dangers a staging with intermediate supports would have had to encounter. Moreover, it was desirable that any staging should be practically clear of cold seasons, minor floods, and should allow of a rise in the river of at least 30 feet without causing any material obstruction to the waterway.

The perspective view shows the staging in course of construction. It consisted of a series of long struts springing from a point near the base of each pier, and spreading out in a fan to support a horizontal beam of double whole timbers on which the platform was laid for erecting the girders. The corresponding struts in the up and down stream fans (which were 19 feet apart center to center, the same distance as the girders) were connected by horizontal braces, each brace being a pair of half timbers bolted together with the struts between them, and with diagonal struts in the rectangle between each pair of horizontal bracings. At equal vertical distances of 12 feet, ledgers of half timbers in pairs connected all the main struts of each fan with each other and with the main column of the pier with which they were in line, being clamped to the columns by heavy wrought iron straps. The outer main struts were built up of whole timbers clamped together, commencing at the bottom with three, one of which eventually branched into a secondary strut. Similarly the vertical next the pier commenced with two whole timbers, and divided afterward into two struts. At the level of each tier of ledgers above the fourth, counting from the bottom, sets of one inch chain horizontal diagonal bracings were put in. These chains were drawn tight by ordinary wagon screw couplings, four hundred of which were got out from England specially for the work.

The two outermost struts from opposite sides were connected at top by a beam of the same section being dropped in before the sill pieces were laid. This beam was 63 feet long and of sal wood (the rest of the staging being deodar), and was trussed by three vertical struts, 10 feet deep, with rods of 2 inches round iron forming a queen truss of 63 feet span. When in place this trussed beam, together with the long struts which it connected, formed a gigantic strut and straining beam truss under the sill pieces.

During erection and until the straining beams were in place each fan was tied back to the main column of the pier with which it was in line by the ledgers, which for the time had to bear a considerable amount of tension.

The timber readily procurable on the Indus does not exceed an average of 22 feet in length, and the number of joints in the work was therefore very great. The stagings were built out from the piers piece by piece, beginning with the vertical struts next the piers, which were soon carried up to their full height. To facilitate the hoisting of the timbers into place, two pairs of Manila 9 inch hawsers were stretched across each span, from the top of the 250 foot completed girders at the shore ends and over a pyramid of sleepers placed on the top of the center pier. From these hawsers tackles were suspended at convenient points as the work progressed.

When the building out of the fan portions was completed, rails were laid on the sills, and two large temporary cranes made for the purpose were moved out to the extremities. The 63 foot trusses were then built on boats, were brought under the cranes, and were raised into place, the cast iron angle sockets at the ends of the straining beams being dropped over the ends of the long struts, which were sprung back slightly to allow of this being done. When these were in place, the sill piece was completed over the top and the platform laid on, a line of rails to the meter gauge being put upon it to bring out the girder material. These stagings proved very satisfactory; levels were taken daily at several points during the time the girders were being built, to test the stagings for settlement, and, notwithstanding the great number of joints, the maximum deflection of the platforms under the full weight of over 600 tons (in addition to the weight of the staging itself) was only $1\frac{1}{8}$ inches. The stagings were by far the most difficult, as well as tedious, part of the work of the construction of the bridge.

Heating by Electricity.

A correspondent in *The Electrician* gives the following reasons why electricity for heating purposes cannot be economically employed, if a steam or gas engine is used to produce the current in the first instance.

In the first case, one-tenth of the heat of the coal only is recovered; then, say, 25 per cent of power is lost in the dynamo; and finally, 25 per cent or more lost on conversion of the current into heat. Thus we get $0{\cdot}1 \times 0{\cdot}75 \times 0{\cdot}75$ of the heat of the coal $= 0{\cdot}05625$, or say, at best, $\frac{1}{20}$ only. Even if coal were burnt in an open fireplace, not more than half the heat is lost. With a gas engine matters are not much better. In short, taking the expense of machinery, etc., into consideration, it is fair to assume that heating by electricity is at least 50 or 60 times more expensive than burning coal direct in the most approved stoves, and 25 to 30 times dearer than coal burnt in an open fire.

Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

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

TERMS FOR THE SCIENTIFIC AMERICAN.

One copy, one year, postage included..... $3 20
One copy, six months, postage included..... 1 60

Clubs.—One extra copy of THE SCIENTIFIC AMERICAN will be supplied gratis for every club of five subscribers at $3.20 each; additional copies at same proportionate rate. Postage prepaid.

Remit by postal order. Address

MUNN & CO., 361 Broadway, corner of Franklin Street, New York.

The Scientific American Supplement

is a distinct paper from the SCIENTIFIC AMERICAN. THE SUPPLEMENT is issued weekly. Every number contains 16 octavo pages, uniform in size with SCIENTIFIC AMERICAN. Terms of subscription for SUPPLEMENT, $5.00 a year, postage paid, to subscribers. Single copies, 10 cents. Sold by all newsdealers throughout the country.

Combined Rates.—The SCIENTIFIC AMERICAN and SUPPLEMENT will be sent for one year, postage free, on receipt of *seven dollars*. Both papers to one address or different addresses as desired.

The safest way to remit is by draft, postal order, or registered letter. Address MUNN & CO., 361 Broadway, corner of Franklin Street, New York.

Scientific American Export Edition.

The SCIENTIFIC AMERICAN Export Edition is a large and splendid periodical, issued once a month. Each number contains about one hundred large quarto pages, profusely illustrated, embracing: (1.) Most of the plates and pages of the four preceding weekly issues of the SCIENTIFIC AMERICAN, with its splendid engravings and valuable information; (2.) Commercial, trade, and manufacturing announcements of leading houses. Terms for Export Edition, $5.00 a year, sent prepaid to any part of the world. Single copies, 50 cents. ☞ Manufacturers and others who desire to secure foreign trade may have large and handsomely displayed announcements published in this edition at a very moderate cost.

The SCIENTIFIC AMERICAN Export Edition has a large guaranteed circulation in all commercial places throughout the world. Address MUNN & CO., 361 Broadway, corner of Franklin Street, New York.

NEW YORK, SATURDAY, FEBRUARY 7, 1885.

Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF

THE SCIENTIFIC AMERICAN SUPPLEMENT,

No. 475,

For the Week Ending February 7, 1885.

Price 10 cents. For sale by all newsdealers.

ENCKE'S COMET.

There is an excitement in the celestial court. Encke's comet has arrived, and star gazers are turning their telescopes to the skies in eager haste to obtain a glimpse of the distinguished visitor. Our eccentric guest is not a prince among comets. It is not a *cometa horrendae magnitudinis*, like those members of the family that in the olden times swept over the heavens, and threw the beholders into an agony of superstitious terror. It does not burst upon the astonished gaze at noonday with a brilliancy akin to that of the sun; its tail is not curved like a Turkish cimeter, nor does it branch out into six tails, each 6,000,000 miles long. It does not span the celestial vault from horizon to zenith; there is no danger of its being considered the harbinger of war, pestilence, and the day of judgment; and there will be no prayers read in the churches beseeching deliverance from "the Turk, the devil, and the comet."

Encke's comet is interesting chiefly for being the first known comet of a short period, for making the shortest circuit of any member of its class, for performing its revolution within the boundaries of the solar system, and for the reason that it seems to be more amenable to physical law than some of the more imposing members of the cometary family, those vast ethereal creations that visit our domain and then rush off into fathomless space,

"On the long travel of a thousand years."

This comet has a history. It is known as Encke's comet because the distinguished German astronomer was the first to carefully investigate its motion. It was first detected in 1786, again by Miss Caroline Herschel in 1795, again in 1805, and finally by Pons, the great comet finder, in 1818. He found on calculating its orbit that it was identical with the comet of 1805, but made no estimate of the length of the period. Encke then took up the task, and studied its movements with a thoroughness before unknown. He established beyond a doubt that the comet's orbit was an ellipse, that its period was about 1,212 days, and that it had made four complete revolutions between 1805 and 1818. These facts being sure, there was no difficulty in identifying it with the comets of 1786 and 1795, and in concluding that in the intermediate returns to perihelion its position had been so unfavorable that it was not seen.

Encke predicted its return in 1822, pointed out the position it would occupy among the stars, and also announced that it would be visible only in the southern hemisphere. He had the happiness of seeing his predictions verified by the observations of an astronomer in New South Wales, who followed the comet during its whole visible course.

Since that time this eccentric visitor has not failed to return to perihelion very nearly at the computed time, although at some returns it has been visible only in the southern hemisphere, and at other returns it position has been so unfavorable that the closest scrutiny has been of no avail in picking it up. Encke's comet is a veteran among comets of a short period, reaching next January the centennial anniversary of its discovery. Why should not the event be celebrated? It deserves to be, for this eccentric member of the system is an exceptionally well behaved comet, except in the matter of yielding to the influence of a resisting medium or some other mysterious power. It has neither been turned into a new path by the disturbing form of Jupiter—sometimes its near neighbor—nor has it split in two parts like Biela's comet, nor is it disintegrating into meteors, like Tempel's comet and the second comet of 1862, that lead the long procession of meteors in the November and August meteor zones.

The orbit of Encke's comet is an ellipse, inclined at an angle of 13° to the plane of the earth's orbit. At perihelion it is 31,000,000 miles, and at aphelion 377,000,000 miles from the sun. Its perihelion is between the sun and Mercury, and its aphelion is between Jupiter and the asteroids. Its motion is from west to east, and its revolution, in the days of its early history, was performed in about 1,212 days.

Encke's comet is by no means a remarkable one. It is a telescopic comet, and consists of a patch of circular light, somewhat condensed toward the center. Though usually visible only through the telescope, it has been seen by the naked eye. Such was its appearance in 1828, when it was in an exceptionally favorable position for observation, and its light was equivalent to a star of the fifth magnitude. At common times there is little trace of a tail, but, on rare occasions, a slight one has been detected, like a faint brush of light, and sometimes with a second appendage opposite the first. Its tenuity is so great that, at its return in 1878, the center of the comet passed directly over a star of the tenth magnitude lying in its path. The star was undimmed by the transit of the densest portion of the comet, and shone through the misty medium as brightly as it had before shone against the dark background of the sky.

This insignificant mass of nebulosity has been of use to astronomers. When at its nearest point to Jupiter, the mass of the huge planet was more accurately determined by means of its "excessive perturbations." In the same way, when it was nearest to Mercury, it was

the means of detecting an error in the mass of the fiery little orb.

But the movements of comets, like "the course of true love, never did run smooth." This member of the family does not complete its revolution on time. Its periodic time is constantly diminishing. Its circuits round the sun grow less and less. The German astronomer did not fail to attack the problem, indeed, he may be said to have devoted the labor of his life to its solution. His conclusion was, that the comet met with a resisting medium in space, a medium too ethereal to disturb such masses as the planets are made of, but powerful enough to affect a body of extreme tenuity like a comet. This theory has it supporters and its opponents, but no other comet, as far as is known, is affected in the same way. The existence of a resisting medium in interplanetary space, and the cause of the retardation of Encke's comet, are still mooted questions that vex the astronomical soul. At any rate, the comet's period is now about 4 days less than it was at the time of its first computation in 1819. The effect of retardation will be to diminish the comet's velocity in its orbit, in consequence of which it will be drawn nearer to the sun. The final result will be that, ages hence, the comet will be precipitated into the sun.

Encke's comet, at its present return, was first seen on the 13th of December, by Herr Tempel of the Arcetri Observatory, Florence, and is described as a faint, nebulous looking object. It was seen on the 17th of December by Professor Young, of the Halstead Observatory. He describes it as extremely faint and somewhat irregular in outline. The best view, thus far reported, was obtained on the 5th of January, by Professor Brooks, of the Red House Observatory at Phelps, New York. He describes it as faint, slightly elongated, and with a small central condensation. It was then in the head of the Western Fish, and moving slowly eastward. It makes its perihelion passage on the 7th of March, will grow brighter until that time, and will soon be visible in small telescopes. The comet was last in perihelion on the 15th of November, 1881. Its period of revolution is now about 1207·86 days, nearly 4 days less than when its orbit was determined by Encke in 1819.

SHOP DRIVING.

There are men who get position by audacity, and not by merit. Such men are sometimes found in the workshop in the position of foremen or bosses, and they make trouble for men and expense for proprietors. Such a foreman appears, always, as though in a great hurry; gives short replies to questions, as though time and words were exceedingly valuable with him; rushes about the shop as though pursued by a constable with an uncollected debt against him; and turns from a possible customer at an important point in conversation to attend to a trifle that would more appropriately be left to a subordinate.

Among the workmen such foremen are troublous; they make quiet workers nervous, unfinished workmen apprehensive, and old stagers angry. They upset the plans of careful, systematic workmen, and induce the "green hand" to imagine that pretense of doing is as good as done. Such a foreman does other mischief; he is not content with infecting others with his superficial activity; he injures the self-respect of the workman, and impairs his usefulness. With the useless drive that comes with the foreman when he goes the rounds of the shop, comes the expectation of relaxation when he goes, and this letting down of workmanlike energy is a natural rebound from the pressure of a strain that is repulsive. This foreman never commends; he criticises and questions. "What! these studs not yet turned? What's the trouble?" "Be sure and get this fit right; don't you know how to do this job?" Such greetings do not put much force into a workman's muscles, nor increase his desire to excel.

These men are north winds or western gales with a notification to all to lie low. They impose for a while even on the workmen, but the workmen find them out sooner than do the shop proprietors.

ASBESTOS IN MECHANICS.

The incombustible and heat-enduring quality of the mineral asbestos has always recommended it for certain purposes; but it is not until within a comparatively recent period that it has come into extensive use in the mechanic arts. For sheathing steam pipes and for steam packing, preparations of asbestos are undeniably valuable, but recently it has been applied to the packing of cocks—plug cocks—for steam, hot water, and acids, with excellent results. The principle of its application is that of a packing, except that, instead of the packing being applied only at one or both ends of the plug of the cock, it extends its entire length. If the plug of a cock is ground to seat, it must be reground as often as it wears to a leak, and under the cutting influence of high pressure steam this wear is very rapid. The plug and its case do not always expand alike under steam heat, and this causes either leaking or binding.

The asbestos, being in the form of disintegrated fibers, lacks the cohesiveness necessary for keeping in place as a packing, and therefore a small proportion of rubber is used as a cement. The proportion of rubber is very small, being from one to six by weight, down to one to twelve by weight, and as asbestos is very light, the amount of rubber is only enough to unite the asbestos fibers. The prepared asbestos is tamped into longitudinal channels in the case or shell of the cock, the channels being four in number, equidistant, and cut in dovetail section, so that the packing may be retained in place. The tamping or driving in of the packing is done by means of set chisels or tamping pins and hammers while the plug is in place, and when the packing is completed, the cock, with its packing, is submitted to a heat of from 340° to 360° Fah. by means of superheated steam at 145 pounds pressure, which vulcanizes the rubber, and makes a solid of the asbestos and rubber combined. This heat and pressure is greater than any steam cock will ever be made to bear so that the packing is practically indestructible by steam.

From this description it will be seen that the plug of the cock has a bearing on four longitudinal packings, its entire length, instead of a solid circumferential bearing, metal to metal. The slight elasticity of the packing allows for unequal expansion of the plug and case, keeping the plug always tight. The packing also reduces the friction of the plug in its case, so that a cock of four inches diameter can be opened and closed with very slight exertion. A ring or washer of the packing is also used at the top and bottom of the plug.

In connection with the Barff process of coating iron, indestructible cocks are made of iron with this packing at a much lower cost than those of brass or gun metal. The Barffed cocks cannot rust, and their surfaces are like hardened cast steel for durability. This method of using asbestos is an English invention, but it has recently been put in practice by a firm in Hartford, Conn., acting under the original English patents. They intend, also, to manufacture this packing in glands for pump and steam packing, for manholes, handholes, and other purposes.

The New Orleans Exposition.

Notwithstanding all the complaints that have been made, the great Exposition is admitted on all sides to be wonderfully interesting. The exhibits, as they now stand, will compare favorably in extent, variety, and attractiveness with those of the Centennial Exhibition at Philadelphia in 1876, although some departments are yet incomplete. Visitors from the North seem never to be tired of roaming over the grounds, now that days of warmth and brightness have succeeded to the dismal weather which marked the opening weeks; the grass is of luxuriant growth, newly-planted shrubbery is sprouting, rose twigs from California are beginning to leaf, and tropical plants of almost indescribable variety contribute their portion toward making a scene of beauty which it would be hard at present to match in any other locality in our own country, if indeed its counterpart could be found in any part of the world.

The feeling of uncertainty regarding the financial prospects of the enterprise, on which, of course, largely depends the smooth working of the show in a great many respects, has been almost entirely removed by the action of the N. O. Cotton Exchange. Director-General Burke asked that body for $60,000, which was promptly raised, and the money used for indebtedness for current expenses, that had got in arrears, owing to delays in getting things in order and the restriction of attendance by the bad weather of the first few weeks. For the last week, however, the main building has been in quite a presentable condition, the boxes, crates, etc., in which goods were packed having generally been removed, while the workmen have put most of the final touches on the stands of the different exhibitors.

The main building, covering more than thirty-three acres, offers never-ending subjects of interest to the visitor, as those will appreciate who remember the amount of time required to obtain any adequate idea of what was contained in the principal structure at Philadelphia, which was only about half its size. Here is presented a representative panorama, through its broad vistas, of the productions and resources of the United States and nearly all foreign countries. It is the greatest school for the dissemination of practical and useful knowledge in the world to-day; the mechanic, the engineer, the farmer—the producer in every walk of life—can here find food for study, with amplest exemplifications of the experience of others, and the would-be man of the world can, figuratively, go into all foreign countries and learn much of their productions and characteristics—all under the same roof.

One of the most complete industrial exhibitions in the main building is that of a Connecticut company making cotton thread. In this display is also included an automatic spool turning machine, where the workman puts armfuls of small cylinders of wood into a hopper, and they come out perfectly made spools. The cotton is taken from the bale here, and goes through all the processes of manufacture till it is finally wound on the spools—eight spools of 200 yards of thread each a minute—when these spools are put into a slide, the labels cut and pasted, and they are ready for boxing—the entire work requiring twenty machines, and the exhibit taking up a space of 24 by 260 feet.

In cotton working and other machinery the Patent Office makes a most interesting display, the growth and development of many of our industries being shown by means of the models of labor-saving appliances. Perhaps the most historically interesting is the model of the original cotton gin invented by Eli Whitney. There is also a model of a contrivance for lifting vessels over shoals, patented by Abraham Lincoln; and another of the Hoe cylinder printing press.

Of interest to those concerned in ship building will be the large collection of models furnished by the United States Government, while the Smithsonian Institution exhibit shows the styles of marine architecture prevalent in various eras and nations, and the Army Department exhibits craft adapted for hospital purposes. Pusey & Jones, of Wilmington, Del., exhibit a handsome model of the iron steamship Hudson, built by them, and plying between New Orleans and New York. The hull is of iron, and the deckhouses, masts, spars, and trimmings are of silver with gold decorations. John Roach also has an expensive collection of models of merchantmen, passenger steamers, and war vessels.

The Chinese exhibit presents many novelties, some of which it is rather difficult for our citizens to comprehend. One of these is a model of a primitive irrigating pump, a hand pump showing one end in the water, and the power applied by a man treading around on a series of handles that project from the top piece; there is also one worked by ox power, the animal turning a crank. One significant feature in this department is the display of cotton cloth of all grades, from the coarsest bagging to a quality so fine as to be more valuable than silk goods. This is a "cotton centennial," it is true, but more than two thousand years before modern industry found profitable employment in working up this fiber for universal use, cotton was largely used in the domestic manufactures of India; and two centuries before the Christian era cotton cloth was either paid in tribute or offered in presents to the Emperors of China as a thing rare and precious, and some of these gossamer filaments are on exhibition here by the side of the products of our modern factories.

The National Cotton Planters' Association will assemble here on February 10, and President Arthur has accepted the invitation of the president of the association to be present. Cotton men from all parts of the world have responded favorably to the invitation sent out by the association through Secretary of State Frelinghuysen, and it will undoubtedly be the greatest assemblage of cotton men the world has ever seen.

The horticultural department of the exhibition received an immense impetus from the recent assembling here of the Mississippi Valley Horticultural Society, which had been given the especial charge of organizing such exhibits.

The society undertook to make a display which would give "large opportunity to study the effects of climate and soil, of latitude and longitude and altitude, in the modification of plant and tree growths, and upon the size, form, texture, quality, durability, and beauty of the fruits of the world," a task to which it has devoted the most earnest effort, and in which it has accomplished great results. Over 8,000 specimens of forest, fruit, and ornamental trees were planted in the exhibition park, the California tree exhibit alone including over 700 species. There is a valuable and complete classified collection of American grape vines, and one bed alone contains 20,000 hyacinths, the total planting of these bulbs by one house amounting to 230,000.

The facilities for the accommodation of visitors and to promote their convenience in attending the exposition are now better than they were immediately after the opening. The buildings are about six miles from the heart of the city, and are reached either by the horse car lines or by steamboats on the river, but the work of getting to and from the grounds should, and probably will, be materially lessened with the coming of the additional crowds expected during February, March, and April. The managers have lately organized a department of information and accommodation for visitors, and are now furnishing lists of places where board and lodging can be had, with prices. The charge for furnished rooms, on the schedule thus made, runs from 50 cents to $2.00 per day, and for board and lodging from $1.50 to $3.50 per day, with, of course, material reductions for weekly or monthly guests. Circulars are also issued giving other valuable information to strangers visiting the city. * *

New Orleans, January 29, 1885.

The Electric Light as a Scarf Pin.

Messrs. Stout, Meadowcroft & Co., whose advertisement appears in another column, are now supplying these curious little electrical devices in first class style. It consists of a miniature Edison electrical lamp, attached to a pin, which is fastened in the scarf or necktie. A couple of fine wires lead from the lamp to a small battery, made in the form of a book and carried in the pocket. By touching a button, also arranged in one's pocket, the necktie lamp is instantly lighted, and continues as long as the button is pressed. The battery becomes exhausted after considerable use, but may be easily replenished. This is a device of genuine excellence, and well illustrates the progress of practical electricity.