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.

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

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

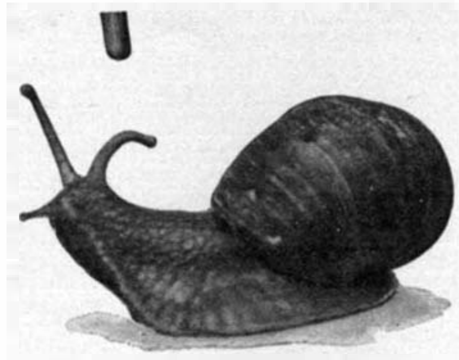


Fig. 1.—Snail Deflecting Left Tentacle at a Distance of 4 Millimeters from a Glass Rod Dipped in Camomile Essence.

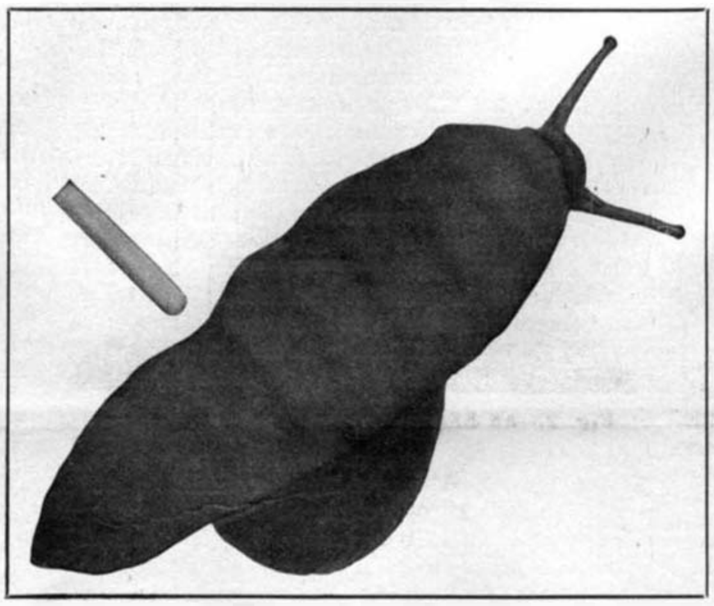


Fig. 2.—Snail Contracting the Edge of Its Foot at 2 Millimeters from a Glass Rod Dipped in Camomile Essence.

THE SENSE OF SMELL IN SNAILS.

The 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.

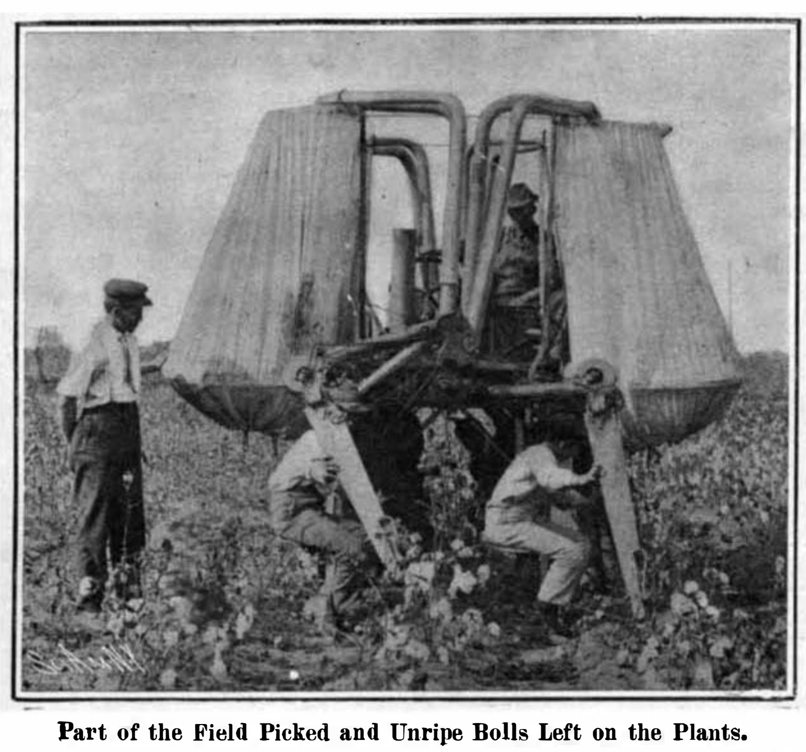
Since the invention of the mower, reaper, and binder operated by animal power and steam engines, the idea of utilizing mechanical means for harvesting the American cotton crop has been agitated. The revolution which was caused in agriculture by the modern methods of gathering the cereal crops indicated 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.

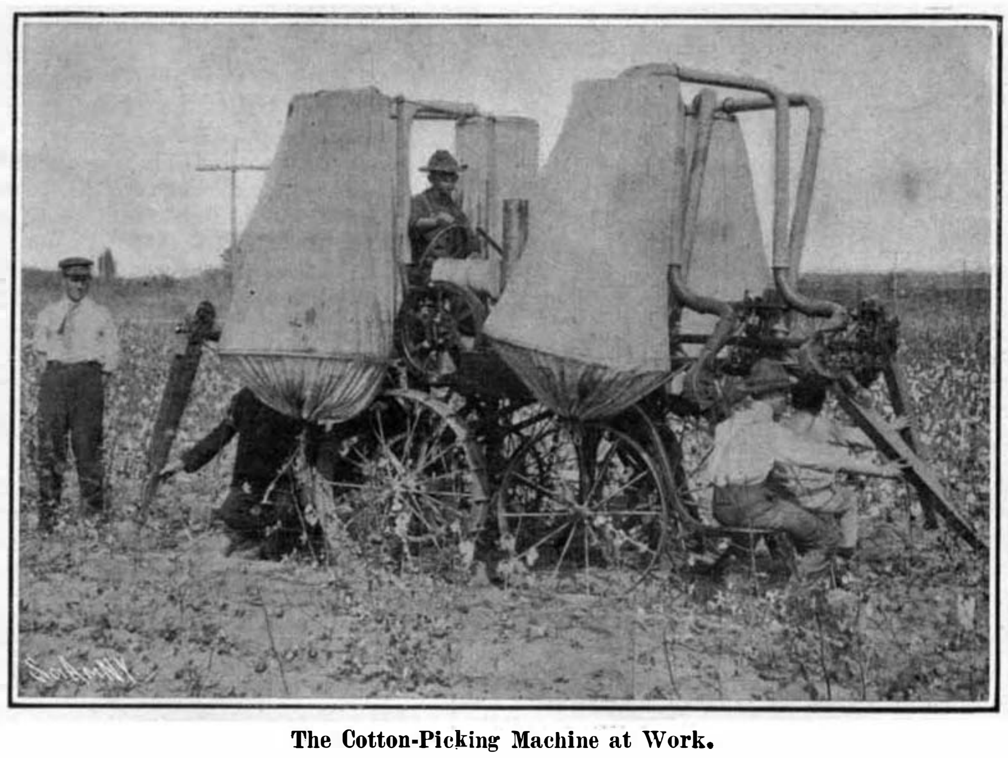
As the photographs show, this picker is notable for the simplicity of its construction. Power is obtained from an ordinary gasoline engine such as is utilized in automobiles of the smaller types. In fact, the engine installed in connection with the picker utilized in the field trials was taken from an 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.