pressure. If all the facts were known, it undoubtedly would be found that the joint where it gave out was a forced one, or in other words, when the boiler was made, the parts did not fit, and were hammered cold to make the one larger and the other smaller, and then to make the rivet holes correspond; the drift pin was freely used—all tending to disintegrate, crack, and destroy the strength of the plates—a most vicious practice.

The supposition that gas externally had any thing to do with the rupture of the boiler, or the destruction caused by it, is absurd; the large quantity of water suddenly liberated at a temperature of over 315°, together with the explosion of the steam, which would be instantly made on liberating the pressure—to this add the steam contained in the boiler, which would expand about 4.7 times—and we need search no farther for the cause of the destruction, lifting boilers, etc.

With regard to the boiler "foaming out" its water in ten minutes. This would be impossible, and to keep the engine running, inasmuch as there was say 120 cubic feet of water in the boiler and to put that through the engine in ten minutes would probably knock it to pieces.

This occurrence will very naturally create a distrust of the remaining boilers. They should be tested by the hydraulic test to a pressure 30 per cent higher than the steam pressure required, and the steam gage should be examined to see if it is perfectly correct.—EDS. SCI. AM.

[For the Scientific American.]

THE SAMPSON SCALE.

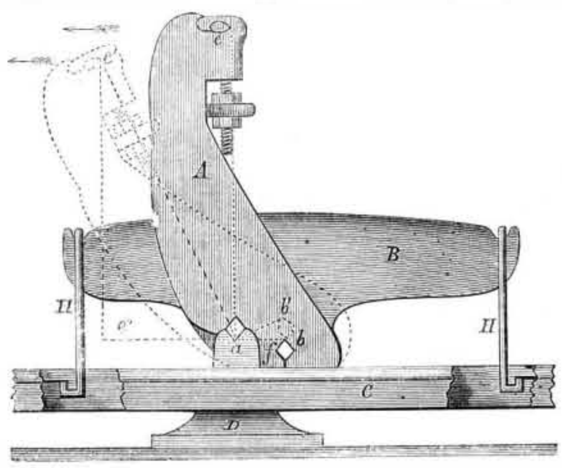
[Entered according to act of Congress, in the year 1867, by M. Richard Leverson, in the Clerk's office of the U. S. District Court for the Southern District of New York.]

A novel and interesting application of the mechanical laws of moments is to be seen in the Sampson Scale, in which the inventor, probably without knowing it, has afforded a beautiful illustration of those laws, and has produced a scale of uneqaled delicacy and which(equal workmanship being assumed) not merely is, but demonstrably must be more sensitive than any platform scale yet invented.

Our readers will no doubt remember that the moment of a force with respect to a point is the product obtained by multiplying the intensity of the force by the perpendicular distance from the point or center of moments to the line of direction of the force. This perpendicular direction is called the lever arm of the force, and the moment itself measures the tendency of the force to produce rotation about the center of moments.

The moment of a force with respect to an axis of moments is equal to the moment of the projection of the force upon a plane at right angles to the axis taken with respect to the point in which this axis pierces the plane as a center of moments.

These are the only principles involved in the Sampson scale to which attention need be called, their application being novel, remarkably simple, and beautiful from their simplicity, as will be seen from the following explanation



The top yoke, B, carrying the frame or bottom yoke, C, hung from it by the links, H, rests upon a knife edge, b, between the ear-shaped connected arms or uprights, A, which rest by their knife edge, a, on D. A chain connects by another knife edge at e, and according to the capacity for which the scale is designed connects either by a bell crank directly with the short arm of the steelyard, or with that short arm through other levers constructed on the same principle with the first, until the desired multiple of the scale weight is obtained.

In a scale capable of weighing 20,000 pounds, the first lever was in the proportion of six to one, a second was in the proportion of three to one, and a third in the proportion of six to one, while the steelyard was in the proportion of a little more than six to one—so that three pounds at the extremity of the long-arm of the steelyard should balance 2,000 pounds upon the platform.

The platform rests upon four carriages, C, one at each corner of the floor. The weight W, resting upon the platform; it is obvious that a is an axis of moments, with respect to the weights, W, and with respect to the weight, P, which rests on the steelyard, and which two weights are in effect two forces tending to turn the rigid body, A, round the axis a, in opposite directions. The weight, P, is a force, P, applied in a horizontal direction at e, and the weight, W, is a force, W, applied in a vertical diretion at b, and it is by making the angle, eab, a right angle, that the extreme delicacy of the scale is secured, while the shortness of the lever arms, ab, ae, frees the scale from the *spring*, which is the chief source of error in almost all the ordinary descriptions of scale, absolutely unavoidable when a long lever arm is employed.

So long as the moments of P and W, with respect to the axis of moments, a, bear the same proportion to one another, so long is the utmost sensitiveness insured. When P and W are ballanced, $P\times ae = W\times ab$, but suppose $P\times ae$ is unequal to $W\times ab$, and let

$$\frac{P\times ae}{W\times ab}=Q \text{ be greater than 1,}$$

then P will pull the scale over (raising the weight, W,) into, say, the direction indicated by the dotted lines, ae' ab'.

The moment of the horizontal force, P, tending to revolve the body, A, about the axis, a, in one direction is $P\times e'e'' = P\ ae' \cos.\ ae'e'' = P\ ae \cos.\ eae'$, and the moment of W tending to revolve the body, A, in the opposite dirsotion about a is $= W\times af = W\ ab' \cos.\ b'af = W\times ab \cos.\ e'ae$ ($e'ab'$ being a right angle and the angle $b'af$ therefore equal to the angle $e'ae$.)

Then the ratio of the moments of P and W, when the body has been drawn to the position indicated by the dotted lines is

$$\frac{P\times ae \cos.\ eae'}{W\times ab \cos.\ eae'}=Q \text{ as before.}$$

But if the knife edges had been otherwise disposed these ratios would have varied with every change in position of the rigid body A.

Suppose the angle $e'ab'$ or eab not to be a right angle, then the moment of P with respect to the axis, a, would have been $= P\times ae$, cos. of the angle which ae makes with the axis of y. Call this angle Y, and the moment of W with respect to the same axis, a, would be $W\times ab\times$ cos of the angle which ab makes with the axis of x. Call this angle X, and the ratio will be

$$\frac{P\ ae \cos Y}{W\ ab \cos X}$$

Let the body A be drawn over say by P, as before. Then the angles made by the lever arms of P and W with the axes of x and y respectively are increased by the same quantity, v, and the moments of P and W become respectively $P\times ae \cos (Y+v)$ and $W\ ab \cos (X+v)$, but

$$\frac{P\times ae \cos (Y+v)}{W\ ab \cos (X+v)} \text{ is unequal to } \frac{P\times ae \cos Y}{W\times ab \cos X}$$

except when $v=0$ or some multiple of 90°. Hence it is that a scale constructed without the very strictest regard to placing the knife edges at the angles of a right angled triangle must be deficient in sensitiveness.

The platform of the Sampson scale rests at its four corners on four carriages, C, which ,swinging feeely by the links H, keep the platform perfectly horizontal and preserve it from rubbing or jamming against the frame. The entire floor covered by the scale constructed to weigh 20,000 lbs. is only 15 feet by 10 feet 3 inches, and so far as its weighing properties are concerned the scale could easily have been built in one fourth or even one sixteenth the space.

The following experiments conducted in our presence show the beautiful results obtained by attention to the simple laws above mentioned, combined undoubtedly with skillful workmanship.

A weight of 4,000 lbs. being placed upon the platform and exactly balanced by a weight of 6 lbs. at the extremity of the steelyard, the addition of half a pound only on the platform caused the steelyard to strike the upper stop. The scale was then balaneed by adjusting the index weight to the half-pound point upon the steelyard and the half-pound weight then removed from the platform, when the steelyard fell and rested on the lower stop.

After exhibiting the deflection caused by the addition or subtraction of a half-pound weight on the scale while 4,000 lbs. were on the platform, the weights were heaped up first on one corner of the platform and then indifferently on different parts of the platform without the slightest deviation in the result or straining of the parts.

A scale constructed on this principle is in use at the weigh lock at Waterford, on the Champlain Canal and elsewhere, and has been very favorably reported on by the State Engineer and Surveyor in his report for 1862, but no explanation of the principle on which its remarkable delicacy depends has, we believe, ever before been given to the public.

The 20,000 lbs. scale referred to above is, we believe, to be seen at the company's office, No. 240 Broadway.

M. RICHARD LEVERSON.

New Mode of Operating Hay Forks.

A very simple and useful contrivance for unloading hay from the cart and depositing the same at any desired part of the barn, has been recently invented by D. L. Miller of Madison N. J. He uses a clutch pulley through which a rope is extended horizontally from one portion of the barn to another near the roof. To the pulley is another rope extending vertically from the way rope to which the fork is attached. It will be understood how easily with such an arrangement one man can unload and deposit in any part of the barn. The invention consists in the arrangement of rigging, it being adapted to the use of the well known large forks.

Blue Coloring Matter.

M C. A. Girard, of Paris, has patented improvements in the manufacture of blue coloring matter. He introduces into a distilling apparatus two parts of commercial diphenylamine and three parts of sesquichloride of carbon, and heats the mixture, taking care to maintain the temperature between 170 deg. and 190 deg. Centigrade. The blue color is rapidly developed, and in five or six hours the mass assumes a bronze aspect and becomes brittle on cooling. The melt with the bronze aspect is powdered and treated until complete exhaustion in a displacement apparatus with benzole or ether at a gentle heat. In this apparatus the warm solvent filters through the powdered melt and is afterward distilled, the vapor is condensed and returned on to the melt, and so on continually. The untransformed sesquichloride of carbon and commercial diphenylamine are dissolved as well as a small quantity of bluish violet; the greater part and the best part of the blue remains undissolved. The blue is then collected and dried, and may, after being dissolved in alcohol or methylated spirit, be at once employed in dyeing or printing; but, if it be desired to purify it further it may be dissolved in boiling alcohol, filtered and precipitated from the filtered solution by hydrochloric acid. The inventor has observed that pure ditolylamine yields under the same conditions a brown coloring matter; pure diphenylamine yields a blackish violet blue; and penyltolylamine a bluish violet or violet blue; but a mixture of diphenylamine and ditolylamine and of diphenylamine and phenyltolylamine in any proportions yields a blue. He, however, remarks that some proportions are better than others, and that two parts of diphenylamine and one part of ditolylamine are good proportions.

NEW PUBLICATIONS.

APPLETON'S HAND BOOK OF AMERICAN TRAVEL—THE NORTHERN TOUR. By Edward H. Hall. D. Appleton & Co., 443 Broadway, New York City.

Beginning with sensible and plain advice to travelers, as applicable to foreigners as our own people, this volume presents all the information required for a tour from Nova Scotia to California, including all the Eastern, Middle, and Western States and the Canadas. Plain directions as to railway and steamboat lines, hotels, objects of interest, and brief descriptions of places, without annoying and wearying with useless trash, give a peculiar value to this book, which some other more pretentious volumes do not possess. Maps of the country and plans of the cities through which the tourist may pass are bound in the book, and will be found to be a great convenience.

BRADSHAW'S HAND BOOK TO THE PARIS EXPOSITION, London. J. Wiley & Son, 535 Broadway, New York City.

This volume contains an alphabetical index of the classes of articles in the Exposition, with all the instruction necessary to visitors relative to the plan of the building, its approaches, prices of admission, and brief and comprehensive details of the general features of this great world show, with a fine map of Paris and its environs. It is timely and interesting, whether the reader is a visitor or only a home seeker for knowledge.

HISTORY OF THE ATLANTIC TELEGRAPH. By Henry M. Field. Second Edition. Charles Scribner & Co., 654 Broadway, New York City.

To any one who cares to read the record of a successful undertaking which puts to shame the wildest imaginings of romancists; who desires to know what human energy and determination can accomplish against the adverse operations and the almost insuperable obstacles of nature, we commend this volume. It seems, even in the details of the enterprise, like the fabulous and incredible statements of ancient story tellers, yet the result is apprehended every day by the people on both sides the Atlantic. The facts about the great submarine telegraph, although appearing occasionally in newspaper paragraphs, have never been so clearly stated as in this volume. We shall draw from them hereafter. Meanwhile we recommend the perusal of this book to all who believe in the ultimate sovereignty of man over nature. They cannot fail to be deeply interested.

KELLOGG'S UNITED STATES MERCANTILE REGISTER FOR 1867–8. Kellogg, Johnston, & Co., 116 Nassau street, New York City.

This work is a compendium of information of inestimable value to every business man. It is divided into two parts, the first including an amount and variety of useful information which otherwise must be sought in ponderous and numerous volumes. The internal revenue laws, including licenses and stamps; the tariff; weights and measures of all nations; general statistics of the country; value of foreign coins; the United States bankrupt law; mercantile laws of all the states; domestic and foreign postage; list of post-offices and telegraph stations, and many other convenient items of information are contained in part first. Part second is a business directory of all the principal cities of the Union, alphabetically arranged and handy for reterence.

TROW'S NEW YORK CITY DIRECTORY. Compiled by H. Wilson, for the year ending May 1, 1868. John F. Trow, 52 Greene street, New York City.

This is one of the books, which, like the dictionary, contain only hard facts, and is of immense value to the business man, the resident, and the stranger. The compiler in his preface says: "It has required almost a half century of constant effort and unremitting practice to bring the complicated organization of forces into perfect working order which are necessary to the annual production of this work. But as the magnitude of the Directory has increased, its defects, we believe, have decreased." This issue contains 177,317 names.

PRINCIPLES OF MECHANISM AND MACHINERY OF TRANSMISSION. By Wm. Fairbairn, Esq., C. E. Henry Carey Baird, 406 Walnut street, Philadelphia.

This volume is a synopsis or abridgement of the author's large work on "Mills and Millwork," and is better adapted to the wants of American millwrights, machinists, and operatives than the former. It contains, in the "Principle of Mechanism," descriptions of most ot the general combinations of machinery, with plans, formulas, and explanations, and the chapters devoted to "Machinery of Transmission" give details of all the different varieties of pulleys, gears, screws, clutches, etc., with a treatise on shafting It is illustrated with engravings, diagrams, and plans, and has a copious index.

THE AMERICAN ANNUAL CYCLOPEDIA and Register of Important Events of the year 1866, Embracing Political, Civil, Military, and Social Affairs; Public Documents; Biography, Statistics, Commerce, Finance, Literature, Science, Agriculture, and Mechanical Industry. Volume VI. pp. 800, 8vo. New York. D. Appleton & Co.

This important and elaborate Annual makes its appearance with its usual characteristics, which are well summed up on the title page as quoted above. A record of one of the memorable years of the world's history, it could hardly escape a plethora of matter more fascinating and marvelous than fiction, and such as every intelligent person wishes to have embodied, indexed and at hand for ready reference in the future. It is appropriately garnished with a portrait of the central political figure of the year, Count Bismarck, and also with the attendant figure of King William I, of Prussia, and with that of Garibaldi as a background.

CHEMICAL NEWS—REPRINT.

We are glad to learn that W. A. Townsend & Adams, Publishers, of this city, have undertaken the republication of the *London Chemical News.* This is one of our best foreign publications, but the high price which it has cost subscribers in this country, has prevented a large circulation. The reprint will be afforded so cheap that the publication must have a large circulation. A prospectus giving full particulars may be found in our advertising columns.

THE CORRELATION AND CONSERVATION OF GRAVITATION AND HEAT, AND SOME OF THE EFFECTS OF THESE FORCES ON THE SOLAR SYSTEM. By Ethan S. Chapin. Springfield, Mass. Lewis J. Powers & Brother. pp. 120.

The writer of this book is evidently an independent and fearless thinker. He does not hesitate to disagree with doctrines which have stood for centuries. The book is speculative, and treats of the most exalted subjects.

RAILWAYS IN ITALY.—By the transfer of Venetia to the kingdom of Italy, the network of Italian railways has been increased to the extent of 600 miles. An uninterrupted line of railway has now been established on the eastern side of the Italian Peninsula. The opening of the line from Ancona to Foligno and Rome, puts the north in communication with Naples. Florence has now also uninterrupted railway communication with Rome.