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.

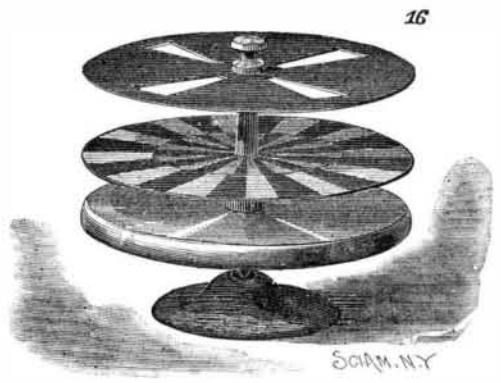
The *Manufacturer and Builder* thinks that the man who is working to secure a small piece of property substitutes a new and distinct ambition for a remote and vague one. Day dreams about large estates and princely incomes may be very amusing, but they are not half so profitable as a vision of a lot 100 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.

(*Continued from first page.*)

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.



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.

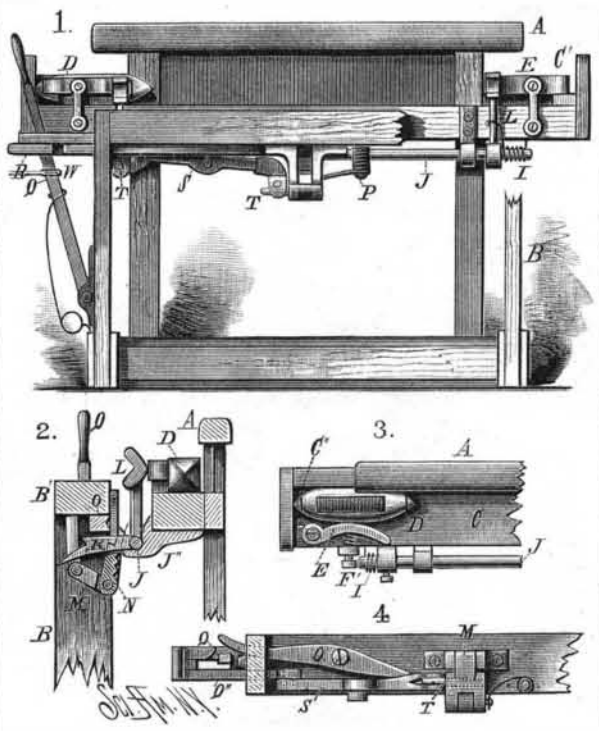
When this experiment is adapted to the large top, the wires are replaced by thin nickel plated tubes, inserted in wooden pins fitted to the spindle of the top. The tubes are provided at their upper ends with small spherical knobs.

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."

Cabbage Flies and Worms.

From the address of President William Saunders, before the Entomological Society of Southern Ontario, we learn that the cabbage crop has been materially injured by the ravages of the cabbage Anthomyia, *Anthomyia brassicæ*, a two-winged fly, which in the larval state burrows in the center of the stem of the young plant and causes its death. This cabbage insect is a native of Europe, is very troublesome in Britain, and has been known as a very destructive insect in this country for about thirty years, but nothing is known either of the date or the method of its introduction. The flies appear in the spring, and deposit their eggs upon the stems of the young cabbages about or a little below the surface of the ground. The eggs hatch in about ten days, when the young larvæ usually bore into the interior and work their way down toward the root; sometimes they merely gnaw grooves on the outer surface of the stem, and by this find their way to the roots, on which they feed. When full grown they change to yellowish red chrysalids in the earth, from which the flies shortly escape, the whole period of their life history, thus briefly traced, occupying about eight weeks. Usually, the plants attacked soon wilt and finally die. It is believed that there are two or three broods of these insects during the year.

Several remedies have been recommended, such as dipping the roots and stems of the young plants in strong lye, or a mixture of earth and cow dung diluted with water, or a thick mixture of soot and water. Any bitter or alkaline substance which would adhere well to the outer surface would probably deter the flies from depositing their eggs. Lime added to the soil, in the proportion of 100 to 150 bushels to the acre, after plowing, and well harrowed in so as to keep it near the surface, has proved a very effectual preventive measure; or even where the insects are at work upon the plants, if the earth is scraped away from about the stem of each, and a handful of lime dusted around it, and the soil again drawn up to the stem, the plants will sometimes recover. Coal dust, gas lime, and stimulating artificial manures have also been recommended.

The cabbage has also suffered from injuries caused by the common cabbage worm, the green caterpillar of the cabbage butterfly, which feeds upon the foliage, and often disfigures it to such an extent as to render it unmarketable. The habit of this caterpillar, feeding as it does among the folds of the leaves, makes it extremely difficult to reach with any sort of poison without at the same time rendering the cabbage unfit for use.

PYRETHRUM, OR INSECT POWDER.

Pyrethrum, or insect powder, which is the powdered flowers of *Pyrethrum cinnerariæfolium*, has been used with good effect, either dusted on the plants or mixed with water and applied to them with a syringe, and this remedy is not in any way objectionable or poisonous. The pyrethrum plant is in my experience quite hardy in Ontario, has stood the severe cold of the past two winters without injury, and flowered freely. It is easily raised from seed, and being a perennial species, when once established it will continue to flower for an indefinite number of years. The flowers, collected when just about to expand, dried, and powdered, are very efficient as a general insecticide.

During the past year or two, many interesting experiments have been made and valuable results obtained in the way of artificially introducing disease among communities of caterpillars, a sort of caterpillar plague or pestilence, which carries them off by thousands. There is a very fatal disease which appears from time to time among silkworms, the larvæ of *Bombyx mori*, when bred for the production of silk, a disease which spreads so rapidly that it frequently destroys entire broods of caterpillars within a few days. So destructive has it been, that it is estimated that the silk crop in Europe is injured to the extent of many millions of dollars annually. During the past ten years it is believed to have reduced the income of silk breeders twenty-five per cent, and in 1879 was said to be the main cause of the great falling off in the silk crop of that year, which was only about one-fourth of the amount ordinarily produced. The celebrated Pasteur investigated this disease, and found it to proceed from the presence of an exceedingly minute form of bacteria, so excessively small that it has been estimated that it would require eight millions of them to cover the head of an ordinary pin. When water containing these minute organisms is sprinkled on the leaves on which the silkworms are fed, they are found to be rapidly infected and capable of communicating this pestilential disease to others with which they are associated. The bacteria may be preserved in a torpid condition without loss of effectiveness for at least a year, probably for several years, and that without any particular care, and when required for use can be rapidly propagated in a suitable fluid.

In my address to you last year, I referred to a similar form of disease which had occurred among cut worms, so abundant in clover fields in the Ottawa district; and in 1878 and 1879 to a similar trouble among the forest tent caterpillars, at that time so abundant. Now, I am glad to be able to report a similar disease among the cabbage worms, and to indicate to you some practical results arising from investigations regarding its nature and mode of operation.

Throughout most of the State of Illinois and in some parts of Michigan, it was observed last autumn that a large proportion of the cabbage worms sickened and died. Hundreds of their bodies were to be seen rotting on the cabbage leaves, or shrunken and dried to a blackened fragment. This was soon brought under the notice of the State Entomologist of Illinois, Professor S. A. Forbes, a most careful and indefatigable observer, who at once proceeded to investigate the cause of this caterpillar plague. He found the disease at first to be very unevenly distributed, some isolated fields showing no trace of it, while others not far distant were fairly reeking with death and decay; but as the season advanced it spread in every direction, until in some districts almost every worm perished. He says: "We can conceive something of the significance of this disease if we imagine the terror and dread which would seize mankind if such a plague should suddenly assail human life. Whole towns would be depopulated, and the dead would rot in the streets by hundreds. There would be no escape for any, because the contagion would be conveyed by the very food and drink by which life was sustained."

On dissecting specimens of the dead caterpillars, the microscope showed their intestines to be full of undigested food, and swarming with a species of *micrococcus*, which appeared in the form of excessively minute spheres about one twenty-five thousandth of an inch in diameter, sometimes single, sometimes in pairs, and occasionally in strings of from four to eight. He found that these minute organisms could be readily cultivated in beef broth, and that a single drop of fluid from a diseased worm introduced into a vessel of such broth would in two or three days render the whole contents milky with myriads upon myriads of these microscopic organisms, precisely the same as those taken from the diseased larvæ. He also found by experiment that the disease could be communicated to other species of caterpillars. Experiments continued during the present year have shown that by propagating this form of bacteria in the manner described, and mixing a pint of a well charged culture with a barrel of water, and syringing cabbages with this fluid, the disease may be introduced, thus furnishing us with another means of defense against some of these injurious insects.

Telephonic Induction.

Mr. Preece's paper on "Induction between Wire and Wire," lately read before the British Association, revealed a somewhat alarming extent of electrical induction. In Gray's Inn Road a telegraph wire suffered induction from a telegraph cable 80 feet below in the ground. The complaints induced Mr. Preece to arrange experiments on a larger scale. In Newcastle, induction was noticeable at 3,000 feet distance. Experiments on the Durham-Darlington lines, and two other parallel lines, the one 10¼ miles east, the other 5¼ miles west, proved that on a Sunday when all other traffic was stopped, a peculiar signal given on the central wires of 18 miles length could distinctly be heard at the four corners of the two other parallel wires, and, moreover, Morse signals were heard which could only come from a line 40 miles away. Two other lines were therefore selected; one from Newcastle 55 miles long, with 10 wires, the other from Gretna, 40 miles long, with 17 wires, the two being about parallel and 40 miles distant from one another. The wail produced by intermittent increasing and decreasing currents by means of a special commutator in the one line was sadly audible in the other. Mr. Preece did not consider these tests conclusive evidence of induction, because earth was used as return lead, although the respective line terminals were most carefully insulated. Another series of experiments is, therefore, now being carried on, with gutta percha wires bent so as to form squares, of a side of ¼ mile length. Two such squares have been placed on the ground ¼ mile apart; and what is intrusted to a telephone inserted in the one closed circuit can be listened to in the other. If facts of this kind become known, the telephone will not gain in favor. Cables are not much better, perhaps; signals given in the one cable to the Scilly Islands have been heard in the other cable half a mile away. It is further intended to carry a special double line of copper wire to Wales. Professor Silvanus Thompson objected to the term induction, which has become the household explanation for a good many different troubles. As the earth was used in Mr. Preece's tests, and perfect insulation is a practical impossibility, the lines of force tapped at any two points must necessarily indicate current variations. Mr. Preece protested against having characterized the phenomena as induction phenomena. It was remarked that at the electrical tramway line at Giant's Causeway, a telegraph wire is only 28 feet from the conductor rail, and no induction effects have ever been complained of, although the postal authorities had to be satisfied about a great many points before agreeing to have the two lines so near one another. A test experiment was further suggested. Let us take three parallel wires, the one for the signals, the other two on the same side of the first for listening with the telephone at the one terminal; if we have to deal with conduction, it cannot make any difference whether or not we join the two other wires by auxiliary wires, so that they form one complete telephone circuit; if it is induction, a difference must result.

Mr. Preece further related how he had found a piece of a needle, suspected of being in his daughter's hand, when Professor Hughes' induction balance and Bell's contrivance, with which he localized the bullet in President Garfield's body, had failed. Mr. Preece strongly magnetized a steel needle of the same size as the one which had broken in his daughter's hand. Suspending this by a paper stirrup, he observed a deflection when the needle was near the hand, and succeeded in localizing the steel piece in the palm, so that an operation could be performed a fortnight after the accident, yielding a piece of the refractory needle ½ inch long.

New Theory of Coal Formation.

The *Bulletin de la Ceramique* points out that the theory enunciated by M. De Grand' Eury is opposed to the idea that large trees and shrubs produced coal; and in further support thereof it is stated that the carboniferous flora consisted of plants deficient in substances necessary for producing coal—the investigation of M. Gaston de Saporta on this point indicating that this vegetation consisted of a relatively thin circle of wood and of a large quantity of a softer substance. Brogniart and Elie de Beaumont attribute the formation of coal to the transformation of the close herbaceous vegetation which surrounded the larger forest trees and plants. Similar opinions have been expressed by M. Ponchet and other savants; so that M. Grand' Eury has more or less eminent authorities for his statement that a calculation of the accumulation of trees, etc., necessary for the conversion into even a thin coal bed of a forest suddenly buried under water, or gradually letting its residue gather on the ground, leads to an evidently erroneous result, so greatly is it necessary to exaggerate either the mass of vegetable matter or the duration of the process of coal formation. Even admitting for a moment that coal is produced by the decomposition of trees, M. Grand' Eury asks how it can be maintained that wood, in losing its moisture, has become liquid. Wood is known to contain a good deal of water, and coal has only traces of it. While he regards it as certain that coal was at one time liquid, and gradually assumed a solid shape, he considers that coal beds were formerly beds of naphtha and bituminous petroleum, produced by the decomposition of inferior aquatic vegetation under the influence of heat and dampness. As a proof of this assertion, he quotes the fact that the porous minerals found at the bottom of coal pits are impregnated in their pores with naphtha and petroleum. This is at once detected by their odor; and it is therefore argued that this naphtha could only have been absorbed during the first state of coal formation. It is further remarked that this theory serves to explain the formation of petroleum, asphalt, and other bituminous springs, which are found at various depths, and even at the bottom of some lakes. A porous soil would allow of filtration; and hence M. Fongas has remarked that in calcareous districts the coal found is usually of somewhat poor quality.

Photo Printing on Silk.

In the *Photographische Mitarbeiter* the following recipe for preparing silk for printing from is given:

No. 1.

Tannin	40 grammes.
Water	1,000 c. cm.

No. 2.

Salt	40 grammes.
Arrowroot	40 "
Acetic acid	150 c. cm.
Water	1,000 "

No. 1 is mixed with No. 2, well shaken, and filtered. The older the mixture, the better it is for use. In this bath the silk is thoroughly immersed, and allowed to remain for three minutes, when it is taken out and hung up to dry.

Sensitizing solution is composed of a silver one to ten, acidified with nitric acid.

Toning Bath.

No. 1.

Chloride of gold	1 gramme.
Water	200 c. cm.

No. 2.

Sulphocyanide of ammonium	20 grammes.
Water	500 c. cm.

No. 1, after shaking, is mixed with No. 2. In a few days the mixture will become clear, when it is ready for use. It is preferable to dilute with from two to four times the quantity of water. Fixing and washing as usual.