3".6, and he is in the constellation Virgo.

NEPTUNE

is morning star. He rises on the 1st at 2 h. 11 m. A. M. On the 31st he rises at 0 h. 15 m. A. M. His diameter on the 1st is 2".5, and he is in the constellation Taurus.

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

The 36-Inch Lick Telescope.

We have received from Messrs. Warner & Swasey, Cleveland, O., who constructed the mountings of this great instrument, a fine print of same which they have lately caused to be engraved.

This instrument, the largest and most powerful refracting telescope in the world, was erected in 1888 at the Lick Observatory, which is located on Mt. Hamilton, in Santa Clara County, California. It is about fifty miles southeast of San Francisco, and twenty-six miles east of San Jose. It is 4,200 feet above sea level, and in sight of the southern end of San Francisco Bay.

The column is of cast iron, 10×17 feet at the base and 4×8 feet at the top, and weighs 20 tons. On this rectangular column rests the head, weighing 4 tons, in which is journaled the polar axis.

Around this head is a balcony, on which the assistant astronomer is stationed. By a system of wheels he is able to adjust the instrument on any star desired, and read its position by microscopes illuminated by electric light. Access to the balcony is gained by a spiral staircase on the south side of the column.

The polar axis is of steel, 12 inches in diameter, 10 feet long, and weighs 2,700 pounds. The declination axis is also of steel, is 10 inches in diameter, 10 feet long, and weighs 2,300 pounds.

The tube is of steel, 57 feet long. Its diameter is 4 feet at the center, tapering toward each end to 38 inches. The tube complete, with all its attachments, weighs 5 tons. This is made to follow the star by means of a driving clock, weighing one ton, controlled by a double conical pendulum which is placed near the top, and within the column, and is reached by a landing from the spiral staircase. At the side of the great tube three small telescopes of 6 inch, 4 inch, and 3 inch aperture are attached, which serve as finders.

The magnifying power ranges from 180 to 3,000 diameters.

The object glass is 36 inches clear aperture, and weighs, with its cell, 532 pounds. By special accessories the telescope is adapted to spectroscopic, photographic, and micrometric work.

The center of motion is 37 feet above the base, and when the telescope is pointed to the zenith, the object glass is 65 feet above the base of the column. When turning the instrument in declination, the weight that is put in motion is 7 tons, and when turning it in right ascension 14 tons is being moved. The total weight of the instrument is 40 tons.

The Paris Exhibition.

THE FRENCH LOCOMOTIVE EXHIBIT.

PARIS, June 5, 1889.

If as much could be said of the design of the French locomotives as can be said for the workmanship, this would be a grand exhibit for quality as well as magnitude, but the French seem to have got very little further than Crampton did in the improvement of the locomotive. Crampton undoubtedly did a very great deal for the locomotive of his day, but very little of it remains in present practice outside of France. When Napoleon the Second visited Queen Victoria the engine which took him from Dover to London was No. 149, a Crampton engine, with an intermediate crank shaft and having a single pair of driving wheels behind the firebox. A very large part of the journey was made at a speed of over 60 miles an hour. This class of engine has, however, gone out of use even in France, notwithstanding that it survived all other forms of Crampton engines in England. None of Crampton's designs was copied in America that I ever heard of, except perhaps the use of a perforated pipe running along the steam space, so as to dispense with the steam dome.

A very large proportion of the French locomotive exhibit consists of compounded engines, and in this case the Crampton plan of a return crank carrying the eccentrics serves well for the outside cylinders. Locomotive No. 2,367 of the Chemin de Fer du Nord is a compound six-wheel coupled engine with Crampton valve gear. In this engine there is a good deal of overhanging weight forward of the leading wheels—an alleged defect for which Bodmer's locomotive was condemned by the English government after it had run off the rails. Another exhibit of the same company has the Joy valve gear, which lends itself with many advantages to the compound system.

Locomotive No. 623, exhibited by the Chemin de Fer de l'Ouest, has inside cylinders, with Crampton valve gear. The coupling rods on this engine are outside the Crampton eccentrics, so that the return crank not only drives the valve gear, but also drives the trailing driving wheels—a construction which seems to me to be thoroughly bad. The valves are on top of the cylinder, inside the smoke box. The links for the valve gear are straight bars, the link itself lifting upward and the link die moving downward. On account of the eccentrics for the link motion being inside the side rods, the back driving-wheel axle box has a collar on it equal in thickness to the two eccentrics, this construction being necessary in order to keep the coupling or side rods in line. This engine is provided with a screw for working the reversing lever. The workmanship of this engine is exceedingly good. The Society Alsatienne des Constructions Mecaniques exhibit a compound locomotive in which the inside cylinders connect to the front pair of 5 ft. 6 in. driving wheels, while the outside cylinders drive the back pair of 5 ft. 6 in. driving wheels, the two pairs of wheels not being coupled. This arrangement I consider to be decidedly objectionable, considering that there is but little room for a receiver in a locomotive. A Joy's valve gear is employed for the outside cylinders, the slide spindle guide being suspended from the lower guide bar. In connection with this engine a peculiar feature of French locomotive practice may be noted, viz., that the steam chest comes in beneath the cylinders, and parallel with the ground, so that it can only be got at when the engine is standing over a pit. On speaking to a French engineer on this point, he answered, "We do not find it inconvenient. What could we want to get at the valves for, unless the engine is in the shop for examination or repairs? When we put the valves in, we put them in right and we attend to the lubrication properly, and if you in England or America have to arrange to get at the valves when the engine is in service, there is something wrong in your practice or construction." To an argument of that kind nothing can be said, unless one has statistics to fall back upon to show that it does or does not in practice prove inconvenient to place the cover in such a position.

The Chemin de Fer de Paris-Orleans exhibit engine No. 479 of 1889, which has inside cylinders, but Crampton valve gear with Gooch links. The piston stroke of this engine is greater than I ever saw in modern locomotive practice, being at least twice the piston diameter. A feature on this engine (the bracing of the inside cranks with iron hoops) is noticeable as representing common French practice. At the works of the Chemin de Fer du Nord at Hellemmes, they told me they found this necessary. But it is not found necessary in England (where a very large majority of the locomotives have inside cylinders, and therefore crank shafts), unless in the case of the appearance of cracks. Hence it naturally suggests itself that the use of the Crampton gear throws extra strain on the crank shafts, thus rendering the hooping necessary. The connecting rods of this engine have their straps and butt ends fitted with dies V-shaped at the ends—a construction rarely found nowadays in England or America. Another and not by any means a pleasing feature of this engine is that it is lagged all over with sheet brass, which is both unmechanical and in bad taste, besides being both ugly and expensive. The axle boxes are highly polished, in fact, burnished, as are also all that is visible of the springs. The buffer plates also are highly polished and have, at the back, some unnecessary fancy curves belonging to an era of the past when ogee scrolls were considered beautiful on engines or machines.

A compound locomotive on the Malet system appears among these exhibits to advantage, the high pressure cylinder being on one side of the engine and the low pressure cylinder on the other. This avoids a good deal of the excessive complication shown on some of the other compound engines, but it does not follow that it accomplishes what is required in a compound engine, and I may refer to it and some other features of French locomotives at a future time.

The Societe Alsatienne, Usine de Belfort, exhibit a locomotive with a valve gear composed of a sort of a trip mechanism actuated by a Crampton return crank and a rod from crosshead *a la* Joy. It is a wonderful compound of cam, screws, bevel gears, tongues, spiral springs, etc., all of a heap, and is doubtless the first, and is pretty sure to be the last, of its race. I hope the inventor had a good idea of what he wanted to accomplish, but cannot compliment him on his method of accomplishing it.

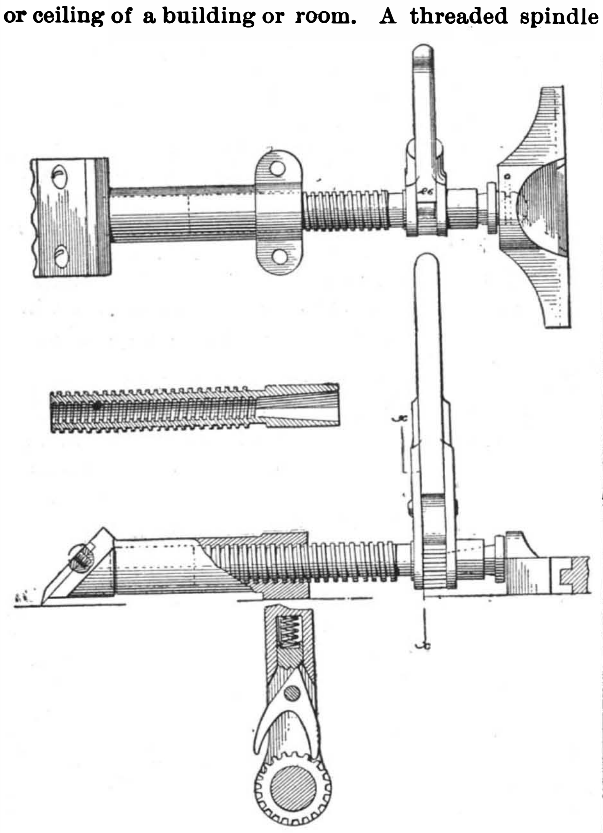
Another compound locomotive has the low pressure cylinder on the outside and a Joy valve gear. The high pressure cylinders are inside, with an ordinary link motion. The piston rods of the outside cylinders of this engine are, say, 3 inches in diameter and 10 feet long, passing through a bush guide provided in the guide bar hanger—a piece of designing not likely to be followed. There is one locomotive with a truck of the American form in the front, and I understand that, in a new and improved form of locomotive being got out by the Nord, the American truck is to be used, and some other features tending more toward English and American practice. The general appearance of French locomotives is not at all elegant or attractive to a mechanical eye, for there are too many bent pipes, cranked arms, and twists and turns in the various parts. It must be confessed that in this matter there is room for improvement in American practice too, and that the most pleasing and mechanical looking locomotive made is the English, with its straight lines and few bends or curves. It looks so simple and straightforward, and as if everything came fair in its proper place without having to be turned aside to get out of the way of something else. In French locomotive construction there is less uniformity than in any other I have as yet seen, and it seems quite clear that it is in a state of transition. At present, for example, you can find almost every form of connecting rod that can be found in the present or past practice of engine building, but at the same time the old patterns predominate. In link motions there are more old styles than new, and in valve gears a feature I never saw in any engine practice, and which I reserve until I have had a better opportunity of examining it.

The workmanship both for fit and finish on the French locomotives is very good, better, much better, than in either American practice. How much of the work is hardened in the case of steel, or casehardened in the case of iron, I have not as yet learned, but from the importance of this point I will look into it. There is not much cast iron work about these locomotives. I notice some steel wheels with solid webs, after the American style, and some wooden wheels on a locomotive truck, but wooden wheels have not found favor for locomotives either in England or France. All passenger carriages on English railways have wooden wheels (the Mansell pattern), and there is no doubt they are cheap, wear well, ride easy, and are easy upon the permanent way.

There are one or two locomotives here with very odd looking square smoke stacks, that are so large at the base as to create the suspicion that there might be a feed water heater inside them, but more of this anon. There is quite a large exhibit of French railway carriages and one or two dummies for street railways, but as this part of the exhibit is not quite complete, it may be reserved for the present. JOSHUA ROSE.

AN IMPROVED FLOORING JACK.

The illustration herewith represents a jack for laying floors, clamping sash, etc., which may be conveniently manipulated and used for various purposes. It has been patented by Messrs. Herman F. Townsend and Charles T. Winslow, of Groton Pond, Vt. The body has a threaded bore, and at its outer end has an inclined head or base, upon which is attached a plate having teeth in its lower edge, the plate being attached by screws, so that it can be readily removed. The inner end of the body has ears, whereby the device may be fastened to the floor or attached to the sides or ceiling of a building or room. A threaded spindle



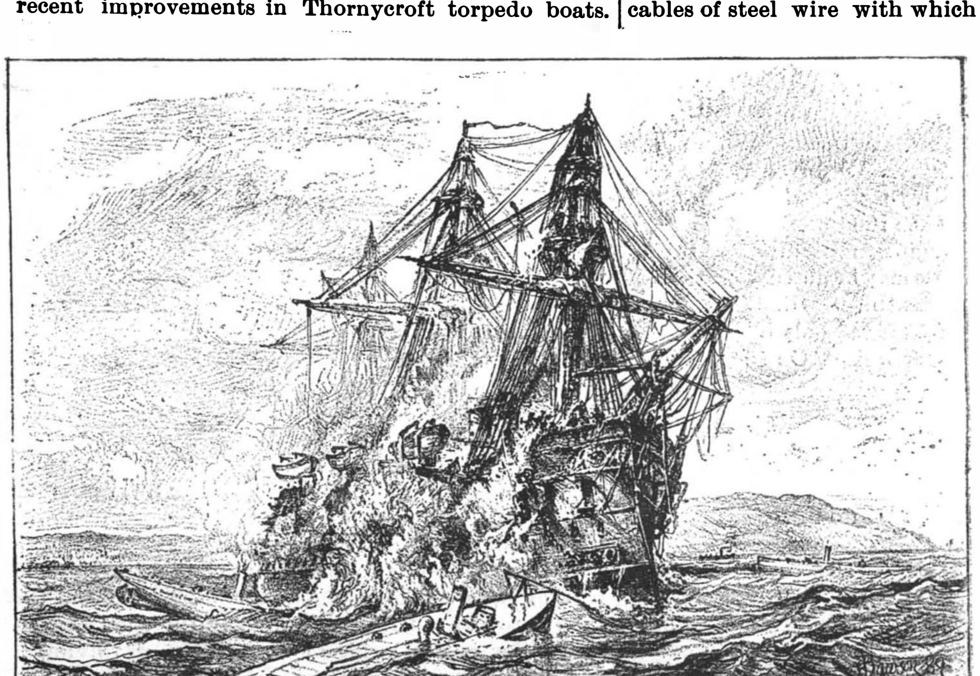
TOWNSEND & WINSLOW'S FLOORING JACK.

is secured in the bore of the body, this spindle being tubular and threaded on its interior, both interior and exterior threads extending to within a short distance of the outer end, which is enlarged and provided with a tapering rectangular bore and attached ratchet wheel. At each side of the latter are journaled the members of a lever, the inner end of which is bifurcated, or provided with arms attached upon opposing sides. In the end of the lever between the arms is a longitudinal recess in which is a spring having secured to its lower end a head-block with beveled sides and a central notch, the head-block being adapted to slide in the recess, as shown in one of the views. Between the arms of the lever and the head-block is pivoted a V-shaped dog, the angled body of which engages with the head-block and the members with the ratchet wheel, either member being thrown in engagement according to the direction in which the spindle is to be revolved. In operation, the teeth of the body-plate are driven into the floor beam, joist, or other support, and the clamp-block is forced forward by means of the ratchet lever, thereby revolving the spindle, which is interiorly threaded to admit of the attachment of a drill chuck or point, if it is found desirable to use the ratchet in that connection.

TORPEDO BOATS.

An able paper was read, not long ago, before the United Service Institution, by John Donaldson, on the recent improvements in Thornycroft torpedo boats. It was accompanied by various diagrams, among them an illustration, which we give, intended to show how these little vessels are expected to operate in attacking one of the great French ironclads. In the discussion, Admiral Barnaby, speaking of the torpedo boats, said:

"It is undoubtedly true that she can be pierced by shot. I have heard that so often said concerning big ships, for which I was responsible, that I can sympathize with our friends the torpedo boat builders when it is said that the shots can get in. Of course they can, and I have no doubt the people in the torpedo boat will feel terribly nervous when they are going to make the attack. But be perfectly sure the people will be very nervous on board the ironclad that is going to be attacked. That is an important thing. If you can succeed in making the other fellows nervous, never mind that you are running some risks yourselves. The real point lies, I think, there. It can be of no use to attempt to give protection against shot. I know that in France, where they have enormous ironclads of 11,000 and 12,000 tons, they are as nervous as can be over this fact, that the whole of their batteries can be searched out by machine gun fire. They know that, and they do not see how to remedy it. But if you cannot remedy it in a ship like that, what are you going to do with such vessels as these? The best thing you can do is to get a number of them and make them as good as ever you can."



HOW TORPEDO BOATS ARE MEANT TO ATTACK IRONCLADS.

Bicycles.

The Supreme Court of Indiana was recently called upon to review a non-suit in an action brought to recover damages for being struck down on sidewalk by a bicycle rider. The trial court had held that bicycling was a form of pedestrianating, and that the bicyclers had as much right on the sidewalk as any pedestrian. The appeal from the non-suit was argued in the forenoon. When the court adjourned for dinner, Judges Coffey and Berkshire started to walk to their hotel, and as they were passing out of the capitol grounds a clumsy bicycle rider ran into them, knocking both down, and badly bruising the former. This practical argument had such a convincing effect on the minds of the learned judges that they immediately overruled their unrendered decision and filed an opinion setting forth that a person who "rudely and recklessly" rides a bicycle against a man standing on a sidewalk is responsible for damages for assault and battery.

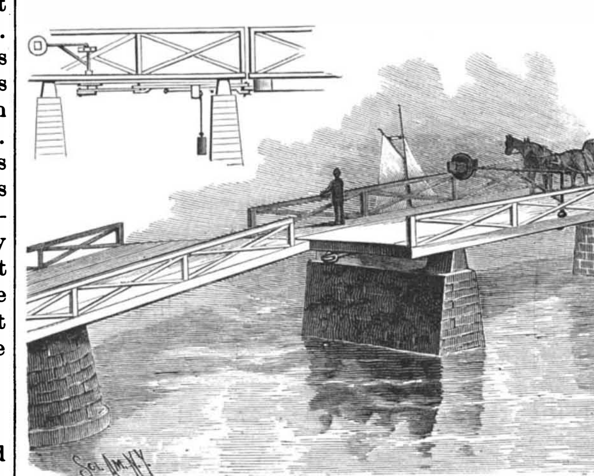
After quoting an Indiana law forbidding persons from riding or driving on the sidewalks, the court says: "If sidewalks are exclusively for the use of footmen, then bicycles, if they are vehicles, must not be ridden along them, since to affirm that sidewalks are exclusively for the use of footmen necessarily implies that they cannot be traveled by bicycles. It would be a palpable contradiction to affirm that footmen have the exclusive right to use the sidewalks and yet concede that persons not traveling as pedestrians may also rightfully use them. We think, however, that a bicycle must be regarded as a vehicle within the meaning of the law."—*N. Y. Law Journal.*

Testing the Safety Apparatus of the Otis Elevators at the Eiffel Tower.

At the Eiffel tower, an experiment was performed recently which produced a strong impression on those present. The engineer of the American firm of Otis subjected the Otis lift to a final test before handing it over for public use. The lift, the car of which consists of two compartments, one above the other, weighs 11,000 kilogs., and loaded with 3,000 kilogs. of lead—that is to say, weighing 14,000 kilogs—was raised to a considerable height. There it was fastened with ordinary ropes, and this done it was detached from the cables of steel wire with which it is worked. What was to be done was to cut the ropes, and allow the lift to fall, so as to ascertain whether, if the steel cables were to give way, the brakes would work properly and support the lift. Two carpenters armed with great hatchets had ascended to the lift, and were ready to cut the cables. At a given signal, a blow cut the rope. The enormous machine began to fall. Every one was startled, but in its downward course the lift began to move more slowly, it swayed for a moment from left to right, stuck on the brake, and stopped. There was a general cheering. Not a pane of glass in the lift had been broken or cracked, and the car stopped without shock at a height of ten meters above the ground.

AN IMPROVED DRAWBRIDGE SIGNAL.

A drawbridge signal, which shall be automatically displayed when the bridge is open, is shown in the accompanying illustration, and has been patented by Mr. M. H. Long, of Sabula, Iowa, the small figure giving a sectional view of the signal-operating mechanism. To the under side of each end of the draw is connected a double cam-faced flange, and upon the bridge approach is mounted a crane, which carries a

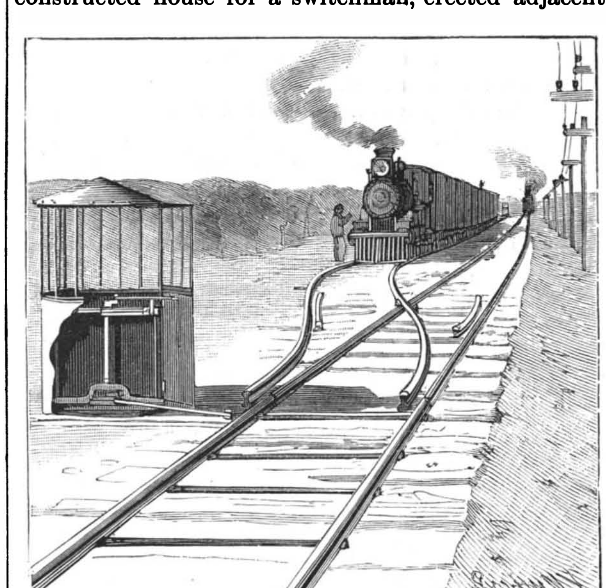


LONG'S DRAWBRIDGE SIGNAL.

disk, to serve as a day signal, and a box in which a lamp may be placed for a night signal. The crane is supported by a collar resting upon a wear-plate, centrally apertured to provide for the passage of the crane-standard, to the lower end of which is secured a sleeve, which carries a sliding lever-arm, pivotally connected by a link with one arm of a bell-crank lever mounted beneath, the other arm of the lever being connected to a slide. Upon the forward end of this slide is an anti-friction roll, borne upon by the cam-flange of the draw, so that when the latter is in closed position the disk-supporting arm will be held substantially parallel with the roadway. In order that this arm may be moved to indicate the open position of the draw, a weight is connected to the slide by a rope or chain, whereby, as the draw is opened, the disk-supporting arm is automatically carried to a position across the bridge roadway, being again returned to its normal position on the closing of the draw.

A LOCK-HOUSE FOR SWITCH-STANDS.

The accompanying illustration represents a strongly constructed house for a switchman, erected adjacent

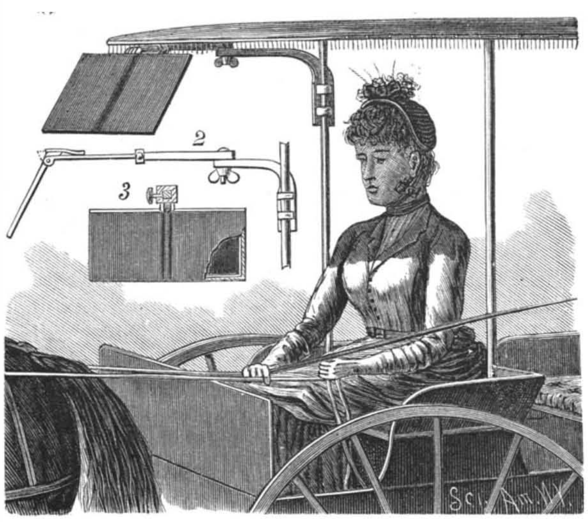


McCARTHY'S LOCK-HOUSE FOR SWITCH-STANDS.

to the switch for a siding, to operate which the operator has to enter the house, and cannot again leave it till the switching rails have been returned to open the main track. The invention forms the subject of a patent issued to Mr. Wm. J. McCarthy of Menominee, Mich. The house, shown partly in section, is of sheet metal, with a lower flange adapted to be bolted to switch ties, the upper section of the house being open, for the convenience of the operator in giving signals, and having a sheet metal roof. Within the house is arranged a switch-stand of any proper construction, the vertical crank-shaft of the stand having an upper crank connected by a link to an eye secured to the inner side of the door. The vertical crank-shaft has the usual operating lever, which, when the siding is open, occupies a position to hold the door of the house closed, retaining the attendant until the lever has been thrown to a position to move the switching rails to open the main track. This construction is also designed to prevent the interference of meddlesome people with the switch rails.

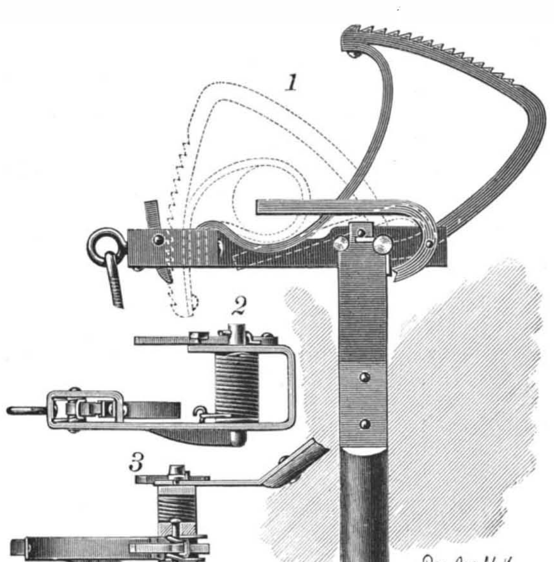
AN IMPROVED SUNSHADE FOR VEHICLES.

The accompanying illustration represents a simple and readily manipulated device, whereby the eyes of the driver may be shielded from the sun, while the device may be readily folded up and concealed out of sight when not desired for use. This invention has been patented by L. V. Luce, of No. 585½ St. Charles Avenue, New Orleans, La. Fig. 2 represents a



SUNSHADE FOR VEHICLES.

side elevation of the device, Fig. 3 showing the shade, partly in section. An angular bracket is adapted to be secured by clamps to one of the supports of the canopy of the vehicle, a horizontal arm being pivoted to the bracket, and this arm having a recess adapted to receive a rod with enlarged head, slotted to receive a lug forming a portion of the shade. This shade is preferably rectangular in form, and covered with cloth, leather, or other suitable material, the central bar of the shade frame terminating in the lug by which it is attached to the rod extending from the horizontal arm.

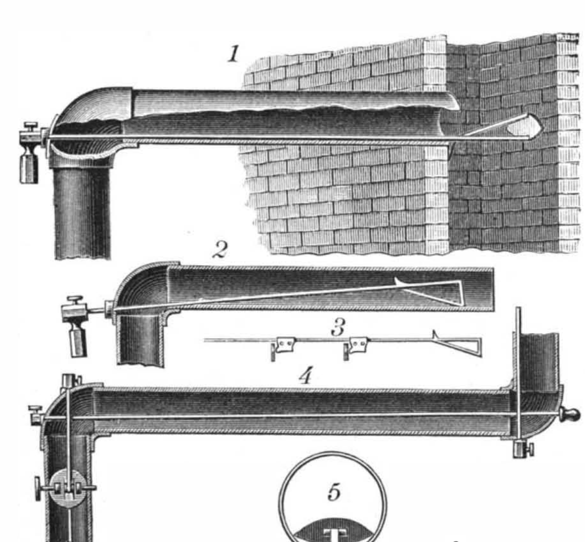


WICKHAM'S DEVICE FOR CATCHING ANIMALS

The device may be readily and conveniently attached to or detached from any vehicle; and by means of the thumb screw by which the horizontal arm is attached to the bracket, the shade may be conveniently moved to any desired position in front of or at either side of the driver, according to the direction in which the sun is shining.

A STOVEPIPE ANCHOR AND FLUE CLEANER.

The accompanying illustration represents a device for locking stovepipes to the chimneys, and also pro-



OLDFIELD'S STOVEPIPE ANCHOR AND FLUE CLEANER.

viding for the cleaning of the pipes. It has been patented by Mr. Leonidas H. Oldfield, of No. 72 West Washington Street, Chicago, Ill. Fig. 1 is a sectional view of the device when used to anchor a pipe to a chimney, and Fig. 4 represents a stovepipe tied therewith. Fig. 2 shows the device in position for use as a pipe cleaner, Fig. 3 representing the rod provided with additional cleaners, while Fig. 5 represents a cross section of pipe with additional cleaners, which, when not in use, are made to assume a horizontal position. The invention consists essentially of a rod with a spur extending from one side and a plate extending from the other side, a catch or handle being arranged in connection with the rod, the rod being held in place to lock the parts by a thumb screw on its outer end. To clean the pipe the handle is turned up to free the spur from engagement with the flue wall, bringing it into the position shown in Fig. 2, when the soot may be readily removed by reciprocating the rod.

AN IMPROVED ANIMAL CATCHER.

The illustration herewith represents a recently patented device specially adapted for catching hogs, sheep, etc., by the leg. Fig. 1 represents a plan view of the device, the full lines showing it as set for use, while the dotted lines represent the position of the parts when in engagement round an animal's leg. Fig. 2 is a side elevation of the device, and Fig. 3 a sectional end elevation. The main frame of the device has a handle by which the operator moves a tripping lever therein against the animal's legs, when the handle becomes detached, as the animal is caught, the operator then holding the animal by a rope attached to a ring in the other end of the frame. A shaft, actuated by a spring, is mounted to turn in the frame, the tripping arm being held on the shaft, while a segmental arm is also held on the shaft, and a band, preferably of leather, is secured to this segmental arm and to the frame. A spring pawl is fulcrumed on the frame and adapted to engage the notches on the segmental arm as it is brought to closed position, folding the leather band around the animal's leg, and locking it in place.

For further particulars with reference to this invention, address the inventor, Mr. Thomas Wickham, in care of James Wickham, No. 212 South Barstow, Eau Claire, Wis.

AN IMPROVED SPRING BACK FOR STOOLS, ETC.

A spring back for use on piano and organ stools, chairs, and office stools, and especially the high desk stools used in banks, etc., is illustrated herewith, and has been patented by William P. James, of Lincolnton, N. C. Figs. 1 and 2 represent side and rear elevations showing the device as applied, and Fig. 3 a sectional view. The seat may be of any desired shape, but the back support is connected thereto by a frame, preferably of round bar iron, having two downwardly projecting limbs, each suitably bent and formed with a crook where the frame comes close to the back of the seat. The frame is here connected to the seat by metal loops, and is further bent below to form a loop projecting inward beneath the seat. A spiral spring, bearing at one end against a plate secured to the under side of the seat, bears at its opposite end against the loop portion of the frame, which has its motion limited by working within a hook forming part of the spring-carrying base, to restrict the spring seat back from working either too far forward or backward. By this construction the frame is restrained from independent up or down and lateral movement, but is free to rock forward and backward.

CRYSTALLIZING FRAMES FOR MONOGRAMS, DESIGNS, ETC.

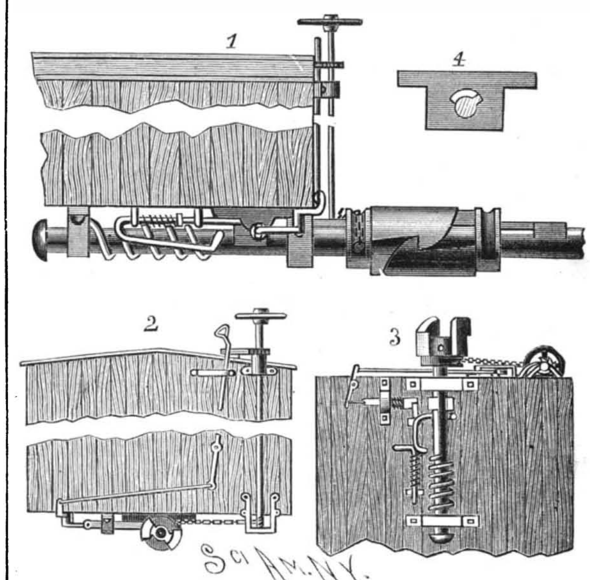
A special construction of frames prepared to retain crystals, as of salt, alum, or other crystallizing material, for the production of monograms, mottoes, and various designs, is illustrated herewith, and has been patented by Mr. Albert E. Beller, of Ogden, Neb., the illustration also representing an emblematic device thus produced. The frame is an open or skeleton one, formed of wire, wood, or other suitable strips, to inclose or support and form the design. These several wires or strips, or such portions as are intended to be incased by crystals, are then covered or wrapped with soft and flexible or fibrous material, to which the crystals will adhere. The whole frame thus covered is then steeped in any suitable crystallizing solution, and allowed to remain therein until a sufficient deposit of crystals has been made upon the covered portions, the uncovered parts of the frame being left bare by reason of the non-affinity of the crystals to form on or adhere thereto.

Advantage of a Trade Mark.

Last year, says the *Canadian Manufacturer*, a firm in London, Ont., inserted in the papers an advertisement of a stove polish, to which they gave the name "Nonsuch," and which they recommended in a card headed "Hello! Nonsuch." A gentleman who desired to write to the firm forgot their name entirely, but remembered distinctly the "Hello! Nonsuch." So he risked the consequences and addressed his communication to "Hello! Nonsuch, London, Ont," and the fame of the article, combined with the quick intelligence of the postal authorities, triumphed over every obstacle, and the letter reached its destination.

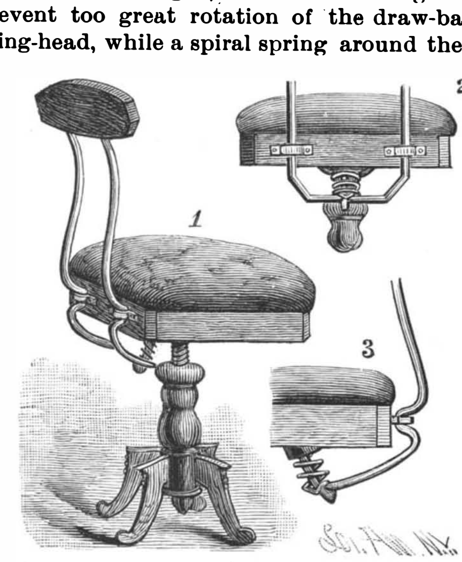
AN IMPROVED CAR COUPLING.

A car coupler designed to be automatic in its action, and preclude danger to the trainmen, by obviating the



SWENSON'S CAR COUPLING.

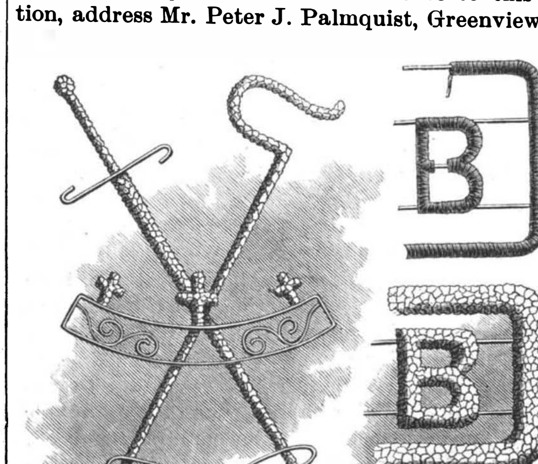
necessity of their going between the cars, is illustrated herewith, and has been patented by Mr. Alfred Swenson. Fig. 1 is a side view and Fig. 2 an end view of a portion of a car body provided with this coupler, Fig. 3 being an inverted plan view of the car body and coupler. The draw-bar is made integral with a draw-head having a central cylindrical section and two hooks, with inclined forward edges, and upon the draw-bar is a longitudinal rib, to the rear of which is a flat-faced boss or projection. The forward portion of the draw-bar is supported by a block having a recess within which the longitudinal rib rides, as shown in the sectional view, Fig. 4, such recess acting as a stop to prevent too great rotation of the draw-bar and coupling-head, while a spiral spring around the draw-



JAMES' SPRING BACK FOR STOOLS OR CHAIRS.

bar causes the rib to normally rest in the position shown in this figure. As two cars provided with this coupler approach each other, the inclined faces of the hooks on the forward ends of the draw-heads are forced to pass each other, when the main spring on the draw-bar causes the hooks to engage each other, as shown in Fig. 1, when the draw-heads are coupled. To uncouple the cars, a vertical shaft is operated, provided with a pawl and a ratchet, and a hand-wheel above the roof of the car. This shaft is connected to the draw-head by a chain bound upon a semi-sheave formed on the draw-bar just to the rear of the draw-head.

For further particulars with reference to this invention, address Mr. Peter J. Palmquist, Greenview, Ill.



BELLER'S CRYSTALLIZING FRAME.

American Association for the Advancement of Science.

The thirty-eighth meeting of this association will begin in Toronto, Canada, Aug. 27, at the Queen's Hotel, the sessions to continue for a week, and the meeting closing with excursions extending to Sept. 7. A special circular in relation to railroads, hotels, etc., will be issued by the local committee, of which Mr. Charles Carpruael is president and Prof. James Loudon secretary, and members about changing their address for the summer should notify the committee. The officers elected for the Toronto meeting are:

President—T. C. Mendenhall, of Terre Haute, Ind.

Vice-Presidents—A. Mathematics and Astronomy—R. S. Woodward, of Washington. B. Physics—H. S. Carhart, of Ann Arbor, Mich. C. Chemistry—William L. Dudley, of Nashville, Tenn. D. Mechanical Science and Engineering—Arthur Beardsley, of Swarthmore, Pa. E. Geology and Geography—Charles A. White, of Washington. F. Biology—George I. Goodale, of Cambridge, Mass. H. Anthropology—Garrick Mallery, of Washington. I. Economic Science and Statistics—Charles S. Hill, of Washington.

Permanent Secretary—F. W. Putnam, of Cambridge, Mass. (office Salem, Mass.)

General Secretary—C. Leo Mees, of Terre Haute, Ind.

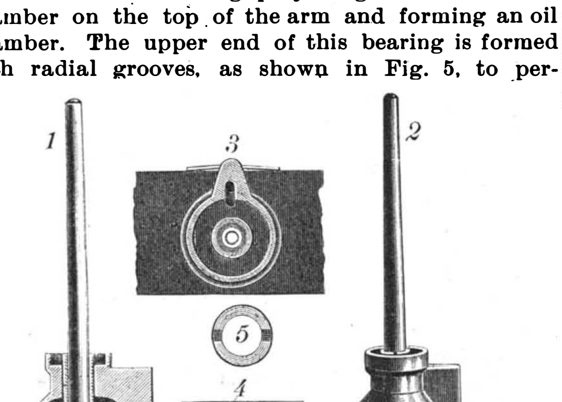
Secretary of the Council—Frank Baker, of Washington.

Secretaries of the Sections—A. Mathematics and Astronomy—G. C. Comstock, of Madison, Wis. B. Physics—E. L. Nichols, of Ithaca, N. Y. C. Chemistry—Edward Hart, of Easton, Pa. D. Mechanical Science and Engineering—James E. Denton, of Hoboken, N. J. E. Geology and Geography—John C. Branner, of Little Rock, Ark. F. Biology—Amos W. Butler, of Brookville, Ind. H. Anthropology—W. M. Beauchamp, of Baldwinville, N. J. I. Economic Science and Statistics—J. R. Dodge, of Washington, D. C.

Treasurer—William Lilly, of Mauch Chunk, Pa.

A SPINDLE SUPPORT FOR SPINNING MACHINES.

The accompanying illustration represents a spindle support from which the oil cannot be thrown out by centrifugal force, but will be properly distributed to the bearings, and the spindle kept clean. It has been patented by Mr. Joseph Duffy, of No. 48 Wayne Avenue, Paterson, N. J. Figs. 1 and 2 represent a vertical section and elevation of the device with the oil trough in section, Figs. 3 and 5 being horizontal sections through the tubular bearing of the spindle, and Fig. 4 a horizontal section near the base. The tubular socket portion which receives the lower end of the spindle has horizontal arms connected by a vertical portion, the upper horizontal arm having an aperture through which projects a tubular bearing for the spindle, the upper end of this bearing projecting into an annular chamber on the top of the arm and forming an oil chamber. The upper end of this bearing is formed with radial grooves, as shown in Fig. 5, to per-



DUFFY'S SUPPORT FOR SPINNING SPINDLES.

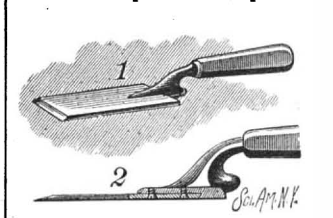
mit the passage of oil from the chamber down between the spindle and the tubular bearing. Surrounding the lower end of the aperture in the upper arm is an annular chamber, into which projects the neck of a whirl mounted on the spindle, the whirl having an annular chamber with inclined sides. From one side of the upper annular chamber an oil passage extends down through the vertical arm and the lower horizontal arm to the tubular socket at the base, and beneath the whirl, in the top of the lower horizontal arm, is an annular oil chamber also connecting with the socket at the base. As the spindle revolves, the oil works down into the upper annular chamber, the inclined sides of which prevent its escape, the oil returning to the spindle and up its tubular bearing when the spindle is at rest. Should this chamber become overcharged, the oil is carried by centrifugal force into an outer chamber and into passages finally leading to the tubular socket at the base.

The American Engineers' European Trip.

Some weeks ago we spoke of the visit of the different American engineering societies to Europe. With the Paris exposition as the central feature of interest, they proposed to visit engineering works of importance within an accessible distance. We have already printed a notice of their arrival in London and of the many receptions and entertainments to be tendered them. Already comments on the engineering works of England have begun to reach us from them, the contrast between American and English methods proving quite impressive. It is evident that both in the way of instruction and pleasure the trip will be a memorable one to all concerned, and that a crop of ideas will be gathered that may serve as a source of seed to reproduce in this country the valuable features of the more conservative engineering practice of the older lands.

PALMER'S IMPROVED CARPENTER'S CHISEL.

The illustration herewith represents a chisel or gouge for carpenters' use which has been patented by Mr. Theron H. Palmer, of San Bernardino, Cal. Figs. 1 and 2 represent top and side views of the device, which has its shank and handle portion bent out of line with its blade or cutting portion. The blade is provided with an anvil or hammer block at its rear to form a striking surface, when using a hammer or mallet with the tool to force it up to its work, instead of striking on the end of the handle direct, which is liable to split or bruise the handle.



A Curious Chemical—Oxalomolybdic Acid.

A new substance, singular alike in its chemical nature and in its properties, says *Nature*, has been discovered by M. Pechard. It is a mixed acid derived from oxalic and molybdic acids, and is, therefore, termed "oxalomolybdic acid." The crystals of oxalomolybdic acid, when dry, may be preserved unchanged either in sunshine or in the dark; but, if moist, they quickly become colored blue when exposed to the sun's rays. If characters be written on paper with the solution, they remain invisible in a weak light; but when exposed to sunshine, they rapidly become visible, turning to a deep indigo color. It is curious that this effect only happens when the solution is spread over paper or other surfaces; for the solution itself may be kept unaltered in the bottle for any length of time, except for a trace of blue at the edge of the meniscus, where, by surface action, a little is spread against the interior glass walls. If a sheet of paper be immersed in a saturated solution of the acid, dried in the dark, and then exposed behind an ordinary photographic negative, a very sharp print in blue may be obtained by exposure to sunlight for about ten minutes. The color instantly disappears in contact with water; so that if a piece of this sensitized paper be wholly exposed to sunlight, one may write in white upon the blue ground by using a pen dipped in water. If, however, the paper with its blue markings be exposed to a gentle heat for a few minutes, the blue changes to black, and the characters are then no longer destroyed by water

Keeping at It.

It is a great mistake to suppose that the best work of the world is done by people of great strength and great opportunities. It is unquestionably an advantage to have both these things, but neither of them is a necessity to the man who has the spirit and the pluck to achieve great results. Some of the greatest work of our time has been done by men of physical feebleness. No man has left a more distinct impression of himself on this generation than Charles Darwin, and there have been few men who have had to struggle against such prostrating ill health. Darwin was rarely able to work long at a time. He accomplished his great work by having a single aim, and putting every ounce of his force and every hour of his time into the task which he had set before him. He never scattered his energy, he never wasted an hour, and by steadily keeping at it, in spite of continual ill health and of long intervals of semi-invalidism, he did a great work, and has left the impression upon the world of a man of extraordinary energy and working capacity. Success is rarely a matter of accident, always a matter of character. The reason why so many men fail is that so few men are willing to pay the price of self-denial and hard work which success exacts.—*The Christian Union.*

The Population of the United States.

The present estimated population of the United States is 64,000,000. The rate of increase, exclusive of immigration, is estimated at 1·8 per cent per annum—about 100,000 a month. By immigration the increase of population averages over 43,000 a month, or over half a million yearly. The aggregate annual growth from both causes will not fall much short of a million and three-quarters. The estimated foreign population is not far below 14,000,000.

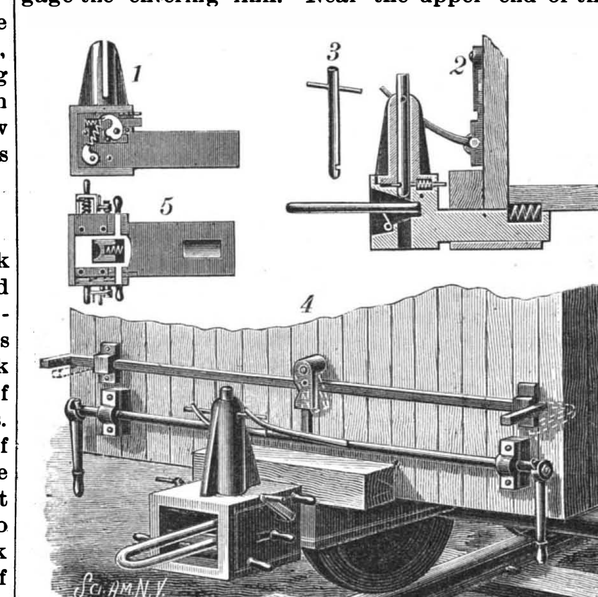
The Sources of Beautiful Colors.

The *American Druggist* has formulated a list of the choicest colors used in the arts, as follows:

The cochineal insects furnish a great many of the very fine colors. Among them are the gorgeous carmine, the crimson, scarlet carmine, and purple lakes. The cuttlefish gives the sepia. It is the inky fluid which the fish discharges in order to render the water opaque when attacked. Indian yellow comes from the camel. Ivory chips produce the ivory black and bone black. The exquisite Prussian blue is made by fusing horses' hoofs and other refuse animal matter with impure potassium carbonate. This color was discovered accidentally. Various lakes are derived from roots, barks, and gums. Blue black comes from the charcoal of the vine stalk. Lamp black is soot from certain resinous substances. Turkey red is mud from the madder plant, which grows in Hindostan. The yellow sap of a tree of Siam produces gamboge; the natives catch the sap in cocoanut shells. Raw sienna is the natural earth from the neighborhood of Sienna, Italy. Raw umber is also an earth found near Umbria and burnt. India ink is made from burnt camphor. The Chinese are the only manufacturers of this ink, and they will not reveal the secret of its manufacture. Mastic is made from the gum of the mastic tree, which grows in the Grecian Archipelago. Bister is the soot of wood ashes. Very little real ultramarine is found in the market. It is obtained from the precious lapis-lazuli, and commands a fabulous price. Chinese white is zinc, scarlet is iodide of mercury, and native vermilion is from the quicksilver ore called cinnabar.

AN IMPROVED CAR COUPLING.

A car coupling designed for use with a link and pin, and permitting an automatic coupling of two cars on a slight collision, while also adapted for the coupling of cars of different heights, is illustrated herewith, and has been patented by Mr. Vincent Nusly, of No. 718 Franklin Street, Sandusky, Ohio. Figs. 1 and 2 are sectional side elevations of the drawhead, Fig. 3 shows the coupling pin, Fig. 5 is a plan view of the drawhead with the top plate removed, and Fig. 4 is a perspective view of the improvement as applied. Supported by a suitable bearing in the bottom of the car is mounted to slide a bar on the front end of which is the drawhead, a spring holding the drawhead to permit a slight inward motion when two drawheads come together. In an offset on top of the drawhead the coupling pin is held to slide vertically, a notch in the lower end of the pin being engaged by a horizontal slide in the top of the drawhead, this slide having a rearward projection adapted to be engaged by a transverse beam on the front of the car, and having a projecting arm at each side of the drawhead for conveniently moving it by hand. A spring presses against the slide to hold it in engagement with the raised coupling pin until two drawheads come together, when the pin drops to engage the entering link. Near the upper end of the



NUSLY'S CAR COUPLING.

coupling pin are arms passing through vertical slots in the offset on the drawhead, the arms on the pin being adapted to be engaged by arms projecting from a shaft extending transversely on the front of the car, each outer end of this shaft having a lever by means of which the shaft may be turned to lift the coupling pin into its raised position. On this shaft is also fastened centrally an upwardly extending arm, adapted to be locked in place by a lock plate pivoted on the front of the car, and pivotally connected with a transverse rod, on each outer end of which is a handle for laterally moving the rod to disengage the lock plate, the locking of the arm holding the pin in its uppermost position when the cars come together, even if the slide is disengaged from the notch in the pin. In the drawhead is a link-raising mechanism, operated by handles at the side, whereby the link may be raised or lowered and held in the desired position to couple cars of different heights.

MISSISSIPPI RIVER IMPROVEMENTS.

For many years the question of the practical feasibility of confining the Mississippi River within fixed channels has been a most important one, not only as it affected the improvement of navigation over this great inland water course, but also from the necessity of protecting great properties along its banks, which have been frequently endangered by its fitful changes. In 1873, for instance, the banks of the river fronting the city of Memphis, Tenn., commenced rapidly caving in, the encroachment of the river destroying extensive sites and endangering costly structures, such as warehouses, elevators, cotton compresses, etc. In 1876 the bank had receded 350 feet, and was continuing to cave in at the rate of 100 feet per annum, thus promising to quickly destroy what had before been the finest harbor on the river above New Orleans, accessible to the largest vessels.

For a long time the national government has made annual appropriations for various improvements of the river, the most of the work so done having been originally for the construction and repair of levees, but in 1879 Congress passed an act organizing the Mississippi River Commission, to take more comprehensive action in regard to the whole matter, and of this commission Major-Gen. Q. A. Gillmore, of the engineer corps of the U. S. army, was president up to the time of his death, April 7, 1888. The general plan of work adopted by the commission contemplated the reduction of the low water width of the river below the mouth of the Ohio to about 3,000 feet by means of permeable dikes, behind which artificial banks should be formed by deposit, and the preservation of the natural curves of the river by reveting caving banks, together with the construction of levees.

Our first page illustrations represent the progress of this work at a portion of the river styled Plum Point Reach, about fifty miles above Memphis, Tenn. The river here takes a great bend into the Arkansas shore, and for a distance of some eighteen miles its channel was constantly changing, while numerous bars were formed, very seriously interfering with navigation. Previous to the commencement of these improvements the river at this point was frequently unnavigable for vessels of more than 4½ feet draught, while now, at the low water stage, it is navigable for vessels drawing 8½ to 9 feet. The work has been substantially completed about three years, requiring only slight repairs from year to year, while the natural current is evidently wearing the channel steadily deeper and making changes therein less likely to occur hereafter.

The principal form of protection for the banks shown in our views consists in firmly anchoring mats of light timber and brush, to extend from below to quite high water mark, these mats being connected, by the manner in which they are woven on board and moved to place, to form a continuous protection to the portion of the bank they cover. A break anywhere in this mat covering would soon be found by the current when the water rises, and great care is, therefore, taken to make this matting cover continuous before the weight of stone or other material which is to hold it down is put in place.

The general manner of conducting operations is pretty thoroughly indicated by our illustrations, although the details vary in different localities. The hydraulic grading shown in Fig. 1, and one manner of sinking mat by pumping sand upon it, as shown in Fig. 3, indicate some of the recent improvements in methods of conducting the work, the whole plant for carrying on which is owned by the government. Fig. 2 shows the weaving of the mat in place upon the bank. Fig. 5 shows the weaving barge, with a load of brush in convenient proximity thereto, the weaving being done on a special frame set at an angle against the bank, the mat as made, shown in Fig. 4, being moved down into position on a bed formed by longitudinal timbers and stakes, the mat being afterward ballasted by loose stones and the pumping of sand upon it. The progress of this ballasting and placing of the mat is shown in Figs. 5 and 6.

The results of the work done at this point on the Mississippi have been so satisfactory as to lead to the more steady prosecution of similar plans for improving other sections of the river. The point at which these improvements were made was notoriously the worst one below Cairo, yet during last year, a season of very low water, no trouble was found in navigating this section. The high water of the year was above the thirty-foot stage for fifteen days, yet all overflow was prevented for a distance of nearly thirty miles. In the similar work done for the protection of Memphis harbor, the success has been equally pronounced. This work was not completed until the fall of 1887, and much of that which was done at first proved inefficient, but with the later methods adopted it is said that not a stick or a stone can be seen to be displaced, and not a foot of earth has been lost behind the revetment. So great is the confidence of those doing business there in the permanence of the water front as now established, that manufacturing and warehousing concerns have lately erected extensive and costly additions to their buildings on the river bank, and the elevator and compress companies have built out on piles driven through the revetment, so as to recover a considerable portion of their lost space.

The cost of such work has been greatly reduced since the government commenced these improvements. What originally involved an expenditure of some $30 per foot of bank was, in the last portion of the work, done for about $12 per foot of bank. The cost of a subaqueous mat 150 feet wide constitutes about one-half the expense, but some of the mats used have been 250 to 300 feet wide. This is said to be the heaviest and most costly work of its kind ever put down, and the engineers claim that it will certainly protect any alluvial bank on the Mississippi River.

The work above described has been ably conducted under the supervision of Capt. Smith S. Leach and Capt. Wm. T. Rossell, of the corps of engineers, U. S. army.

The Mississippi River Commission consists of Col. C. B. Comstock, Lieut. Charles R. Suter, and Maj. O. H. Ernst, of the U. S. Engineer Corps; Mr. Henry Mitchell, of the Coast and Geodetic Survey; Messrs. B. M. Harrod and S. W. Ferguson, civil engineers, and Mr. Robert S. Taylor.

Notes on Telea Polyphemus.

I collected two cocoons of this beautiful moth last fall. As they happened to be free from parasites, I was fortunate enough to observe the very interesting manner in which they came forth. April 30, about noon, the end of one cocoon was noticed to be soft and moist. Every minute or two the moth could be seen struggling to push its way through the softened cocoon. In about ten minutes from the time it was first noticed, the moth burst through, and, drawing its enormous body out, it began to run hurriedly around to find a place suitable for the position necessary to the growth of its wings. Climbing up the window frame, it attached itself to the wood by the sharp hooks on each foot, and there, with its body hanging downward, it waited for its wings to grow.

When it first came forth, its wings, were less than an inch in length, but they grew so rapidly that in fifteen minutes they were longer than its body; in twenty minutes they were of full length, but were still very soft.

The reason for the insect being so anxious to get the right position immediately after emerging from the cocoon is that if the wings are cramped or held in a wrong position, they harden thus and prevent it from flying.

The other moth came forth about half an hour after the first one. I covered it with a low glass cover for about fifteen minutes. It kept running around and turning over on its back in the vain attempt to assume an upright position. Removing the cover, I allowed it to climb an upright stick, when it immediately became quiet. Its wings, which had been slowly expanding, now began to develop as rapidly as in the first one, but its forced imprisonment had ruined its beauty. The hind wings were creased and crumpled so that it could not fly.

During the development of the wings I could see the pulsations in the body as the blood was forced into the tubes of the wings. WALTER A. LYNN.

Silo Presses and Ensilage.

The following is a description of a silo press erected at the Agricultural Experiment Station at Minneapolis, Minn. There are two presses located in the barn, each 16 ft. square and 21 ft. in height. They are so arranged that the top of each is on a level with the thrashing floor of the barn and the bottom is on a level with the basement stables, thus facilitating the feeding of the animals. To a height of 11 feet are walls of stone, 18 inches in thickness, above which the walls are wood. The bed is of concrete, composed of one part Louisville cement, two parts sand, with enough water and gravel added to make a stiff mortar. The floor has a slope of one inch to the center, where is located a well 2 feet in diameter and 4 feet deep, filled with gravel and stones, the bottom being left open. The walls are boarded up with matched flooring, a space being left between that and the main wall for ventilation. Two thicknesses of tarred paper is tacked on to this lining, and over the paper another covering of matched flooring nailed on vertically. This gives an air-tight, water-tight, and frost-proof silo, and one which is constructed to facilitate filling and feeding, and is admirably adapted for preserving the ensilage.

For the greater preservation of the wood, the partition walls are only carried within an inch and a half of the floor, and before filling the silo a strip of tarred paper is folded and nailed to a strip of board at the bottom, one-half of the tarred paper lying on the floor and being held firmly in place when the silo is filled by the ensilage. This makes an air-tight joint when the press is filled, and when it is empty the paper is raised or removed, and a free circulation of air is established, which purifies the chamber and dries and preserves the board partitions. This method of construction, with the use of an air chamber, has proved satisfactory, and in spite of very severe winters has prevented the contents from freezing.

It is well to bear in mind in constructing a silo that it is only a preserving can on a large scale, and the same rules should be observed in both cases. The timber used may be rough, but it is necessary to make a liberal use of tarred building paper. The walls of the silo must always be vertical, that the contents may readily settle by gravity. They must also be strong enough to withstand a strong lateral pressure. It is absolutely essential that the bottoms and walls be air and water tight. It is preferable to divide the space intended for the silo into three equal compartments, so that they may be filled alternately to a depth of four or five feet and then allowed to ferment, the heat rising to 100 or 140 degrees before the section is again filled. The silo in practical use should not be too large, as it is advantageous to remove an inch or more from the surface daily, the ensilage thus being always found sweet and pure and before any mould can gather thereon.

The report of the Department of Agriculture also issues the following directions on the preparation and treatment of ensilage: Although any plant or vegetable fit for cattle food when green may be preserved for an indefinite period in the silo, Indian corn is considered the cheapest and best for ensilage. Such varieties of the corn should be planted as will reach maturity in an ordinary season in the section of the country in which it is to be raised. Plant in rows wide enough to admit of easy cultivation and just thick enough to allow each stalk to form a well developed ear. The crop should be gathered when the grain is fully formed, but in the doughy state, at which period it contains the greatest amount of digestible matter. Corn partially dried is equally desirable for the silo. The corn should be cut in about one-half inch lengths.

In filling the silo, care should be taken to spread it evenly as put in, to pack the corners and sides firmly, to cover the top with a layer of boards or plank. Spread over this a double layer of tarred paper, and then a layer of rough boards, and on the whole a moderate weight of from fifty to one hundred pounds to the square foot. The weighting material may be anything convenient, sand, gravel, or dirt in barrels, stone, fire wood, farm implements, for storage and the like.

Pits should not be opened until fermentation has ceased and the mass has cooled, which will be in from six to eight weeks from the time of filling.

In feeding from the silo, it is better to feed day by day from the top in uniform layers, rather than from top to bottom, as by this method the surface is not exposed long enough to the air to become sour.

Ensilage can be grown and preserved much cheaper than root crops, by the ordinary farmer, and will successfully take their place in feeding value.

Corn ensilage is not a complete feeding ration, as it is deficient in protein, and this must be supplied by some by-fodder, as bran, shorts, or oil cake.

The best results of feeding ensilage are obtained by using it in combination with dry fodder, the best of which is clover hay.

Ensilage furnishes a succulent and easily digested food, greatly relished by all animals during the winter months, when their diet would otherwise be confined to a regime of dry provender. The cheapness and ease with which the silo can be constructed, the certainty with which, when properly constructed, it will preserve the feed from injury, the low cost of raising the crop, and the great yield per acre as compared with hay crops, and the value as a cattle food, render this the cheapest provender a stockman can raise.

Such are the directions given by this report and such are the deductions arrived at.

The Biggest Girders Yet.

In the new addition to the American Museum of Natural History will be used the largest box or riveted girders ever used in the construction of a building, says the New York *Times*. These girders were designed by J. Cleveland Cady, the architect, to support the floors and partitions, and thus obviate the use of pillars or columns, the object being to give unobstructed floor room for the display of specimens. There are twenty-eight of these girders, measuring about sixty-two feet in length, and weighing 40,000 pounds each. They were landed on the North River front of the city in the neighborhood of Fiftieth Street, and the possibilities of modern trucking have been taxed in vain to transport them to their destination at Manhattan Square.

The longest and strongest trucks to be found were brought into requisition, and with twelve horses harnessed to each truck the attempt began. One truck collapsed in Fifty-seventh Street near Tenth Avenue, another at Seventy-seventh Street and Ninth Avenue, while a third, which was fortunate enough to reach the square without mishap, buried its wheels to their hubs and stuck fast as soon as it left the pavement of the street. The contractors have therefore found it necessary to construct a tramway across the square from Ninth Avenue to the building for the transportation of the girders.

THE JOHNSTOWN DISASTER.

In our last issue we illustrated some of the features of the Johnstown disaster from sketches made on the spot by our special artist. These showed very clearly the general aspect of the scene after the water had done its work. These views we now supplement by reproductions of photographs of characteristic scenes which emphasize the resistless force of the torrent that swept down the Conemaugh valley. It is to be hoped that a tangible theory will be formulated by the committee of the American Society of Civil Engineers appointed to investigate the occurrence. It consists of the following members: J. Max Becker, president; James B. Francis, Wm. E. Worthen, ex-presidents; and A. Fteley. The latter gentleman is at present chief engineer of the new aqueduct. The society has delegated this committee to visit the scene of the disaster and report upon it.

The lesson, after all, seems to be the old one so often taught by engineering disasters, the necessity of allowing a large factor of safety. The late Alexander Holley spoke in his epigrammatic way of the factor of ignorance; this factor in the case of the dam and lake overflow was far too small.

The concurrent force of all the investigations made by engineers, including those specially detailed by our contemporary the *Engineering News*, is as follows: The spillway of the dam for nine years proved adequate for the overflow. On the day of the disaster its capacity was overtaxed. The water rose in the dam far above the level of its bottom. The pipes at the base were closed permanently. Had they been open, it has been calculated that they would not have sufficiently relieved the extra flood to have prevented the water from rising to the top of the dam. Moreover, the spillway was obstructed by a bridge, fish screen, and other obstacles which still further interfered with the outflow. The water began to pour over the crest, probably lowest at the center. The water pouring over the crest cut away the earthwork with greater rapidity, owing to its inferior construction. At every instant gaining strength, the great crevasse was soon made, and the lake emptied itself, with the disastrous results known to all. Had the spillway been of adequate size, the dam would have remained intact, and no life would have been lost.

The dam was originally built under the supervision of Mr. Wm. E. Morris, now deceased, who was principal assistant engineer of the Pennsylvania State canals. He had direct superintendence of the western division. Gen. Jas. N. Moorhead, also deceased, was constructing engineer in charge of the work. It was built of earth well rammed and watered and laid in horizontal layers. The remains of this structural feature are present in the step-like contour of the break. It was covered with rough stone on both faces. The five pipes that passed through its base were used for running off the water when it was required to feed the upper levels of the canal. They were not put in place to be used in an emergency only, but were part of the regular feeding apparatus of the canal system. When opened, the water ran down the South Fork and Little Conemaugh to Johnstown, where it entered the canal. About 1858 the use of the dam was abandoned by the State, and four years later the first break occurred. It was in July, 1862. The culvert through which the iron pipes were carried proved defective, and a quantity of water ran out beneath the dam. Little damage to outside property was done, but the dam was undermined and injured, and a depression was formed in its top. Incidentally, of course, the hard rammed layers were disturbed and disintegrated. After this accident the dam was left to itself with about ten feet of water in it until 1875. In May of this year it was bought by a private individual, who four years later sold it to three gentlemen, the organizers of the South Fork Hunting and Fishing Club. The dam was repaired, most of the work being executed in 1880. The five pipes at the base were permanently closed, and for nine years all went well. Eventually a heavy rainfall overtaxed the structure, and the great disaster occurred.

The dam cost, originally, $240,000. It covered an area of about 500 acres, impounding the water from fifty or sixty square miles of watershed. It was 72 feet high and 900 feet long, and formed a lake that held 480,000,000 cubic feet of water, or about 3,600,000,000 gallons. It has been spoken of as the largest artificial lake in the United States, but it was exceeded in size by the reservoirs formed by the following dams:

Croton dam, in New York—434 feet long, 284 feet being of masonry and the remainder of earth. The height is about 40 feet. The foundation of the dam consists of two lines of stone-filled cribs, with 10 feet of concrete between them. The down-stream face is curved, and faced with granite. A small crib dam 300 feet below forms a basin, which serves as a cushion to break the fall of the water. The back of the dam is filled with earth. Impounds 5,000,000,000 gallons.

Sweet Water dam, in National, Cal.—Rubble masonry in Portland cement; 98½ feet high, 46 feet thick at bottom and 12 feet at top. Of curved type, with radius of 213 feet; 360 feet long on crest. Impounds 6,000,000,000 gallons.

Dam at Oakland, Cal.—Earth, 80 feet high, 300 feet long, and 310 feet wide at base. Impounds 5,000,000,000 gallons.

Dam at Redland, Cal.—Bear Valley dam.—Granite masonry in cement; 64 feet high, 300 feet long, 20 feet thick at base, and 1⅜ feet at top. Curved type, with radius of 335 feet. Impounds 10,000,000,000 gallons.

Dam at San Mateo, Cal.—This is to be 170 feet high, 700 feet long, 176 feet thick at base and 20 feet thick on top. It is to be in Portland cement concrete masonry, and is to have a capacity of 32,000,000,000 gallons. It has only recently been begun.

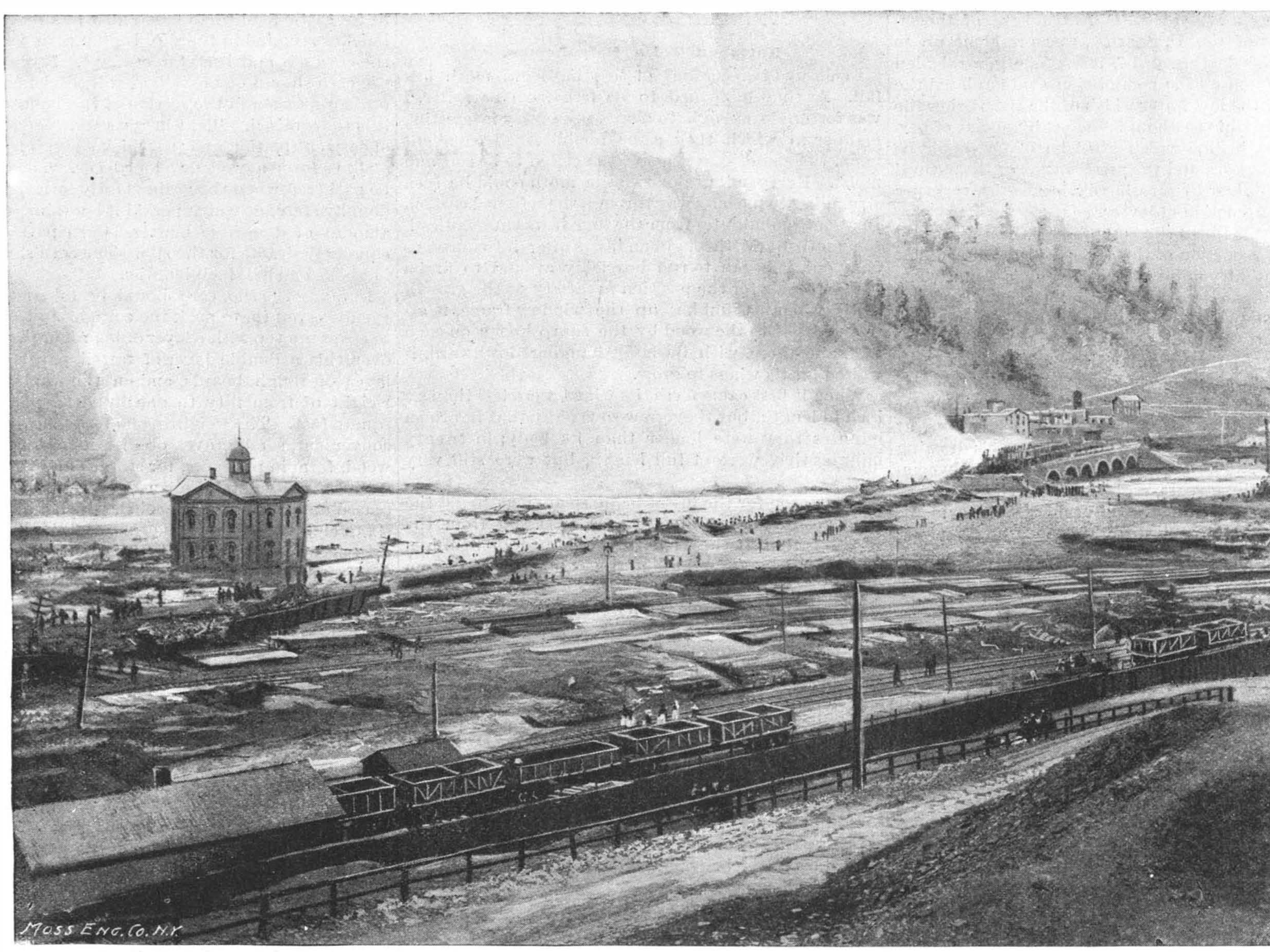
The Quaker Bridge dam will, of course, dwarf all these. It will be 265 feet high from bed rock, with a base 216 feet wide. Ninety-nine feet of its base will be beneath the lake bottom, so that the visible masonry will rise 166 feet. It will impound about 37,500,000,000 gallons of water, forming a lake sixteen miles long.

Apprehensions have been expressed as to the effects of its breaking down. Should such an accident occur, the present Croton dam, which will undoubtedly remain intact and submerged, will lessen, to some extent, the flood. The valley between the Quaker Bridge site and the Hudson River is only two miles long, and has no settlement of any importance in it.

At Johnstown the work of re-establishing the city has been actively carried on. Adjutant-General Hastings remains in charge of the work. A number of soldiers are encamped there for the preservation of order.

Work upon the gorge is still in progress. Stationary engines are in use to draw out the logs and heavier masses, large blasts of dynamite are applied to loosen the debris, and experienced loggers or raftsmen have proved of much help from their skill in handling floating timber. Corpses in an advanced state of decomposition are still found, over thirty having been discovered upon a single day last week. As fast as the remains of animals are extricated, they are burned upon the shores. A number of steam fire engines are on the ground, and have been utilized in pumping out the cellars.

The Pennsylvania railroad had about 3 miles of its roadbed washed away or buried beneath the debris. On the 13th of June, two weeks after the disaster, the line was again open and trains were running through to Pittsburg and the West. The engines carried away in the destruction of the Conemaugh round house were consolidation engines, and very heavy.



THE JOHNSTOWN DISASTER—THE SCHOOL HOUSE, THE ONLY BUILDING LEFT IN THE VICINITY. THE RAILWAY BRIDGE AND BURNING DEBRIS DRIVEN AGAINST IT.—(From a Photograph.)

None were carried less than 100 feet, some were transported 1,200 feet, and perhaps farther. Nearly twenty engines were scattered thus in all directions. Mr. McHenry, of the Cambria Iron Works, states that he saw an engine carried past that for an instant appeared to be floating on the surface of the water thirty feet above the ground. This gives an idea of the power of the water moving down the valley at such high velocity. For the excellent photographs herewith reproduced of the scene of the late disaster, we are indebted to the Dabbs photographic establishment, of Pittsburg, Pa.

The Polariscope as a Thermometer.

The polariscope has recently been applied in France to determining the temperature of incandescent iron and other metals. The color of a glowing mass of metal varies according to its temperature, and a ray of the light when polarized is rotated by a plate of quartz to a degree dependent upon the color. The degree of rotation is measured by the polariscope, and an empirical scale of temperature is thus obtained, which has been found very useful and reliable in metallurgical operations.

THE JOHNSTOWN DISASTER—VIEW ON ELM STREET.—[From a photograph.]

THE JOHNSTOWN DISASTER—VIEW ON MAIN STREET.—[From a photograph.]

Granite.

The essential components of the true granites are quartz and potash feldspar. Although the essential minerals are but two in number, the rocks are rendered complex by the presence of numerous accessories which essentially modify the appearances of the rocks, and those properties render them of importance as building stones. These additional minerals are either present in such amount as to be conspicuous and to exercise an influence upon the appearance and structure of the rock, when they are called characterizing accessories, or they are present in such small amount as to be invisible to the naked eye, when they are called microscopic accessories. If all the minerals which by careful examination have been found in granites should be considered as constituents of the rock, then the latter would appear as very complex. At least two-thirds of all the known elements exist in granitic rocks, and the number of minerals that are liable to be present in special cases is very large.

The following list does not include all of those minerals which have been identified in this rock, for many have been found under circumstances which are so isolated that their occurrence is entirely exceptional. All of the minerals in this list are liable to be found at any time, and may therefore be considered as common constituents of the rock, although the presence of them all together is not to be expected, and some of them may be present in such minute amount as to be of no practical importance. Any one of them, save the two essential constituents mentioned above, may be absent from an individual specimen or from a given locality; and any one may be present in the specimens from a given locality in such amount as to give a character to the rock. Thus almost any one of those minerals which are given as microscopic accessories may assume the character of a characterizing accessory; this is especially true of the iron oxides, which sometimes are present in such amounts as to become characteristic:

Essential:	Microscopic accessories:
Quartz.	Sphene.
Feldspar.	Zircon.
Orthoclase.	Garnet.
Microcline.	Danalite.
Albite.	Rutile.
Oligoclase.	Apatite.
Labradorite.	Pyrite.
	Pyrrhotite.
	Magnetite.
	Hematite.
	Titanic iron.
Characterizing accessories:	Decomposition products:
Mica.	Chlorite.
Muscovite.	Epidote.
Biotite.	Uralite.
Phlogopite.	Kaolin.
Lepidolite.	Iron oxides.
Hornblende.	Calcite.
Pyroxene.	Muscovite.
Epidote.	
Chlorite.	
Tourmaline.	
Acmite.	
	Inclosures in cavities:
	Water.
	Carbon dioxide.
	Sodium chloride (salt).
	Potassium chloride.

—*Prof. G. P. Merrill, in Gov. Report.*

The Elizabeth Thompson Science Fund.

The Elizabeth Thompson science fund, which has been established by Mrs. Elizabeth Thompson, of Stamford, Conn., "for the advancement and prosecution of scientific research in its broadest sense," now amounts to twenty-five thousand dollars. As accumulated income is again available, the trustees desire to receive applications for appropriations in aid of scientific work. This endowment is not for the benefit of any one department of science, but it is the intention of the trustees to give the preference to those investigations which cannot otherwise be provided for, which have for their object the advancement of human knowledge or the benefit of mankind in general, rather than to researches directed to the solution of questions of merely local importance. Applications for assistance from this fund, in order to receive consideration, must be accompanied by full information, especially in regard to the following points:

1. Precise amount required. 2. Exact nature of the investigation proposed. 3. Conditions under which the research is to be prosecuted. 4. Manner in which the appropriation asked for is to be expended. All applications should be forwarded to the secretary of the board of trustees, Dr. C. S. Minot, Harvard Medical School, Boston, Mass., U. S. A. It is intended to make new grants at the end of 1889. The trustees are disinclined, for the present, to make any grant exceeding five hundred dollars. Preference will be given to applications for smaller amounts. The following is the list of grants made: $200 to the New England Meteorological Society, for investigation of cyclonic movements in New England; $150 to Samuel Rideal, Esq., of University College, London, England, for investigations on the absorption of heat by odorous gases; $75 to H. M. Howe, Esq., of Boston, Mass., for the investigation of fusible slags of copper and lead smelting; $500 to Professor J. Rosenthal, of Erlangen, Germany, for investigations on animal heat in health and disease; $50 to Joseph Jastrow, Esq., of the Johns Hopkins University, Baltimore, Md., for investigations on the laws of psycho-physics; $200 to the Natural History Society of Montreal for the investigation of underground temperatures; $210 to Messrs. T. Elster and H. Geitel, of Wolfenbuttel, Germany, for researches on the electrization of gases by glowing bodies; $500 to Professor E. D. Cope, of Philadelphia, Pa., to assist in the preparation of his monograph on American fossil vertebrates; $125 to E. E. Prince, Esq., of St. Andrews, Scotland, for researches on the development and morphology of the limbs of teleosts; $250 to Herbert Tomlinson, Esq., of University College, England, for researches on the effects of stress and strain on the physical properties of matter; $200 to Professor Luigi Palmieri, of Naples, Italy, for the construction of an apparatus to be used in researches on atmospheric electricity; $200 to William H. Edwards, Esq., of Coalburg, W. Va., to assist the publication of his work on the butterflies of North America; $150 to the New England Meteorological Society, for the investigation of cyclonic phenomena in New England; $25 to Professor A. F. Marion, for researches on the fauna of brackish waters; $300 to Professor Carl Ludwig, for researches on muscular contraction, to be carried on under his direction by Dr. Paul Starke; $200 to Dr. Paul C. Freer, for the investigation of the chemical constitution of graphitic acid; $300 to Dr. G. Muller, for experiments on the resorption of light by the earth's atmosphere; $300 to Professor Gerhard Kruss, for the investigation of the elementary constitution of erbium and didymium; $50 to Dr. F. L. Hoorweg, for the investigation of the manner and velocity with which magnetism is propagated along an iron bar; $150 to Mr. William H. Edwards, to assist the publication of his work on North American butterflies.

The Forms of Leaves and their Uses.

Even the most cursory observer of vegetable life must have been often struck with the various forms of leaves. Why they should be so variously formed does not, however, often suggest itself, though there is a reason for the special shape and texture of almost every leaf in existence. Plants, such as grasses, daffodils, and others which usually grow in clusters, have generally narrow leaves growing upright, so as not to overshadow one another. Other plants, of isolated habits, have an arrangement of foliage which secures to themselves the space of ground necessary for their development. The daisy, dandelion, or shepherd's purse—which may mostly be seen in pastures—are examples of this. A circle of broad leaves pressed against the ground, forming what is known as a rosette growth, effectually bars the approach of any other plant and keeps clear from all other roots the space of ground necessary to its own nutriment. Floating leaves, and leaves of marsh plants, are usually of simple outline, for, having few competitors, they are not liable to get in one another's light. Submerged plants have mostly leaves of narrow segments—the reason for which is not very well understood, though it is assumed by naturalists that it is for the purpose of exposing as large a surface as possible, in order to extract the minute proportion of carbonic acid dissolved in a vast bulk of water.

Leaves on the boughs of trees are often much divided, so as to fold easily, to prevent their being rent and torn by high winds, while the glossy surface of evergreens is intended to throw off rain and dew, which might freeze on them, and so cause injury to the tissues within. But the hairs on the surface of leaves are perhaps the most interesting study of all. With the aid of a microscope, the beautiful and systematic arrangement of these can be easily discerned, and their uses understood. On many plants there are glandular hairs, to catch or deter small creeping insects; on others there are hairs set so as to act as effectively against young animals as a spike palisade against obtrusive boys; on others, hairs which arrest the drops of moisture and force them down the leaf-stalk, to moisten the earth about the roots; while others are protected by a series of poisoned stings. The ordinary nettle is an example of this, and the beauty and ingenuity of its mechanism is truly wonderful. Each nettle hair is armed with a brittle and pointed siliceous cap, which breaks off in the wound; and the poison is then able to flow out through a tubular hair, from a reservoir at its base. There is scarcely a form of leaf but is specially modified by nature for some particular purpose, and the discovery of this purpose is a source of very pleasant and profitable study to young naturalists.—*Horticultural Times.*

The Manchester Ship Canal.

Some interesting statistics were lately given by Mr. Alderman Bailey, one of the directors, with reference to the progress of this work. He stated that 15½ million tons of earth and rock had been excavated, and that 28 million tons more remained to be removed. It was anticipated that the work would be finished in two years from 1st of January next. There were on the works 183 pumping engines, 82 steam navvies, 5,000 wagons, 158 locomotives, and 116 steam cranes, and in a few months 15,000 men would be employed. He further gave some particulars as to the cost of haulage of one ton, which was stated to be 6d. per mile on the highways, 2d. on the railways, 1-66d. per mile on the Leeds and Liverpool Canal, 1-116d. per mile on the Aire and Calder Navigation, and between New York and Liverpool about 1-300d. per mile.

Natural Gas in the Manufacture of Steel.

The process of James J. McTighe, of Pittsburg, for manufacturing steel is applicable to the production of the various grades thereof, from the soft kinds used for sheets and rails to that employed in the production of tools, needles, surgical instruments, etc.

He describes the process as follows: It has commonly been held that the brittleness of iron or steely irons is due, according as the iron is hot or cold, to the presence of an excess of sulphur or phosphorus. Discarding this theory, and assuming that the "cold-shortness" or "red-shortness" of iron or steel is due principally to an admixture of oxide of iron, I have devised a new method or process of manufacturing carburized iron, according to which, even though both sulphur and phosphorus be in excess in the metal, it is exceedingly ductile when of the soft variety and having the qualities demanded in steel intended for widely different purposes.

Hitherto in the manufacture of ordinary steel of low grades—such, for instance, as is used for rails, boiler plate, etc.—it has been customary to desiliconize and decarburize molten cast iron by blowing air over or through it. It is an acknowledged fact that this air leaves an oxide of iron mixed with the mass.

My invention has for its object to rid the entire mass of iron of all this injurious oxide as well as to recarburize it to the required degree, as also to purify it by the extraction of phosphorus, sulphur, etc.; and to these ends my invention consists in the combination of two processes—the one being the treatment of any kind of molten ferric compound, usually called "cast iron," by air or oxygen for the purpose of desiliconizing, decarburizing, and oxidizing the other being the, treatment of the same after the first step by commercial marsh gas, commonly known as "natural gas."

The first process need not be described, as it is practiced now in a variety of ways, and is well known to commerce as the "Bessemer" or "Siemens-Martin" method.

The second process consists in forcing natural gas through or over the bath of molten iron produced by the first process. The *rationale* of this second process is as follows: The gas disassociates the instant it comes in contact with the molten iron, as it always does in the presence of great heat, the carbon and hydrogen both assuming the nascent state. Carbon having in the presence of heat a great affinity for oxygen, deoxidizes the oxide of iron existing in the mass, thus producing a certain quantity of heat calculated to keep the mass in a molten condition. Hydrogen, on account of a similar affinity, assists in this reaction and result, and the twofold product—carbonic oxide or acid and hydric oxide—passes off as waste, the developed heat effectually preventing the chilling of the mass in the converting vessel. Simultaneously a further quantity of nascent hydrogen combines with portions of the sulphur and phosphorus, and forms, respectively, sulphureted and phosphureted hydrogen, which pass off as vapors, thus further purifying the product. It is also probable that a portion of the nascent carbon will unite with some of the sulphur to form bisulphide of carbon—another vapor that is at once carried off. A certain quantity of the nascent carbon unites with the molten mass of iron to form steel, which will be of high or low grade, according to the duration of the required described reaction.

The special features in the use of natural gas are:

First, its entire freedom from elements which might prove injurious to the steel, especially sulphur and phosphorus. This feature is not found in any gas made from any kind of coal.

Secondly, in the comparatively low amount of carbon it contains, it being almost entirely marsh gas.

All other gases made from petroleums, oils, fat, etc., are very rich in carbon. When such carbons are brought into contact with molten iron, the amount of carbon disassociated by heat is so great as to chill the mass at once or leave flakes of uncombined carbon distributed throughout the mass, which, when the iron is rolled into thin sheets, appear on the surface and effectually prevent its being properly galvanized or tinned. The percentage of nitrogen and free hydrogen shown by some analyses to be in natural gas obviously diminishes the risk of producing such carbon flake.

By the use of natural gas a practical and cheap substitute is obtained in place of the expensive spiegel iron heretofore adopted, and a fine quality of excellent steel of any desired grade is obtained economically and commercially, the same furnace producing, as desired, rails or plate, or sheet or razor, or wire, or cast or malleable steel, a result heretofore never hoped for. These various grades of steel will follow the varying amounts of carbon allowed to combine with the molten iron, and they can be in practice regulated with the scientific precision of chemistry.

RECENTLY PATENTED INVENTIONS.

Railway Appliances.

CAR AXLE BOX. — Edward Leslie, Orangeville, Ontario, Canada. The bearing herein provided for is adapted for the standard box, the angular motion of the axle being allowed for, while a narrow bearing brass can be used, which is properly supported at the upper part, a flat key fitting into the casing provided with a central aperture, while an intermediate plate is held on the under side of the key with a circular offset fitting into the aperture of the key.

CAR PLATFORM.—Robert S. C. Fuller, New York City. An auxiliary platform, capable of independent movement, is pivoted on the rigid platform of the car, whereby, when the cars are coupled, the platform of one will meet that of the opposing car, the platforms remaining in contact throughout their width irrespective of the curves of the road, while a gate folding at the side of the car may be opened to extend from one car to the other parallel with the outer sill of the platform.

CAR PUSHER.—Joseph C. Chrisman, Sewell Depot, West Va. This device is intended especially for pushing cars in coal mines, as well as for other uses, and has a base formed of two foot sections adapted to slip in one direction along the rail, and to clamp against any reverse movement, a slide bar being connected with one of the sections and sliding through the other, with lever connections between the latter section and the slide bar and a push bar or rod.

TRACK PLOW.—Edward Leslie, Orangeville, Ontario, Canada. This is an ice or snow plow designed to loosen any hardened snow or ice immediately next to the track, and having a flanger mechanism to remove snow or ice in proximity to the inside of the rail and discharge it a sufficient distance from the track to prevent its falling back.

Electrical.

BRUSH HOLDER FOR DYNAMOS. — Walter S. Bishop, New Haven, Conn. This is a simple and efficient device for holding the brush in the position of use with a light and uniform pressure, the brush being rendered adjustable in the holder by a positive screw movement, the brush-holding arm being pushed forward into contact with the commutator cylinder by a spiral spring, while there is an adjusting screw for moving the brush backward and forward through the brush socket.

ELECTRICALLY CONTROLLED ENGINE. —James E. Byrne, Brooklyn, N. Y. This invention relates to a hydraulic engine operating in connection with sheaves and cables, the latter attached to a car or cage to move it up and down, and provides means whereby the controlling valve is operated by electricity from the car instead of by hand power, and also for automatically reversing the car switch when the car reaches its upper or lower limits of travel.

Mechanical.

ANTI-FRICTION BEARING. — Bethuel G. and George H. Handy, Monroe, N. Y. This is a roller bushing for sheaves in which there is a rotary tubular box within an outer casing, and a series of rollers journaled in the box parallel with its axis, the faces of the rollers contacting with the inner side of the casing, and there being a space between the outer surface of the box and the rollers to prevent frictional contact.

PIPE TESTING MACHINE. — Michael Sexton, New York City. This invention provides for the use at each end of the pipe to be tested of a frame carrying a clamp screw with a packed head, one of the two clamp heads being provided with a testing fluid inlet, whereby water, steam, air, or other fluid may be forced into the pipe from a compressing apparatus, at any desired pressure, to discover sand or blow holes, splits, etc.

WATER WHEEL. — James T. Rohm, Locust Grove, Pa. Mounted in a closed casing is an upper horizontal rimless water wheel, having inclined buckets, and a lower horizontal water wheel having oppositely inclined buckets, with a surrounding rim extending upwardly and inclosing the other wheel, the opposite rotary motion of the two wheels being transmitted in one direction to a gear wheel.

LEVER FOR LOOMS.—Joseph A. Evans, Philadelphia, Pa. This is a shuttle-box-operating lever designed to improve the box lever of a power loom adapted for weaving fancy fabrics by making the lever in two parts and jointing it to work as freely as a solid lever, yet yield at the center to permit both ends to go up, should the plunger be arrested in its upward movement from the anchor wings becoming locked.

SPRAY CYLINDER FOR PAPER MACHINES.—Granville D. Crance, Valatie, N. Y. This invention covers a spray cylinder cleaner in which the cylinder has an extension at one end and a discharge pipe at the other, a rod with a handle fitting in one end of the cylinder, while at the other end of the rod is a swab, which is to be reciprocated in the cylinder for readily cleaning it.

Agricultural.

DISK HARROW. — George T. Booth, Christchurch, New Zealand. This invention provides means for securing the disks more firmly on the bolt or axle, to prevent excessive wear and tear, and also to regulate the pressure of the disks on the soil, and so that the pressure may be transferred to the outer or inner end of the disk bar, while wheels and axles are provided, so that the disks may be carried well clear of the ground while traveling.

COTTON HARVESTER. — Richard H. Purnell, Rosedale, Miss. This is a machine for picking cotton from the rows of plants in the field, a principal object being to prevent the team from knocking out the ripe cotton, for which the picking box is made to operate at two rows distant from the team, so that there will be between the team and the row of cotton being picked a row of picked plants, thus saving great waste.

HAY RAKE AND BALING PRESS. — John A. Hooton and Gilbert L. Wiard, Atkinson, Neb. This invention covers a combined machine of a hay rake and double baling press, with elevator, longitudinally extending baling boxes with alternately operating plungers, and a feeder delivering alternately into the boxes, taking up the hay from the swath, baling it, and dropping the finished bales in the field.

Miscellaneous.

STAMP CANCELER. — Benjamin Summers, Petersburg, Penn. This canceler has a main plate with a handle and parallel cheek pieces in combination with a tumbler, to which a rod is connected, blocks being held in ways between the cheek pieces and connected to the tumbler, whereby the down thrust of the handle will move the blocks in a straight line between the cheek pieces.

GRATE. — Salvatore J. Buzzini, New York City. This invention relates to grates for stoves, ranges, etc., the grates being made to reciprocate or shake preferably in straight horizontal directions to free the grate and fuel from ashes, and to swing to one side to dump the contents of the fire box, the invention covering various novel arrangements and combinations of parts.

COATING PAPER. — George Manahan and Henry Gade, New York City. This invention covers an apparatus for applying to one side of a web compositions of various kinds in a fluid form, provision being made for the required varying amount of the acting smearing surface, and the apparatus being mainly intended to be used in applying a preservative and weather proof composition to a web of paper for making sheathing or building paper.

Business and Personal.

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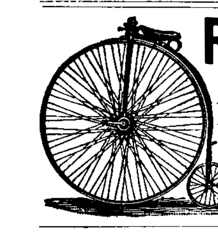

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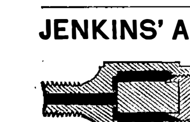

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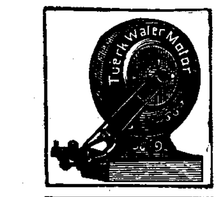

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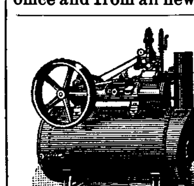

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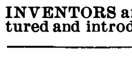

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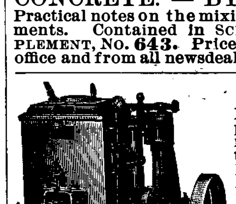

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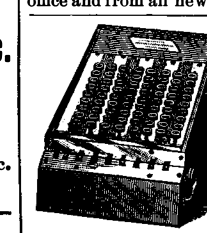

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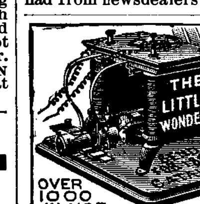

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