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EXPERIMENTS WITH THE SCIENTIFIC TOP.

BY GEO. M. HOPKINS.

A scientific top and a few experiments adapted to it were described in the last issue of this journal. Several other experiments, possessing more or less interest, are illustrated by the annexed engravings.

The ability of the heavy top to run for a long time and maintain an equable motion renders it particularly serviceable in experiments requiring uniformity of action.

Two experiments in sound are illustrated: Fig. 1 showing the adaptation of a simple siren to the top, and Fig. 2 Savart's wheel. The siren consists of a disk of pasteboard, having four concentric rows of ⅜ inch holes, there being 12 holes in the inner row, 15 in the next, 18 in the next, and 24 in the outer row. The disk is varnished with shellac to render it waterproof. It is mounted on a chuck fitted to the tapering hole of the top spindle. When the disk is rapidly rotated by the top, and a jet of air is blown upon either row of holes through a flexible tube provided with a small glass or metallic nozzle, a musical sound will be produced by the air pulsations caused by the interruptions of the air jet by the perforated disk. The sounds produced by the different rows of holes are those of the perfect major chord. A large number of experiments with this simple siren are described in Prof. A. M. Mayer's interesting little book on sound. Savart's wheel is simply a toothed disk fitted to the chuck and adapted to be rotated by the top. When the disk is turned very slowly, with the edge of a card held against the teeth, a series of little taps are heard, which do not at all resemble a musical sound; but when the wheel is revolved rapidly by the top, the contact of the card with its periphery produces a sound that may fairly be called musical, the sound being composed of the rapidly repeated taps.

In Figure 3 is shown a disk similar to that used for the siren, but having double the number of holes in each circular row. The holes are ⅛ inch in diameter. The disk is blackened to render the effects more conspicuous, and the hole in the center of the disk is eyeleted to prevent wear. A metal disk, secured to a tapering spindle fitted into the top spindle, carries a crank pin $\frac{3}{16}$ inch from the axis of rotation. The eyelet of the disk is placed loosely on this crank pin, and when the crank is revolved by the top the disk is gyrated; every part of its surface being made to travel in a circular path ⅜ inch in diameter, when sufficient friction is applied to it to prevent it from rotating with the top. In this case each perforation of the disk forms a circle, and the circles formed by the entire series of holes interlace, appearing like so many chain links interlocked. By allowing the disk to revolve at different speeds very complicated figures are produced, sometimes like lacework, sometimes like twisted chainwork. Occasionally one part of the figure will appear to turn in one direction while another part turns in the opposite direction. Some of these figures are shown in Figs. 4 and 5. A similar experiment, developed in a different way, is shown in Fig. 7. The black cardboard disk is provided with a central eyelet, which receives the crank pin, as in the case of the perforated disk. On each of two diametrical lines crossing each other at right angles are formed pairs of holes, in which are cemented silvered glass beads or bright spherical steel buttons. The latter were used on the disk illustrated. They are symmetrically arranged, so that the inner four may follow each other in the same path, and the outer four may follow each other in a path of their own.

THE CHAMELEON TOP.

By treating this disk after the manner of the perforated disk above described, many brilliant and surprising effects may be produced.

By holding one edge of the disk lightly between the thumb and finger, so that it will not revolve, but will be made to gyrate by the little crank, each button will describe a ⅜ inch circle, or a small oval, or an ellipse, as shown in Fig. 7. By allowing the disk to slip slowly between the thumb and finger, a series of double scrolls will be produced, as shown in Fig. 8.

By varying the speed of rotation by the application of more or less friction to the disk, a great variety of intricate and beautiful figures are produced. Examples are shown in Figs. 9, 10, and 11. The effect shown in Fig. 11 is secured by allowing the edge of the gyrating disk to strike the finger once during each gyration. The luminous curve in this case appears to have a slow retrograde motion.

In Fig. 16 is shown a cardboard disk mounted loosely on the top spindle and provided with two series of black radial bars, the inner series having 13 bars, the outer series having 12 bars. To the chuck inserted in the spindle is secured a black disk having four radial slits.

When the top is revolved and the lower disk is retarded, some very curious illusions will be produced. At times one part of the lower disk will appear to remain stationary, while the other part will appear to revolve. Again, the two series of radial bars will appear to rotate in opposite directions. Viewed in another way, they appear curved.

By replacing the slitted disk with the perforated disk (Fig. 3), and arranging the perforated disk so that it may be retarded by the friction of the finger, some curious effects will be seen. The different rows of holes will appear to advance and recede

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feed and bilge pumps, are worked from the piston rod cross heads by means of drag links and bell cranks arranged so that the various buckets and plungers serve to counterbalance, to a considerable extent, the weight of the high and low pressure cylinder pistons, thus practically doing away with the unpleasant jerk so noticeable in many paddle boats. The water for condensing the exhaust steam is circulated through the condenser tubes by one of Gwynne's "Invincible" pumping engines, capable of discharging over 3,000 gallons per minute.

The paddle shafting is all forged of "double wrought" iron for extra strength, and the paddle wheels are of the ordinary description, each having nine feathering floats of wood. The diameter of the wheels is 21 ft. 10 in. over all, and 47½ revolutions were easily obtained; but owing to the unusual severity of the specified trial (viz., four consecutive runs between the Cloch and Cumbrae lights, 15·744 statute miles), and the firemen not being accustomed to forced draught, the average number of revolutions on the trial trip was half a revolution less, viz., 47, and resulted in a clear mile of additional speed over the 20 miles guaranteed; for the time taken to run the "lights" was exactly a mean of 45 minutes, or as nearly as possible 21 miles per hour, the engines indicating 2,680 horse power.

This gratifying result was very much due to the saving of weight effected by the adoption of the "navy" boilers in conjunction with forced draught supplied by two of Capell's fans driven by Chandler's high speed engines, which worked very quietly and satisfactorily, giving an air pressure equal to 1½ in. of water with ease, but on trial ⅞ in. only was required, thus leaving a liberal margin for the inferior Australian coal, which from their extensive colonial connection Messrs. Rankin & Blackmore have found requires much larger boiler power than is necessary with our own good steam coal.

There are six steel boilers in the Ozone, 7 ft. 9 in. in diameter and 15 ft. long, with a working pressure of 90 lb.

Scientific Women.

An agreeable illustration of the capacity of the feminine mind to grapple with the abstractions of science was afforded in the recent annual meeting of the American Science Association, whose proceedings were illuminated by the personal participation of several lady members. A paper by Mrs. Nuttall Pinart was read, in the section of anthropology, containing some analyses of Mexican inscriptions. The novelty of her interpretation consists in interpreting the Mexican symbols as phonetics and not as ideograms, thus completely revolutionizing the previous conceptions on this subject. Her method has been applied to the deciphering of calendar and sacrificial stones of Mexico, and was suggested by the presence on these of phonetic symbols occurring in picture writings. This so-called calendar stone Mrs. Pinart believes to be the market stone of the city of Mexico. It regulated the time of holding the market days; and perhaps the division of the Mexican year rested upon these times. It also gives evidence to the existence of a communistic government.

In the section of chemistry, Mrs. Helen C. De S. Abbott read a paper upon the proximate composition of a bark from Honduras, known as "chichipati," which contains a new camphor and a yellow coloring matter, chichipatin, apparently of value as a dye and substitute for fustic. The same lady also presented some considerations of the relations of the chemical constituents of plants to their morphology and evolution, maintaining that the chemical constituents follow parallel lines with the evolutionary course of plant forms. In the section of economic science, a paper was read, written by Mrs. John Lucas, of New Jersey, upon silk culture; and finally, in the section of mathematics and astronomy, Anna Winlock's views were read on "the limitations in the use of Taylor's theorem for the computation of the precessions of close polar stars."—*American Analyst.*

The Incentive to Own a Home.

The *Manufacturer and Builder* thinks that the man who is working to secure a small piece of property substitutes a new and distinct ambition for a remote and vague one. Day dreams about large estates and princely incomes may be very amusing, but they are not half so profitable as a vision of a lot 100 by 200, with a snug little dwelling house upon it. With this before him, a man will rise early and retire late, turning his hand cheerfully to any and every kind of work. He will have a motive for rigorous economy which will make it a pleasure. He will have the vision of the last payment before him as a perpetual motive to moderation in passions, economy in expenses, abstinence from expensive pleasures and from expensive companions. Thus it will come to pass that a judicious debt, incurred at the beginning of a journeyman's or laborer's career, will become his good genius, watching over him, inciting him to all industry and to self-government. Every laboring man ought to own his house. The first duty of the workingman should be to convert his earnings into real estate.

EXPERIMENTS WITH THE SCIENTIFIC TOP.

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in a very erratic way. Figs. 12 to 15 inclusive illustrate the well known and very interesting toy known as the chameleon top. This top is shown in this connection, as the beautiful experiments which have been adapted to it may be transferred with great advantage to the heavier top. Fig. 12 shows the top itself, with the black sector lifted out of its normal position to show the colored segments on the face of the top.

When the top is spun with the black sector resting on its face, a great variety of changes of hue may be produced by retarding the sector, by touching the metallic radially ribbed disk attached to its center. This operation causes it to shift its position on the top, and expose the different colored segments in succession. Persistence of vision causes the segments to appear as circular bands of color, which constantly change.

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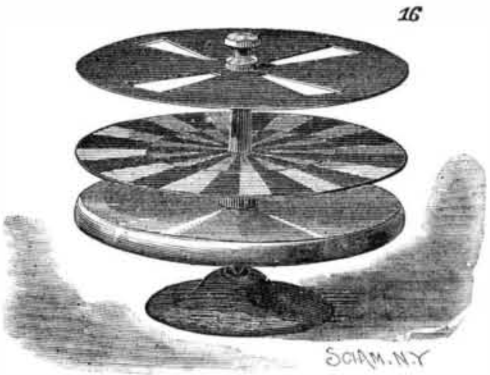


RADIAL DISKS.

When the colored paper ellipses shown in Fig. 13 are thrown upon the top and touched by the finger, the colors are curiously blended.

The tricolored disk shown in Fig. 14 is to be supported loosely on one of the wires shown in Fig. 15. This disk, when revolved, yields some very pretty effects. The wires shown in Fig. 15, when inserted in the hollow top spindle and revolved, produce the figures shown in the upper portion of the engraving, appearing like phantom vases, bowls, etc.

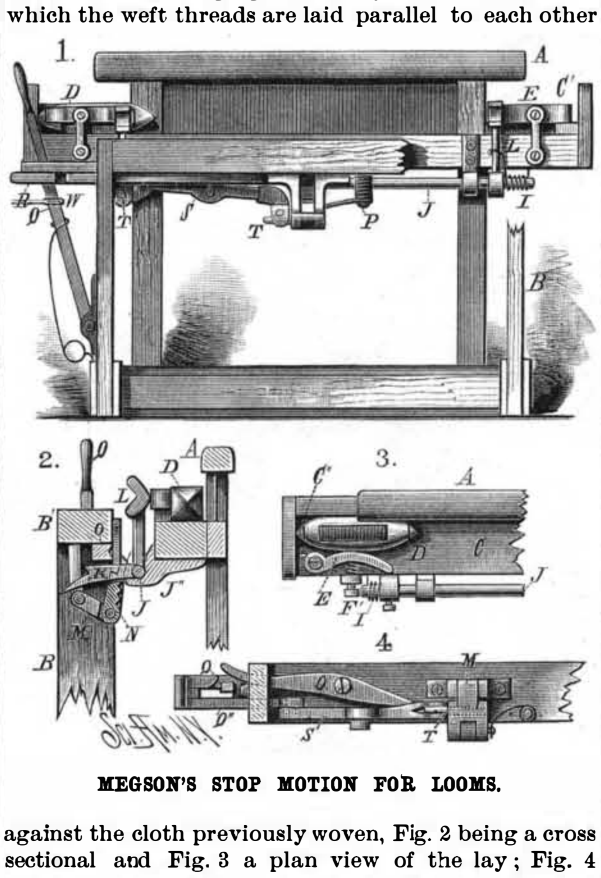
When this experiment is adapted to the large top, the wires are replaced by thin nickel plated tubes, inserted in wooden pins fitted to the spindle of the top. The tubes are provided at their upper ends with small spherical knobs.

In addition to the experiments described, there are of course many others of equal interest which may be performed by means of a heavy top.

The spinning device shown and described in the first paper has been adapted to a large gyroscope.

A STOP MOTION FOR LOOMS.

The invention herewith illustrated provides a construction by which the belt is automatically shifted and the loom stopped in case the shuttle fails to leave the box. Fig. 1 shows a front view of the lay of the loom, or the swinging frame, by the movement of which the weft threads are laid parallel to each other against the cloth previously woven, Fig. 2 being a cross sectional and Fig. 3 a plan view of the lay; Fig. 4 showing a plan of the under side of the breast beam. The lay, A, is mounted to swing between the side pieces of the base frame in the usual manner, toward and from the breast beam, also secured on the base. On the upper part of the lay is the shuttle race, C, with the boxes, C', for receiving the shuttle, D, the front of each box being formed by a curved lever, E, pivoted at the outer end of the lay in such a manner as to swing toward and from the back of the lay, the lever being pushed inward by a spring, F'. In lugs on the front of the lay is journaled the shaft, J, the middle of which is supported by a forked piece, J', between the prongs of which projects a dagger, K, that acts against the bunter, O, and a supplementary bunter, N. Arms, L, project upward from the shaft, their heads resting against the outer swinging ends of the levers, E, and springs, I, being coiled around the ends of the shaft, each having one end resting against the adjacent arm in such way as to press the arms against the levers, E. From the under side of the breast beam, B', jaws, M, project downward, to which the supplementary bunter is pivoted, a spiral spring, P, being secured to the supplementary bunter.



MEGSON'S STOP MOTION FOR LOOMS.

In operation, should the shuttle fail to enter the box, one of the prongs of the dagger, K, will strike the ordinary bunter in such way that the belt will be shifted and the loom stopped. By the previous method of construction, if a shuttle of a single-shuttle loom should fail to leave its box while a pattern was being formed by the harness, and the loom was allowed to run, both the take-up and the pattern chain would require adjusting, and with a loom employing more than one shuttle the warp threads would be broken.

This invention has been patented by Mr. John Megson, of Adams, Mass.

Nitrate of Soda.

Extensive deposits of nitrate of soda exist at Antofagasta, Taltal, and other places in the desert of Atacama, but the chief center of production is the newly acquired province of Tarapaca, which is described as one immense bed of this valuable salt. At the present time the nitrate business appears to be passing through a series of crises which is the result of two distinct causes. A commission appointed by the United States Government to inquire into the industrial and commercial condition of the Central and South American States, writing on the subject of the nitrate deposits, says that, in 1875, the Peruvian Government appropriated the nitrate deposits of Tarapaca, and compelled the proprietors of works to hold them under leases from the Peruvian Government, and to produce nitrate subject to the payment of a royalty, but the production was limited to a certain specified quantity per annum. The object of the Peruvian Government in appropriating the nitrate deposits, and in limiting the production, was to prevent nitrate competing with guano as a fertilizer.

When Chili took possession of Tarapaca, the works belonging to the Peruvian Government were sold, those which had been seized, but not paid for, were restored to their rightful owners, and the production of nitrate was declared to be free. A considerable impetus was thus given to the production, which was already in excess of the demand, when, rather more than a year ago, a sudden collapse in a large consuming market brought about a crisis in the nitrate business. About three years ago the beet growers commenced to use nitrate as a fertilizer. The roots attained an enormous size, and the quantity produced per acre far exceeded that obtained by any other fertilizer. Experience, however, soon demonstrated that, although the beet roots attained an unprecedented size under the influence of nitrate as a compost, it was at the expense of the saccharine matter contained in the root, and it was also discovered that the salt had a deleterious effect upon the sugar in the act of granulation, and even upon the sugar itself.

The result of this discovery has been the refusal of the best sugar producers to purchase roots to which nitrate had been applied. To meet this altered condition of affairs, the nitrate producers combined not to produce more than 10,000,000 quintals per annum; and with the object of finding a new outlet for their production, the owners of nitrate works agreed to offer a prize of £1,000 to the discoverer of a new use for nitrate, and they also purposed distributing among agricultural societies, institutes, and schools 500 tons of salt for experimental purposes. A considerable quantity of iodine, for which practically there is an unlimited market, is obtained from nitrate, but as it is a residual product, the quantity obtained obeys the laws of production of nitrate. The iodine is held in solution in the water in which the nitrate earth is boiled and washed, and the reagent used is sulphuric acid. The total value of the nitrate of soda exported in 1883 amounted to £6,409,000, of which the United Kingdom took £5,878,000, and the United States £168,000. The total value of the iodine exported in 1883 was £597,000, of which £90,000 went to the United States and £355,000 to the United Kingdom.

REFERRING to a carpenter who was seriously injured from the falling of an insecure scaffold, the *American Builder* adds: "It seems too bad, with the genius this country affords, that it cannot find some one who will invent a scaffold which will prevent the fearful loss of life which is daily occurring through the carelessness of those who build the ordinary joist and board affair."