in the field of Fig. 2. It is this very experiment which for a long time puzzled Mr. W. de Fonvielle while he was conducting his known researches of 1880.* All the other armatures to be used here must be more carefully balanced than those used in the two-coil field of Fig. 2, since the effects produced in the circular field are notably more energetic.

This inexpensive motor, working satisfactorily as it does, will illustrate many principles bearing on the theory of polyphase machinery, and in particular those involved in experiments such as the following: insufficiency of an oscillatory field to produce rotation; character of rotating fields; effects of self-induction and resistance on the difference of phase; bipolar diphase motor; four-coil diphase field; rotation of magnetized and non-magnetized armatures; Arago's rotations; reactions of Foucault's currents on the field; synchronism and asynchronism; three-wire diphase arrangement; reversal of rotation; self-starting, slip, etc.

Thus our experimental motor, though not recommended as having any commercial value, will yet be found very serviceable in the lecture room.

THE SENSE OF SMELL IN SNAILS.

BY DR. ALFRED GRADENWITZ.

In the higher animals the various senses are localized in separate organs. This distribution, as we go down the scale of animal life, becomes less and less specialized, until in cellular forms it is hard if not impossible to distinguish any special sense organ. Mollusks may be said to occupy an intermediate position on this ladder of evolution. While they are in a measure possessed of true organs of sense, still these organs answer other purposes besides responding to sensations alone. An interesting instance of this behavior is afforded by *Helix pomatia*, the common snail, which has been recently made the subject of an extensive investigation by Prof. Emile Yung, of the University of Geneva, Switzerland. While previous naturalists had ascribed to the snail a strong sense of smell, it was not known where the sense organ was located. Prof. Yung shows that the sense is distributed over the entire body, in so far as it is not covered by the shell. Some parts, however, possess the sense of smell in a particularly high degree, viz., the two pairs of tentacles, the lips and the edges of the feet.

The following is one of the experiments made by Yung in carrying out his investigations. When a brush wetted with a drop of water was brought near a snail, immediate contact was necessary to produce a visible response, except in the case of the large tentacles which also contain an eye. Whenever the brush was brought within 1 millimeter of the eye, the tentacle was perceptibly deflected. Evidently this effect could be produced by the sense of sight, of heat, or of smell. Special experiments, however, proved the first two hypotheses to be inadmissible. Hence the sense of smell must be the cause of the snail's aversion.

In further investigating this sense Yung substituted camomile essence for the water. The odor was perceived at a distance of 4 millimeters. Whenever the brush was brought nearer to the animal (see Fig. 1), the tentacle would be deflected. Similarly the back would be depressed and the edge of the foot would be turned, when the camomile essence was brought near these parts of the body (see Fig. 2).

* Comptes-rendus de l'Academie des Sciences, 1er Semestre, 1880, p. 801.

Clearly the sense of smell is spread over a wide area. It may, however, be said that when repeating the same experiment, the response was found gradually to decrease in intensity, the snail becoming used to the stimulus. The sense of smell among lower animals

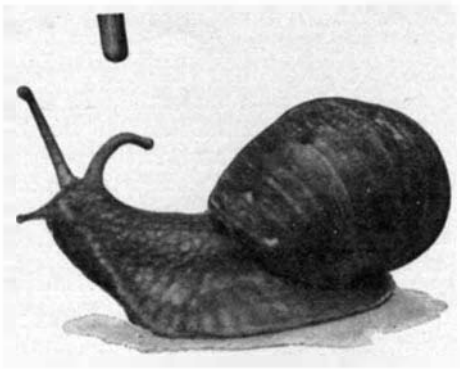


Fig. 1.—Snail Deflecting Left Tentacle at a Distance of 4 Millimeters from a Glass Rod Dipped in Camomile Essence.

plays an important part in the quest of food. Experiments made in this direction by Prof. Yung showed this rôle to be quite secondary in the case of snails, the food being perceived at maximum distances of only 15 to 20 centimeters, and 40 to 50 centimeters in some exceptional cases. The fact that snails are frequently found in kitchen gardens thus seems to be due not to their sense of smell, but to the moisture of the garden. The foregoing results are confirmed by histological investigations, the most sensitive parts of

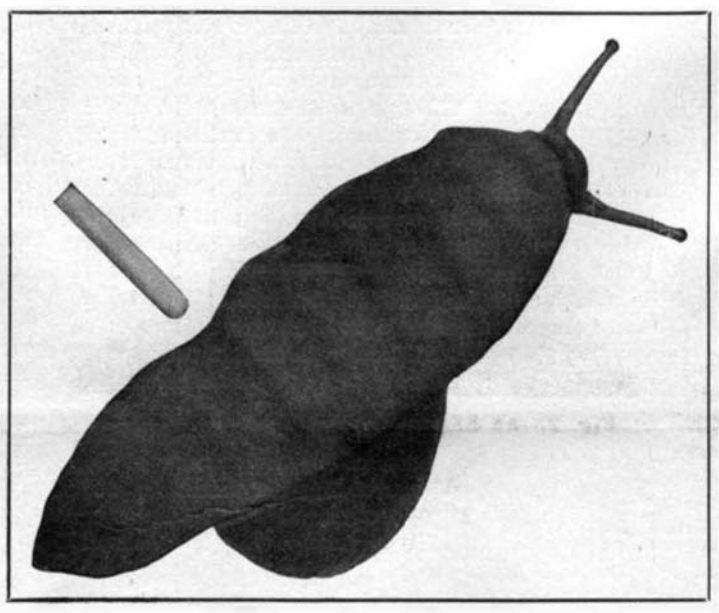


Fig. 2.—Snail Contracting the Edge of Its Foot at 2 Millimeters from a Glass Rod Dipped in Camomile Essence.

THE SENSE OF SMELL IN SNAILS.

the body being found to possess especially large numbers of sensorial cells.

The subdivision and localization of the organs of the senses is thus seen to be rather elementary in the case of snails.

A MACHINE FOR PICKING COTTON.

BY WILLIAM DALE.

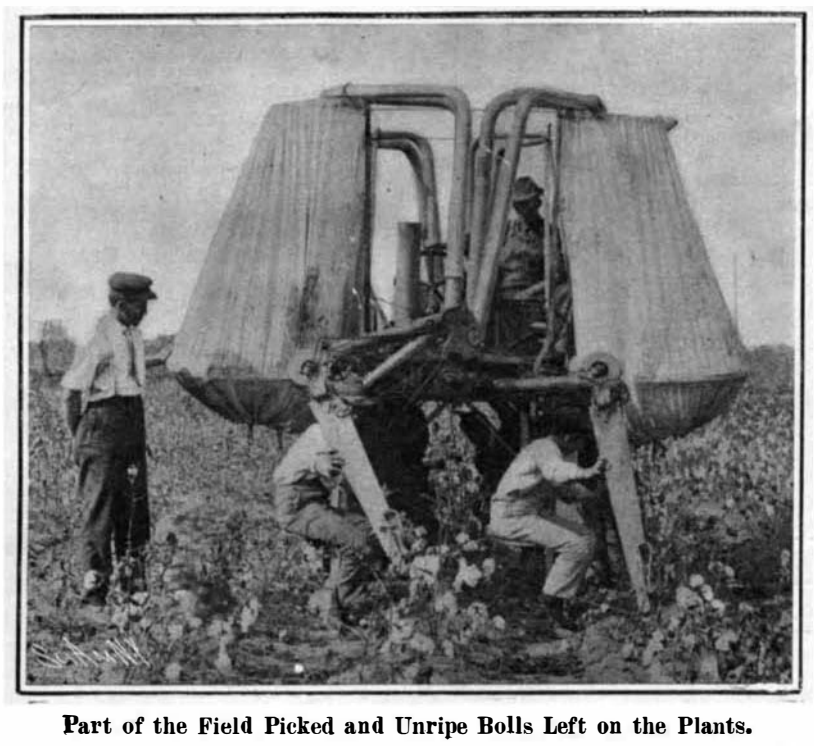
Since the invention of the mower, reaper, and binder operated by animal power and steam engines, the idea of utilizing mechanical means for harvesting the American cotton crop has been agitated. The revolution which was caused in agriculture by the modern methods of gathering the cereal crops indicated the saving in time and labor which could be effected in the southern cotton fields if a machine were perfected which would harvest the ripe cotton more expeditiously than the negro farm hand.

A number of devices has been invented to take the place of hand labor in gathering the cotton crop. With one exception, however, all of these have proved failures. The principal defect has been that the machines would harvest the immature as well as mature cotton. Those familiar with this branch of agriculture know that a field must be covered several times after the bolls begin to open, as, unlike grain, the cotton does not ripen with any uniformity. During the last harvesting season, however, a machine was employed in several of the Southern States, which proved to be not only a decided improvement over the ordinary hand method, but by its means only the ripe cotton was picked, the other plants being untouched.

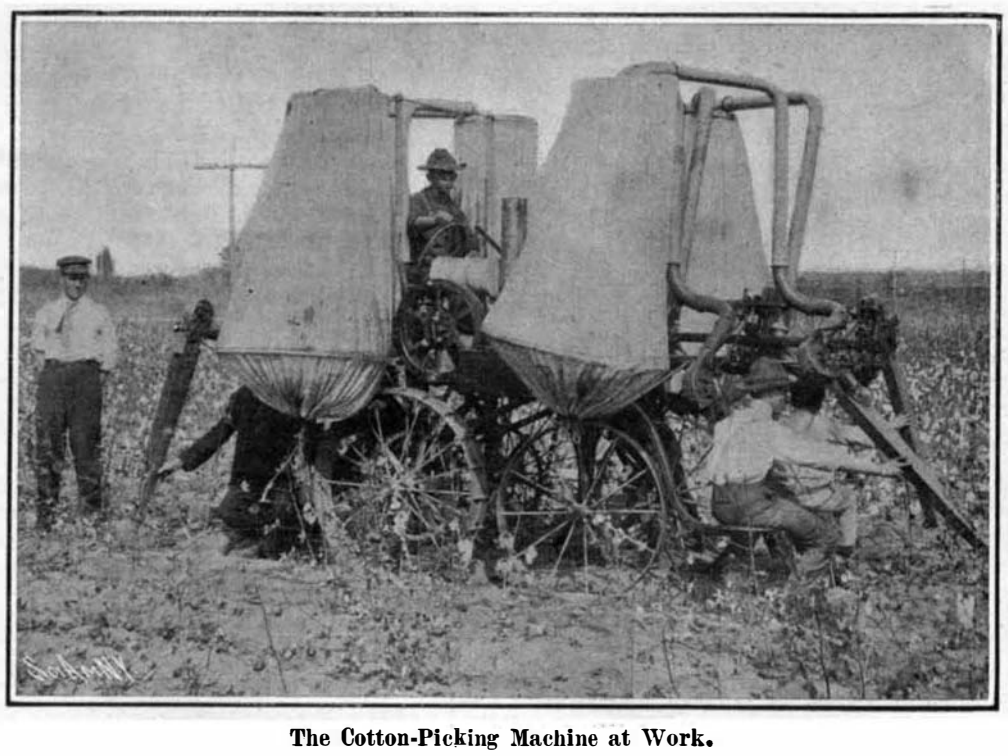
As the photographs show, this picker is notable for the simplicity of its construction. Power is obtained from an ordinary gasoline engine such as is utilized in automobiles of the smaller types. In fact, the engine installed in connection with the picker utilized in the field trials was taken from an Oldsmobile and developed but 8 horse-power. In moving the picker over the ground, gearing is employed as in traction engines. Sprocket chains pass around sprocket wheels on the rear axle, thence upward and around the driving shaft. The engine, which is mounted on the rear of the truck frame, as indicated in the photographs, is employed not only to move the picker over the field but to operate the mechanism by which the cotton is harvested and placed in the storage receptacles. There are four of the latter attached to the sides of the machine. They consist merely of cloth cylinders which are open at the top, the bottom ends being held together by strings so that when the cotton is to be removed it is only necessary to loosen the end by pulling the string, when the contents of the receptacle will fall out.

The lint is conveyed to the receptacles by tubes which are attached to the series of picking devices. The lower portions of these tubes, which are made of thin sheet iron, terminate in steel conduits of the same diameter inside. Each conduit or pipe contains a fan which serves two purposes. It "doffs" or cleans the cotton, blowing out any bits of leaves, casing, or other foreign matter which may have been caught up with the lint by the picker arm, and drives the lint through the tube into the receptacle with which it is connected, by air pressure.

The picker arms are dirigible in design and comprise eight in all, four attached to the forward section of the machine and four to the rear section, all of course being connected with the tubing leading to the cotton receivers and working in connection with fans. The picker arms are fastened to the conduits by means of hinged joints, and as the illustrations show, each consists of a case inclosing an endless belt which revolves upon pulleys placed at either end. This belt is provided with a series of curved teeth. At its outer end the upper part of the casing is cut away, so that the belt is exposed for several inches. When the cotton is to



Part of the Field Picked and Unripe Bolls Left on the Plants.

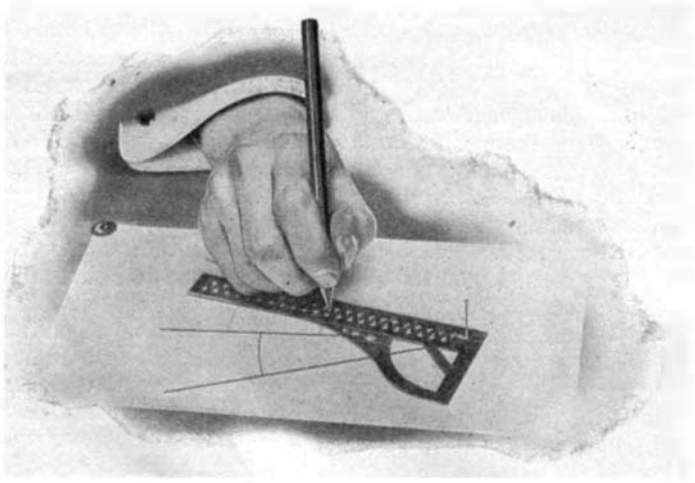


The Cotton-Picking Machine at Work.

A MACHINE FOR PICKING COTTON.

be removed from a boll the operator directs the outer end of the picking arm in such a position that the teeth engage the lint. As fast as it is stripped from the boll it is carried by the endless conveyor to the blower casing, as it is called, doffed, and forced through the tube into the receiving bag. The picking head, as it might be called, is provided with a shield intended to prevent hulls, leaves, and twigs from being drawn into the picker, but, as already stated, any small particles of foreign matter are removed by fans.

The means for actuating the picker belts and doffer fan consist of a light shaft running longitudinally of the machine and parallel to the fore and aft extension tubings. This shaft is geared to the engine through the medium of gears and friction clutch, the lever of the clutch being arranged convenient to the driver. This shaft has a constant speed and is independent of the motion of the machine through the field. Power is applied to the picker belt and doffer fan from this shaft through an arrangement of light sprocket wheels and chains, which permit the dirigibility of the picking arms without in the least interfering with their flexibility.



A CONVENIENT DRAFTING INSTRUMENT.

There are seats provided on the machine to carry four operators, and each operator is provided with two picking arms, one for each hand. The arrangements of seats and picking arms is such that when facing in the direction in which the machine is traveling over the field, the two rear operators face to the right, one picking one side of the center row and the other picking one side of the left outside row. Thus all of the center row and one-half of each of the outside rows, in all equal to two rows, are picked.

During the trials which were made in the cotton fields in North Carolina and Alabama, it was found that eight horse-power was ample to give the machine necessary momentum with its force of hands, also to operate the picking and transferring mechanism. The rate of speed in the fields varies of course according to the amount of cotton to be picked. Where a large proportion of the bolls are open the field is covered in less time than where a small quantity of cotton is ready to be gathered, but it is obvious that with devices which can be guided as described, only the mature cotton need be gathered. As the picking belts revolve at the rate of about 350 feet per minute and eight of the pickers are in continuous operation, the capacity of the machine is much greater than where expert negro labor is employed. During the tests in Alabama the machine moved at the rate of 31 feet per minute, picking three rows of plants simultaneously. In a day of ten hours it covered nearly five acres. The operators were young negro boys, constituting all of the manual labor with the exception of the engineer. In this trial the machine harvested 3,000 pounds of cotton in a day at a total cost of $4.75, including fuel and wages. At the usual price paid for cotton picking in this State the expense for harvesting the same quantity would be $15, while the machine covered a given area in one-sixth of the time which would have been required by six expert cotton pickers. In harvesting cotton in North Carolina the same results were obtained.

While the general design of the cotton picker allows three rows of plants to be harvested at one time, it can be readily enlarged to take in four or possibly five rows, and it is probable that with other improvements its capacity can be greatly increased, just as the harvester and binder of the wheat field has been radically changed since it was first introduced on the farms of the West. The inventor of the cotton picker, Mr. George A. Lowry, is now experimenting with several additional devices which are intended to further increase its speed and efficiency.

A CONVENIENT DRAFTING INSTRUMENT.

In the accompanying engraving we illustrate a very handy little drafting instrument, which may be readily used as a scale, a rule, a square, a curve, a protractor, and a compass. The form of the instrument, as clearly shown in the illustration, comprises two arms forming a right angle with each other and thus providing a square. The longer arm is graduated to sixteenths of an inch, while the shorter arm is provided with a three-quarter scale. Connecting the two arms is a web with its inner edge curved to the arc of a circle whose center is at the point where the two arms meet. The outer edge of the web forms an irregular curve, which the draftsman will find convenient for various purposes. The face of the web is graduated to the degrees of a circle, thus providing a ready protractor. When the instrument is used as a compass, it is arranged to turn on a pin as a pivot. This pin is held in a notch in the instrument by means of a small leaf spring. It will be observed that the longer arm of the instrument is pierced by a series of holes one-eighth inch apart. These serve to accommodate the point of a pencil when drawing the arc or circle. A series of notches are provided for the pivot pin. These are one thirty-second of an inch apart, so that if it is desired to draw an arc whose length is measured in odd thirty-seconds of an inch, the pin is shifted back or forward to the required notch. Larger holes are provided adjacent to the pencil holes, so that the paper can be seen immediately in advance of the pencil point. Circles can be readily drawn without the bother of adjusting a pair of compasses. The convenience of this instrument for work away from the regular drawing table will be apparent to all draftsmen, as it does away with the inconvenience of carrying around a lot of bulky instruments. This improved drafting instrument is being introduced by the Ready Manufacturing Company, of Rochester, New York.

A NOVEL TOY.

A very amusing toy for children is provided by the recent invention of Mr. H. E. Coates, of 820 K Street, Sacramento, Cal. The toy is in the form of an apparently docile mule which, nevertheless, is very balky, and will buck and kick in the most lifelike manner whenever any effort is made to make it move along. The toy beast is mounted on a wheeled base, the wheels being preferably toothed, in order to hold the base in position during the bucking performance. The fore-legs of the animal are rigidly secured to the base, and on the fore-legs the body is fulcrumed so that it can be swung into the position illustrated in our engraving. The eyes of the mule are painted on a pair of slides, and the latter are connected with the ears. A cord runs from these slides under a staple in the base to a lever near the fore-feet of the animal. Another cord connected to this lever passes around a catch at the side of the base, and leads to the operator. When the cord is jerked slightly, the mule throws back his ears and shows the whites of his eyes. A stronger pull makes him lift his hind-legs and kick. The hind-legs and tail are connected by cords to the fore-legs, so that they assume a very lifelike position when the mule kicks. To add to the amusement, a toy rider is mounted on the animal, and it is part of the game to make the beast buck so violently as to throw his rider. Vicious as the beast may seem, he can be quickly pacified by slipping the cord off the catch at the side of the base, and then when the cord is drawn, the lever will swing forward against the staple, and the mule will meekly submit to be drawn anywhere around the room.

A NOVEL TOY.

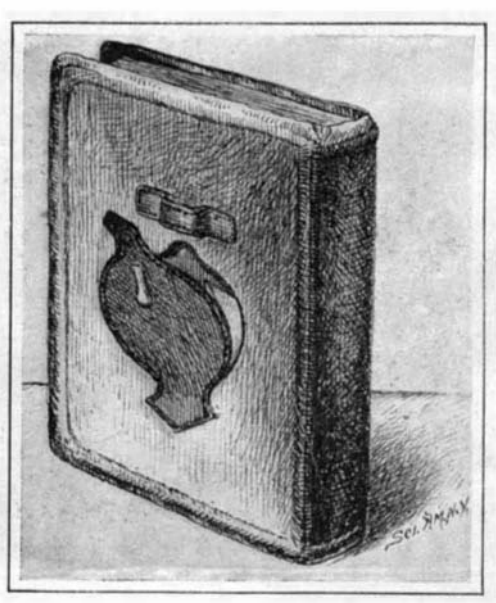
RETAINING DEVICE FOR BARRELS.

A patent has recently been granted to Mr. F. C. dos Passos, Augusta, Ga., on a device adapted to be placed in barrels to retain and compress goods in brine. The device is exceedingly simple, and is designed to take the place of the unsightly weight commonly employed for this purpose. As shown in the accompanying engraving, it comprises a cover, which is placed in the barrel and held in contact with the articles in the brine by a screw. The latter is threaded through a bar, which is held in place in the barrel by means of springs projecting from the opposite ends. The bar is of a concavo-convex form, and the springs secured thereto are cut with double points. The device is placed in the barrel with the concave side uppermost, and the spring points engaging the side walls of the barrel serve to fix the bar against upward movement, and thus provide a good bearing for the screw. Access to the fish, pickles, or the like, below the cover, can be had by unscrewing this screw and tipping up the cover. The bar can be readily pressed down into the barrel, as required. The screw is so adjusted that the bar lies wholly above the liquid, so as to prevent corrosion of the spring points. The only parts that are liable to come in contact with the brine are the cover and the screw, which is preferably made of wood. When it is desired to disengage the bar, it may be inverted by swinging it laterally, when it can be readily drawn out. The spring points may also be adjustably attached to the bar, so that when they are loosened the bar may be removed without being inverted.

RETAINING DEVICE FOR BARRELS.

BOOK PURSE.

A very novel idea is presented in the accompanying engraving which shows a hymnal, prayer-book, or religious manual, fitted with a purse in which money for the contribution can be carried. The purse is large enough to hold a number of coins without increasing the bulk of the book, or detracting from its appearance. In the cover of the book a pocket is formed, and this is covered by a flap mounted on the cover of the book. Folding side pieces connect the flap with the book cover, to prevent the money from falling out when the purse is opened. The purse is closed by a tongue at the upper end, which is slipped under a loop or strap, secured to the book cover. The tongue may be withdrawn from the loop by pulling on an ear connected with the flap. The upper end of the pocket is provided with a recess, to permit of slipping the finger into the purse and under the coin. The purse does not detract from the appearance of the book, but on the contrary the flap is artistically designed and serves as an ornament. The device will prove of great value to ladies, who have heretofore been obliged to carry their contributions in their gloves, with the danger of losing the money and the inconvenience of getting at it when it is wanted. The book purse is the invention of Miss Emma L. Sweet, of Wallace, Idaho.



A BOOK PURSE.