Scientific American,

MUNN & COMPANY, Editors and Proprietors.

PUBLISHED WEEKLY AT
NO. 37 PARK ROW (PARK BUILDING), NEW YORK.

C. D. MUNN. S. H. WALES. A. E. BEACH.

VOL. XXII., No. 16 . . [NEW SERIES.] . . *Twenty-fifth* Year.

NEW YORK, SATURDAY, APRIL 16, 1870.

Contents:

(Illustrated articles are marked with an asterisk.)

INTERNATIONAL EXHIBITION OF 1871, IN LONDON.

The English Government, profiting by the experience of the past twenty years, have decided to adopt a new system of exhibitions, and instead of holding them every ten years, and making them universal, they propose to have annual exhibitions, confined to a limited number of articles. The past increase of manufactures, and the multiplicity of applications of science to the arts, render a universal show of them at one time, and in one building, next to impossible. The last Paris exhibition building covered nearly forty acres of ground, and the park outside embraced eighty acres more. The number of exhibitors was fifty thousand, and of separate articles there were several millions. The visitors to the palace were counted not by thousands, but literally by millions. It was noticed that the English Commissioners should have been appalled by the prospect in store for them if they were to undertake another World's Fair, in 1871. Nothing short of a building covering a hundred acres, and a park with a hundred more would suffice for the purpose, and then must follow the vast expenditure of money to put things in order at the appointed time, ready for the inroads of exhibitors, who would naturally apply for space. The thing was manifestly not to be thought of, and the Commissioners have wisely decided to hold annual exhibitions open to people of all countries, but confined each year to specified articles. They have asked the co-operation of our Government, and as a preliminary to opening a correspondence with the English Government, the Secretary of State has appointed Mr. N. M. Beckwith United States Commissioner.

Mr. Fish could not have found a better man for the position in this country. Without the energetic and able management of Mr. Beckwith during the Paris Exhibition of 1867, our country would not have been represented at all. He has well earned a recognition of services rendered at that critical period, by this appointment to superintend the proposed co-operation of the United States in the new scheme of annual exhibitions, and if any one can work out the problem practically, it is Mr. Beckwith.

Her Majesty's Commissioners announce that the first of a series of annual international exhibitions of selected works of fine and industrial art will be opened in London, at South Kensington, on Monday, the 1st of May, 1871, and be closed on Saturday, the 30th of September, 1871. The exhibition will take place in permanent buildings, about to be erected, adjoining the arcade of the Royal Horticultural Gardens. The productions of all nations will be admitted, subject to obtaining the certificate of competent judges that they are of sufficient excellence to be worthy of exhibition. The objects in the first exhibition will consist of the following classes, for each of which will be appointed a reporter and separate committee.

1. Fine arts: paintings, sculpture, engravings, architectural models, tapestry, decorative designs, copies of ancient pictures.

2. Scientific inventions and new discoveries of all kinds.

3. Manufactures: pottery, earthenware, wool and worsted, educational manufactures and belongings, such as school buildings, books, maps, toys, and games for physical training, illustrations of modes of teaching fine art, natural history, and physical science.

4. Horticulture: The Royal Horticultural Society will exhibit new and rare plants, showing specialties of cultivation.

One third of the whole available space will be assigned to foreign exhibitors, who must obtain certificates for the admission of their objects from their respective governments. The objects must be delivered free of charge and unpacked at the building, but all expenses of show cases, installation, etc., excepting machinery, will be borne by the Commissioners. It is desirable to have prices and full descriptive labels attached to all articles. Foreign countries appoint their own judges and reporters. There will be no prizes, as the certificate of having obtained the distinction of admission to the exhibition, will be decreed sufficient to reward the exhibitor for his trouble. The arrangement of articles will be in classes, without regard to nationalities, and thus be better placed for study and examination.

Mr. Beckwith, in a recent letter to the Secretary of State, thus speaks of this modified plan of international exhibitions:

"The method proposed will obviously diminish the cost of the exhibition; small exhibitions being less expensive, in proportion, than large ones. The personal expenses of exhibitors and visitors will also be diminished; less numerous bodies being supplied with transport and living, better and cheaper, in proportion, than multitudes, which are often in excess of the means provided. The educational effects are more important. Discoveries and inventions spring up continually in numerous and widely separated localities and countries, and in like manner new applications of science and art are constantly made in the productive industries. But the knowledge of such inventions and improvements spreads slowly. The rapid diffusion of this knowledge by bringing together for study from all countries, their best products, which are the practical expressions of the most advanced sciences, inventions, arts, and industries, is the leading object of international exhibitions.

"The vast accumulations and bewildering varieties of products hitherto collected, and the confusion and excitement incident to great but transient assemblies of persons, renewed daily by departures and fresh arrivals, are unfavorable to study."

Mr. Beckwith estimates the necessary expenses for clerk hire, advertising, stationery, office rent, storage, and reporter, at from ten to fifteen thousand dollars. This is a small sum for so important a matter, and no doubt will be readily appropriated by Congress.

POWER AND EFFICIENCY OF SCREWS.

The screw is a very ancient device, and the fact that in modern mechanism it still holds so prominent a position is proof enough of its essential value. It is true that the hydrostatic press of Bramah has made great inroads upon the domain formerly held by the screw in mechanics; but the probability is that so long as man retains his present ascendency over the forces of nature, it will continue to be one of the chief instruments of his power.

The weight which can be raised by a screw is generally estimated by multiplying together the force applied to the end of the lever, the length of the circumference, through which this force travels, dividing the product by the pitch expressed in the same denomination as the circumference through which the power applied to the lever travels, and subtracting the loss caused by friction. Friction is, however, so variable on different screws, and so dependent upon the materials of which they are composed, their proportions, and the quality of the lubricators employed, that it may be said to be almost a controlling element in the question of power and efficiency.

We have only in view such screws as are intended to raise and sustain, without other appliances, the load they are intended to bear, and shall therefore leave out of the discussion those of abrupt pitch used on die presses, etc.

It is evident that in proportioning a screw to bear a given load the following points must be considered: first, the size of its thread, and that of the nut with which it engages to bear the proposed load; second, the axial pitch, or the distance the screw will advance for each revolution of the lever; third, the abruptness of the incline, or what amounts to the same thing, the normal pitch, or the distance from either the upper or lower side of the thread to the corresponding side of the adjacent coil, measured on the shortest distance between the sides; or to use a term not strictly correct, at right angles with the thread.

The length of a coil of a screw measured on the interior, may be found by squaring the circumference of the cylinder about which it winds, adding to the result the square of the pitch in the same denomination, and extracting the square root of the sum. The result will be the length of the coil in the same denomination as is used to express the circumference of the cylinder.

If a base line of indefinite length be drawn, and the pitch of the screw be laid off from the base line, and perpendicular to it, and an arc be described from the point on the perpendicular where the pitch terminates with a radius equal to the length of the coil, as above calculated, it will cut the base line at a point which, joined to the point taken as the center of the arc described, will complete a right angled triangle, the angle of which opposite to the side which equals the pitch, is equal to the angle formed by a horizontal line tangent to the cylinder and any part of the face of the thread, in a vertical screw of the given dimensions.

This angle diminishes when with the same pitch the diameter of the cylinder increases. When it is subtracted from ninety degrees, the remainder is the angle formed by any part of the upper surface of the thread, and a line erected thereon parallel to the vertical axis of the screw. Friction will increase or diminish with the increase or diminution of the latter angle, the smaller it is the greater the friction, and *vice versa*. As the angle depends for its acuteness on the diameter of the cylinder, it follows that the less the diameter is the more acute will be the angle and the greater will be the friction under a given load.

In other words the power applied to rotate the screw, and the resistance to its motion, act to press together the faces of the coils in the nut and the coils on the cylinder, but the power acts at right angles to the faces, and the resistance in the direction of the axis of the screw. The resultant friction for each revolution may be obtained by multiplying together the coefficient of friction for the material of which the screw and nut is constructed, the diameter of the cylinder plus the width of thread, the resistance, and the decimal 3·1416, and adding to the product the continued product of the pitch, the power applied to the lever, and the length of the leverage, like denominations being used for measurements, and also for weights during the operation.

In the case of a wrought iron screw with a brass nut the coefficient of friction is 0·103, where tallow is used as an unguent; with sperm or lard oil it would be 0·075. With a screw of wrought iron in a cast iron nut it would be about the same. With wrought iron screw and nut, 0·081 would be the coefficent of friction, with sperm oil as a lubricant.

The securing the greatest strength with least friction has been studied, and there is no doubt that the thread is best made so that its vertical section in a vertical screw is a square, and its depth one sixth the diameter of the newel or cylinder upon which it winds.

TELO-DYNAMIC CABLES.

The method of transmitting mechanical power through long distances, by means of wire cables, is daily extending; and there can be no doubt that for more than ordinary distances the plan is a very economical one, in all the particulars of first cost, subsequent expenses for repairs, and working efficiency.

For a long time the question of the best means for transmitting power to great distances has been one of the first importance; and a great number of methods have been essayed to accomplished the desired end, many of which have been at sundry times discussed in these columns.

Experience has shown however that none of these methods can approach in economy the telo-dynamic cable. We have our doubts whether the invention of this method is justly ascribed to M. Hirn, but there is no doubt that to his labors and experiments the development and demonstration of the great advantages of the system are largely due.

At the great French Exposition, M. Hirn exhibited his telo-dynamic apparatus, and it attracted much attention. The secret of its economical application is the transmission of power at high speed, so that both a light cable and light pulleys may be used. In this way a very large working power may be accomplished by a small cable, and although some loss will be sustained from friction in speeding down to the required velocity, the gain in the transmission will more than compensate for all such losses.

Transmission at high speed is not so essential when a small power is to be transmitted through a comparatively short distance, but where the distance is great it cannot be dispensed with. The resistance of the air is also a formidable absorbent of power at high speeds and long distances, and it is probable that a slower motion of the transmitting pulleys, with a larger cable than recommended by M. Hirn, will be found the best practice for distances of less than five hundred feet. Our opinion is that the speed should increase and the size of the cable diminish as the distance and the amount of power to be transmitted increase, according to some ratio which we do not consider as yet fully determined. The velocity of the cable recommended by M. Hirn is nearly a mile per minute, the cable being 0·39 of an inch in diameter.

In the mines of Falun in Sweden one hundred-horse power has been thus transmitted to a distance of nearly three miles, and it is estimated that for much larger distances the loss from all sources in transmission need not exceed twenty-five per cent.

A number of these cables are now working over short distances in this country. Among the ones recently put up is a cable at Lockport, New York, by which twenty-five horse-power is transmitted over a distance of 700 feet, with perfect success, and, we are informed, with remarkable economy. The total length of the cable is 1,484 feet. It is operated with frictioned gears. The cable pulleys are five feet in diameter, and the cable is 15-32 of an inch in diameter.

We regard the introduction of this system as marking an era in mechanics, and opening the way to the utilization of of immense natural water powers, hitherto neglected on account of inaccessibility or other adverse circumstances.

BOILER EXPLOSIONS.

The report of the Midland Steam Boiler Inspection and Assurance Company, for 1869, contains, among much other very interesting and instructive matter, the following paragraph, which we commend to the earnest attention of those who believe in the "inexplicable power" of steam.

"It is observed with regret that boiler explosions are still attributed by those who have given little attention to the facts of the cases to mysterious causes, such as electricity, decomposition of water, explosive gases, etc., and it is believed nothing will better convince those responsible for boilers of the simple causes which lead to explosion, and the easy means of preventing them by due care or inspection, than accurate records of those boilers which have exploded."

Now what is the record. From corrosions 16 out of 59 boilers reported exploded. From *over repairs, patch upon patch*, 12 went up. Low water caused the destruction of 8. Weak tubes without strengthening rings brought 8 more to grief. Want of stays caused the ruin of 4. Weak manhole without strengthening rings brought to an untimely end 3 more. One only is reported as having blown up from extraneous causes, and 7 are reported as bursting from unknown causes, or from causes of which no trustworthy particulars could be obtained.

We once heard of an individual of limited education who, when in reading he chanced to stumble upon a long word, escaped the difficulties of pronouncing it by calling it "sundries." So it has got to be the fashion among those who are always ready to philosophize upon what they really know little or nothing about, to charge the explosions of all boilers, of which the causes are unascertained, to an inexplicable force, which covers ignorance of real or probable causes.

There seems a tendency in the human mind to look for supernatural rather than for natural causes of events, and this tendency only diminishes as people become educated to analyze complex occurrences and trace effects to causes. But even with those who are thus educated, there seems to be a charm in a search for some hidden, though it may be natural cause for a phenomenon, so that in their endeavor to detect the remote, they overlook immediate causes altogether.

Now if instead of looking so far for occult forces, owners of steam engines would look for defects in boilers, and not content themselves with once looking, but continue on the lookout for defects that are constantly liable to occur, they would show far more wisdom and suffer less damage.

The appendix to the report alluded to states that the most prevailing evil has been that of "seam ripping where cracks extend from rivet to rivet, until too little sound seam is left to retain the boiler whole. About thirty very dangerous seam rips have been discovered, besides many others where the mischief had commenced." Bad iron, bad workmanship in not matching rivet holes, so that the strain of expansion and contraction has caused rupture, concentration of fierce heat on too small area, deposit of scale, and imperfect circulation consequent upon accumulation of mud, are the causes of this seam ripping.

The practice of expending money in patching and re-patching, and putting patch upon patch, instead of renewing the boiler, is deprecated in strong terms.

The chief cause of corrosion appears to be small leaks, especially where the flues are difficult to enter, or where the boilers are so covered that the leaks do not show.

CHARLATANS AND CHARLATANISM.

Quackery finds its way into all professions. Medicine has been popularly believed to have given birth to more quacks than any other calling; and it is certain that the diseases of mankind, and the intense longing with which the sick yearn for restored health, afford most favorable opportunities for the practice of deception by those who assume knowledge they do not possess.

We have, however, a shrewd suspicion that law, theology, art, literature, and science are not very much more free from pretenders than medicine. We can certainly speak from knowledge as to the great number of quacks who infest the country, and live by palming off upon credulous dupes that they are in possession of some wonderful secret by which they can make enormous savings in various processes; that they have made some wonderful mechanical discovery or invention, which only wants money to develop it into a very mine of gold.

Our experience has brought us into contact with many of these charlatans, and we have got to know them at sight. They generally want us to publish in the interests of science (always in the interests of science) the interesting fact, that they have, by accident, or by long and arduous study, or have had communicated to them by some remote savage, the secret of doing something or other very much better than any one else ever did it before; but when asked how they do it, they decline to give any information. They also generally express the profoundest confidence that their secret is absolutely unfathomable by any living man whatever, and that all attempts to learn the mystery without paying for it, would be as absurd as to attempt a voyage to Jupiter, or to pump melted gold from the crater of Vesuvius.

Now when a man talks about being able to practice publicly an art, the secret of which is impenetrable to anybody, you may set that man down as either an ignoramus or an unprincipled humbug. Or when a man professes to have made a discovery in physical science, which, from its nature, can be only an inference, from a supposition of his own, he is either a self-deceived individual or worse.

Such an individual it was our ill fortune to encounter about six months since, who claimed to have made the discovery that sound is a substance, which permeates all bodies, solid, fluid, or gaseous; and that in order to free this material which its learned discovered called *Sigule*, all that is required is to knock on one end of a beam or wire, and sigule will ooze out of the other end. By means of a peculiar apparatus this charlatan performed an experiment familiar to all scientists, namely, the reinforcement of sound, so that a sound too feeble to be heard without reinforcement is rendered audible.

This man had succeeded in convincing one or two dupes that he had made a grand discovery, and that he could lay a wire across the bottom of the Atlantic, and that by thumping at either end squeeze out *sigule* at the other, and thus supersede the electric telegraph, make untold millions of dollars, and immortalize the names of his patrons.

How, when we are called upon to answer for our sins, we shall be able to justify ourselves for not giving this fellow a fulsome puff—as did more than one prominent journal—is a question which, if we are to believe him; will render our death-bed a scene of horror and despair. Of this sort are the men who profess to be able to make a pound of butter from a quart of milk; who vend soldering fluids of unheard-of virtues, and of hitherto unknown materials; who sell recipes for preventing the cracking of steel in tempering; who search out some simple-minded and ignorant man possessing money, and seek to convince him that with the aid of a few hundred dollars from his purse, they can produce the long-sought perpetual motion; who work upon the ignorance and avarice of others by professing to discover by some chance the place of deposit of hidden treasure; and so on to the end of the chapter.

Many of them profess to have obtained high honors and degrees from some—always remote—institution of learning, and by pompous manner and high-sounding language seek to impose upon the credulous the seeming of wisdom.

The "cheek" of some of these fellows is really little short of the sublime. They will quote you by the hour passages from authors who never existed, and misquote those who have; and we have not unfrequently seen a man of solid attainments completely brow-beaten and cowed by one of these voluble scoundrels.

Apart from consummate brass, and the professed desire to benefit the world by their great discoveries, their chief characteristic is mystery. Whenever you meet a man with a secret by which he expects and hopes to bless the world, and which no one can possibly penetrate, beware! he has designs on your pocket.

EXPERIMENTAL TEST OF THE LAWS OF THE DEFLECTION OF BEAMS.

We are in receipt of an important and interesting paper read at the Eighteenth Meeting of the "American Association for the Advancement of Science," by Professor W. A. Norton, of New Haven, entitled "The Laws of the Deflection of Beams Exposed to a Transverse Strain Tested by Experiment." The laws of deflection are of such fundamental importance in mechanical construction, that our knowledge of them can neither be too full nor too accurate. While, therefore, we cannot make room for the whole of Professor Norton's paper, we will endeavor to give an idea of the experiments from which he derives his conclusions, and a summary of the conclusions themselves.

The experiments were made upon sticks of white pine of various lengths from two to six feet; and various breadths and depths from one inch to four inches. The details of the apparatus are unimportant, save that they should be such as to secure accuracy in the experiments. On this head we will say that so far as we can discern from the minute account given, the apparatus was without any defect that could lead to possible error.

The strain was applied by a screw, the pressure of which was measured by a Fairbanks' spring dynamometer, and the results obtained were confirmed by repetition with a second set of sticks.

Professor Norton starting with the received theoretical formula for the deflection of beams of a rectangular cross section of uniform dimensions, $f = m\frac{Pl^3}{Ebd^3}$, in which m is a constant, P the power applied, E the modulus of elasticity, l the length, b the breadth, and d the depth of the stick, deduces therefrom a formula for the case of a beam resting freely on two supports and loaded in the middle, to which the experiments wereentirely confined, *i. e.*, $f = \frac{Pl^3}{4Ebd^3}$ If this formula be correct, then the following laws must be true:

1. The deflection is directly proportional to the pressure.
2. It is inversely proportional to the breadth.
3. It is inverstly proportional to the cube of the depth.
4. It is directly proportional to the cube of the length.

He then gives tables of experimental results which show first, that the deflection is only approximately proportional to the pressure, strictly speaking increasing according to a less rapid law. He suggests as the probable explanation of this descrepancy between theory and fact, "that as the force of pressure increases the neutral axis of the cross section of the stick shifts its position, and its distance from the center of gravity of the cross section augments as the pressure becomes greater. From this cause the moment of the resistance to flexure increases indirectly with the pressure, at the same time that it increases directly from the augmented strains of the fibers. The increased moment of resistance to flexure resulting from this shifting of the neutral axis, should be attended with a diminished increment of deflection for the same increment of pressure."

The second law was verified by the tests, if we except such errors as may reasonably be ascribed to differences in the moduli of elasticity of the different sticks, the shifting of the neutral axis in the case of sticks most strained, and possible errors in observation.

In testing the third law the calculated were all less than the observed deflections; but the errors became smaller as the sticks were increased in length. Professor Norton therefore concludes that "the deflection decreases according to a less rapid law than the inverse cube of the depth."

He also concludes from the results obtained in testing the fourth law, that the deflection increases according to a less rapid law than the cube of the length.

Following these conclusions by a train of reasoning as to the true theory of deflection, which we pass as too abstract for the general reader, he arrives at the formula—

$$f = \frac{Pl^3}{4Ebd^3}\left(\frac{4EC\,d^2}{l^2}+1\right).$$

in which f represents the flexure, l length in feet, b breadth in inches, d depth in inches, P prsssure, C and E constants which must be determined by experiment. This formula is not easily translated into common language, so as to be understood by the general reader. The engineer accustomed to regard the laws of flexure as settled, will, however, regard it with interest.

REPORT OF THE NEW YORK COMMISSIONERS OF FISHERIES.

The Commissioners of Fisheries, appointed under chapter 275, of the Laws of 1868, entitled "An act to appoint Commissioners of Fisheries for the State of New York," passed April 22, 1868, have made report for the year 1869, being their second report to the Legislature.

They regret that the act for the protection of the fisheries, prepared by them for the last Legislature, failed to pass. That act provided for a "restriction upon the destruction of the shad in the Hudson river; the size of the meshes of nets would have been limited, and a weekly close-time established, that would have enabled the spawning fish to reach the head waters where they are compelled by nature to deposit their ova." They think that without some such restrictions the restoration of our shad fisheries will be a work of time, on account of the impossibility of getting sufficient mature males and females in proper condition for artificial impregnation.

The Commissioners obtained the services of Mr. Seth Green, the eminent pisciculturist. That gentleman began his operations at Mull's fishery, near Coeymans, on the Hudson; his work was mainly done at night. He would commence drawing the seine for spawners at about eight o'clock, depositing the spawn and melt as he obtained them in pans in his boat, and would stop at about midnight. The impregnated spawn was at once placed in the hatching boxes, each holding ten thousand or more eggs, and left in the current until it was hatched. At every change of tide during the slack water, it was found necessary to shake the boxes to prevent the spawn settling at the bottom and getting smothered. The boxes, which were Mr. Green's patented invention, were one foot by eighteen inches, and were fastened one behind another by ropes attached to floats. They worked, as they have always worked when properly managed, to perfection. The operations were continued until July 13, 1869, when the weather became too warm and the breeding fish so scarce that the enterprise had to be abandoned. Only 15,000,000 of shad were hatched in place of 300,000,000, as could doubtless have been done, had the proper legislation been had. It is possible that these will produce some beneficial effect on the fisheries, but it will not be what it should and could have been, and what it is hoped that it will be this year.

The Commissioners state that the local fishermen have been induced to favor the enterprise rather than to oppose them, as was done on the Connecticut river, and recommend that they be provided with breeding boxes by the State, and be allowed the privilege of using their nets after the commencement of the close season, provided they would hatch the spawn.

The Commissioners have prepared a law to meet the necessities of the case, and ask for its enactment.

The Commissioners state that on the 11th day of November, Mr. Seth Green was dispatched to Detroit to procure the spawn of white-fish, as it was considered that it would be the best locality to obtain them. This conclusion was justified by the result, as millions of eggs could have been obtained when the nets used in catching the mature fish were brought to shore. The first spawn was obtained on the 13th of November; it was impregnated at once, and then packed in moss for immediate transportation, as your Commissioners did not feel justified in erecting a hatching-house for its propagation. Advertisements were put in the New York papers that the spawn would be delivered to all persons desiring it who had facilities for hatching it; and it was rapidly distributed to numerous applicants. However, so much of it was obtained that some was left over, and it was placed in the troughs used by Mr. Seth Green for raising trout at Caledonia. There it throve well, and the fry were soon abundant. Some discoveries were made by the better opportunities thus offered for studying the subject. It was found that the eggs would hatch in sixty-five days, in a temperature of forty-five degrees; that the fry carried the umbilical sack for eleven or twelve days, and that thereafter they lived on precisely the same food as young trout. They did well on lobbered milk, liver, or pulverized meat, and such other nutriment as is usually given to trout fry. It has been generally supposed, heretofore, that white-fish obtained at least a part, if not all, their sustenance from *algæ*, marine plants, grasses, or moss; but the observations of Mr. Green proved this supposition to be incorrect. By careful investigation he satisfied himself that the fish fed on small worms which they found on the plants, and that if they swallowed the plant itself, they did so by accident. These worms are extremely abundant, and the fry would commence devouring them as soon as the umbilical sack was absorbed. The larger fish lived not only on the same worms, but also on fresh water snails, caddies, insects, and other similar nourishment, and were extremely fond of their own spawn. This discovery is sustained by further experiments, and is very valuable, as it determines conclusively how white-fish are to be nourished in their infancy; a matter of great importance to all those engaged in fish culture. Of the results of the efforts of the parties to whom the impregnated spawn was sent, little has been heard at the time this report is made out. The Commissioners remark somewhat severely, "it is found that persons who are anxious to obtain a favor will promptly answer all inquiries, but that when their wishes are gratified they become more careless in their correspondence." Some packages of spawn were transmitted to England, to Mr.