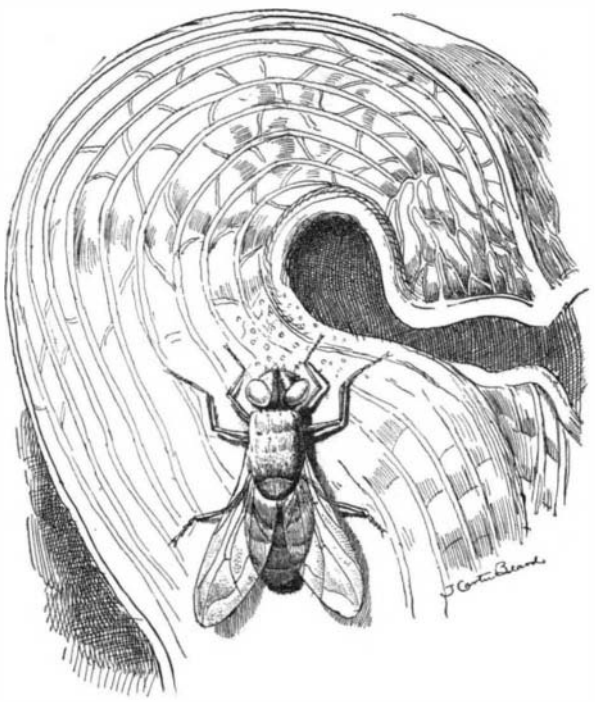
WHERE INSTINCT FAILS.

BY J. CARTER BEARD.

Let the reader, as he finds occasion and opportunity, try the following experiment:

Take a deep, wide-mouthed jar, say from seventeen to twenty inches long, with a neck from five to seven inches in diameter. In this imprison a bee and two or three flies. Place the bottom of the jar squarely



FLY (FEEDING UPON THE HONEY-DEW FURNISHED BY THE SARRACENIA) ABOUT TO ENTER THE PLANT UNDER THE HOOD.

against a pane in the window, drop the curtains about the jar, and unstop its mouth. The flies will invariably make the most of the opportunity given them to escape; the bee, on the contrary, though popularly supposed to be the wisest of insects, will buzz inanely about the closed end through which the light comes, without seeking to escape in any other direction. Light and liberty with the bee are synonyms, and she will perish rather than prove false to her convictions. You can keep her confined with the back door of her prison house wide open as long as you choose; she will not find her way out. Open the window, reverse the jar, and she is off rejoicing about her business, for she is a business female in the strictest sense of the word, a person of regular habits, wedded to a life of routine, within the bounds of which her abilities are indeed wonderful.

Mr. Fly, on the contrary, an idle fellow, "a man about town," whose irregular habits subject him to in-

A BEE (CHALICODOMA) ERECTING A SKYSCRAPER UPON A CELL ALREADY BUILT.

numerable perils, has developed a faculty for getting out of scrapes which, though perhaps not equal to that he possesses for getting into them, is superior to anything of the sort his more industrious compeer can boast of.

Near the cottage where an experiment similar to the one here described was, in pursuance of the suggestion of Sir John Lubbock, tried, grew some pitcher plants; and toward these, as if to show that the instinct of flies also has its limitations, the prisoner that first escaped from the jar made his way. These pitcher plants are the tippling places of fast insects of various sorts, particularly flies. Spread about the opening to the vegetable saloons is a regular free-lunch counter open to all comers. Mr. Fly, attracted by the drops of nectar upon the curious leaf of the Sarracenia, unsuspectingly follows the trail of treacherous sweetness to the portals of the vegetable saloon where the nectar is abundant.

He is a thirsty individual; perhaps his free lunch makes him more so; and the cool, green depths of the pitcher-plant contain a store of tempting liquid refreshment. He crosses the hospitable threshold and enters what is to him a spacious and elegant apartment, strolling along, stopping here and there to sip a drop of nectar, until he is well within the walls of the enfolded leaf. Here he encounters a glazed zone; a portion of the leaf of such a peculiarly smooth and slippery surface, consisting of delicate, overlapping glossy hairs, upon which even he, that can walk upside down upon a glass skylight, finds it difficult to keep his footing. He slips and falls, but spreading his wings, flies and attempts to alight on the opposite side, a little further down perhaps, to avoid the slippery zone, but encounters a surface thickly set with stiff, downward-pointing hairs, that affords him no footing; and even if he succeeds with the greatest difficulty in alighting, prevents his progress upward. Taking flight again and pounding against the walls, bewildered, tired, perhaps stupefied or intoxicated by the food he has taken, he inevitably, sooner or later falls into the liquid at the bottom of the tubular leaf, a pool of death in which are already imprisoned the bodies of numerous previous victims, and so incontinently becomes a subject "to point a temperance lecture or adorn a tale."

Nor is this the only way in which the instincts of flies mislead them. There are certain fungous growths belonging to the Phallus family, which give out a fetid odor very attractive to flies, which lay their eggs upon them, as they would upon decaying animal substances, with the result that the larvæ when hatched perish for lack of food; this is also the case with the odors of several other plants. A smell of cooking cabbage, for instance, has an attractive effect upon bluebottle flies, which if not shut out gather in swarms about the place where that delectable vegetable is being prepared for the table. Sir Stamford Raffles, the discoverer of the *Rafflesia Arnoldi*, a large, fleshy parasite growing out of the roots of other plants, writes:

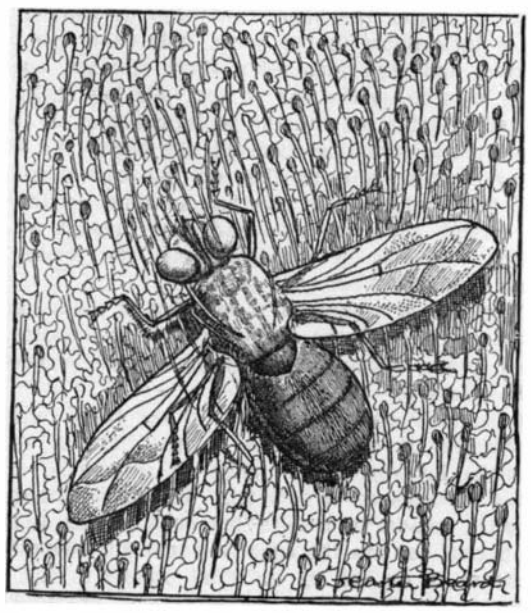
"When I first saw it, a swarm of flies were hovering over the mouth of the nectary and laying their eggs in the substance of it. It had exactly the smell of tainted beef."

Some very interesting and amusing experiments have been made in endeavoring to determine the nature of the instinctive faculty that impels the mason bees to build their curious structures. Mason bees fashion nests of very solid masonry. *Chalicodoma muraria* is solitary in her habits; she constructs her habitation alone and unaided, usually selecting a bowlder of considerable size as a solid basis upon which to build an adobe edifice of a suitable sort of earth moistened with her own saliva. When this is about an inch high she proceeds to fill it about half full of honey and of pollen; lays an egg on it, and closes it over with a roof of cement. After eight or nine of these cells have been completed she adds an additional protection, a thick layer of mortar placed over the entire construction.

A cell in an early stage of construction was taken away, and in place of it was substituted one already built and stored with honey and pollen. One would, in such a case, naturally suppose that the mason bee, glad to be saved so much labor, would simply supply the necessary egg and seal up the cell. But no, indeed! the regular, ancient and established custom in the *Chalicodoma* order of procedure is far too important to be disturbed by a little thing like this; the bee calmly goes on building until the cell is built up as much as a third more than the proper height; then, although a sufficiency of provision for the larvæ had been already supplied, she wastes labor in adding thereunto a second and a supererogative store of food.

Another experiment consisted of piercing a hole in the cell below the part where the bee had been working. In this case the bee is of the same genus, but of a different species from that just described; it is the *Chalicodoma pyrenaica*. This species builds cells as does the other, but fills them with honey as she goes on, raising the walls a bit, then going on several expeditions for honey, then building up the walls again, and so on until the cell is finished.

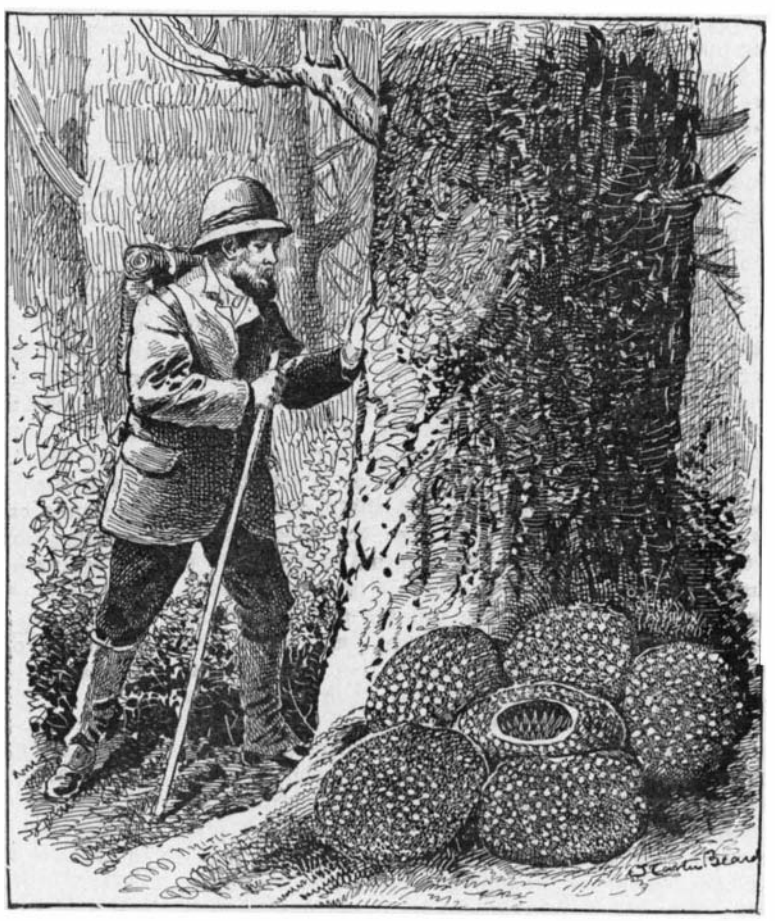
A cell was chosen which was almost completed, and while the bee was away a hole was pierced in the cell below where the bee was working, allowing the honey in the cell to gradually escape. Entirely ignoring an incident so contrary to precedent and established usage, the bee on her return calmly worked



SMALL FLY ENTRAPPED BY THE BRISTLES OF SARRACENIA.

away as if nothing had happened, adding mortar to the edges of the cell and honey, which immediately ran out, leaving the nest empty. This experiment was repeated many times with differences of details, but none in the results. As it might possibly be conjectured that the bee had failed to notice the injury a cell was selected which had but a very little honey in it. A large hole was made in this, which the bee returning with the honey certainly noticed, for she went down to the bottom of her cell, and not only examined the aperture carefully, but felt its edges with her antennæ and pushed them through it. Did she then, as might naturally be supposed, stop it up? Not at all. To do so would be to prove false to all the traditions of her race—be a departure from the immemorial usages of the Chalicodomians, and introduce a new and a disturbing element into the ancient and honorable order of mason bees.

However this is, the poor, devoted creature went on emptying into this vessel load after load of honey, which, as a matter of course, escaped at the bottom as fast as she emptied it at the top. All of one long, hot summer afternoon did she labor at this bootless task, and began again next morning. At last, when, regardless of the result, she had performed her prescribed duty in the prescribed manner, made the cus-



THE PLANT RAFFLESIA ARNOLDI, GIVING OUT THE SMELL OF TAINTED BEEF, UPON WHICH FLIES LAY THEIR EGGS.

tomary amount of journeys and supplied the usual amount of honey, she conscientiously laid her egg and closed up the empty cell.

A detail of her work shows its absolutely automatic character. When the bee brings provisions to add to the stock it has already collected she carries both honey and pollen; in order to deliver these she begins by going head first into the cell and disgorging the honey; then, coming out, she turns around and backs into the cell, and brushes and scrapes off with her hind legs the pollen, quantities of which adhere to the hairs that grow upon the under surface of her body. If, after the honey has been discharged, the bee is interrupted in her work, induced to get upon a straw and then removed a short distance, she returns as soon as she can to complete her task; but instead of going on with the performance at the point where the interruption occurred, she begins the series all over again, entering the cell (at least partially) head first, although she now has no honey to deliver; and having spent the time and gone through all the motions required by this ceremony, she comes out, turns around and adds the pollen.

These are, of course, but a very few of the instances where instinct, or the reflex actions often called instinct. prove inadequate to accomplish the purpose of their existence.

It is quite common to speak of the intelligence of insects, but it really seems, in the light of recent scientific investigations, almost as correct to speak of the intelligence of a watch. Insects doubtless accomplish wonderful results, but such results seem to be effected (as are the equally wonderful adaptations of means to an end by the vital organs in our own bodies) by automatic, unconscious, and unintelligent obedience to internal or external stimuli.

Engineering Notes.

From London comes the news that Mr. Drummond, the engineer of the London and Southwestern Railway, has succeeded in applying the water-tube boiler to locomotives of his line. So eminently successful were the trials that it has been decided to use water-tube in place of fire-tube boilers. A Times correspondent states that in a journey from London to Sailsbury a water-tube engine, drawing twelve cars, finished the trip without any difficulty whatever and without any priming. The coal consumption is said to have been less than 29 pounds to the mile.

A writer in Nature points out the advantage that would be gained by the use of magnetic iron ore as a material for concrete blocks. He points out that if magnetite is used instead of ordinary rock in the shape of fragments, and magnetic sand or ilmenite sand instead of common sea sand, concrete blocks can be obtained which have all the strength of the ordinary concrete blocks, and which weigh, when immersed in water, exactly twice as much as the ordinary blocks. Such an increase in weight makes the magnetic blocks far superior as regards resistance to the waves. Work constructed with magnetic blocks will stand when other work will be destroyed.

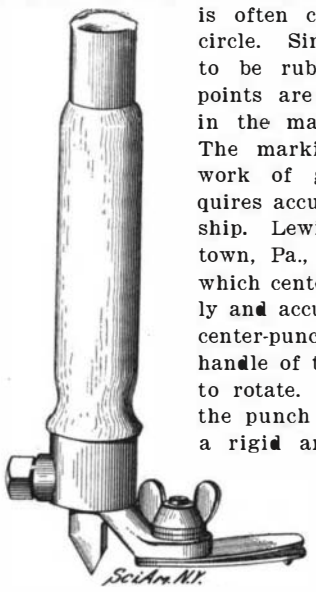
The president of the British Board of Trade has just issued the new rules for the prevention of accidents to railway employés. An English correspondent observes that the action is somewhat belated, considering that it is two years since the Automatic Couplings Act was passed. It seems incredible that more lives are sacrificed each year on the railways than the total casualty list of eight of the biggest battles in the Transvaal. By the new rules the use of the pole for coupling and uncoupling purposes will cease at the end of this year, and all new wagons will be fitted with brake levers, while within a period of ten years the old rolling stock will be similarly improved.

For many years the steam engine was a machine of low rotational velocities, the piston speed averaging two hundred and fifty to three hundred feet per minute only, and this was due chiefly to inadequate machine tools and shop facilities which would not turn out work sufficiently true to allow higher piston speeds. For instance, bearings were not round and plane surfaces were not true; as a result, the wear and friction were great and shafts heated and cut. After better work was done the speeds were increased, so that now it is not unusual to find engines running at three times the speed of twenty-five years ago. One great obstacle then was the wear of details, but the improvement in mechanical construction has been so great that there is actually less wear at high piston speeds than was the case when low speeds were used. One high-speed engine that had been in constant use for 1,560 days, thirteen hours daily, was lately examined, with the following results as to wear: Journals generally, from 0.002 to 0.007; connecting rod brasses in crown, 0.02; crosshead pin, greatest wear in one part, 0.002; eccentrics, no wear. Another engine of a different make was examined after three years' constant use daily, and was in such good condition that it was connected up and started again without any repairs whatever.

Patent Department

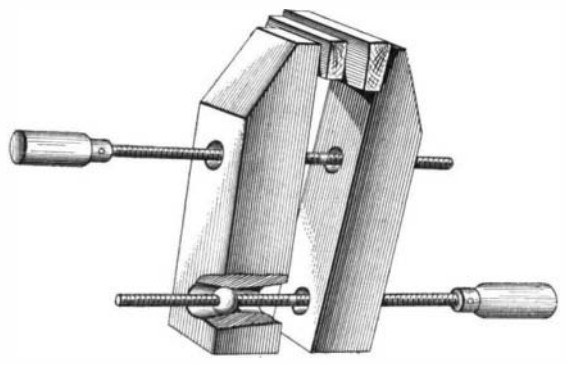
SIMPLE AND INTERESTING INVENTIONS.

Tool for Centering Drills.—In marking the center of a hole to be drilled with a center-punch, the metal is often chalked to describe the circle. Since this circle is likely to be rubbed out, a number of points are pricked with a punch in the material along the circle. The marking of the points is a work of great precision; it requires accuracy and fine workmanship. Lewis Williams of Johnstown, Pa., has invented a tool by which centering can be more rapidly and accurately accomplished. A center-punch forms the axis of the handle of the tool, and is mounted to rotate. A socket is secured to the punch by a setscrew and has a rigid arm to which a bar is pivoted, carrying a center point. The bar and arm are clamped in adjustable relation. It is obvious that the two points can be brought to any distance within the limits of adjustment, and that the centering point can be applied to prick the center. The center-punch can then be swung around on the center-point as a center and tapped with a hammer to make an indentation.



TOOL FOR CENTERING DRILLS.

Clamp.—The ordinary carpenter's clamp has the defect that it cannot be adjusted to any desired angle. Hans Jorgensen, of Chicago, overcomes this defect by using right and left threaded handscrews. The jaws



CARPENTER'S CLAMP.

are bored laterally to receive short pieces of shafting, each of which is bored to receive the right and left threaded handscrews. By means of this construction the jaws can be set at almost any desired angle to each other, thereby obviating the necessity of using additional plugs in connection with the parts to be clamped.

Sword-pistol.—Domenic A. Ricco, of Long Island City, N. Y., has combined a sword and a revolver in such a manner that one handle serves for both. Hence either weapon can be used without changing the grip. First the revolver can be brought into use until all the cartridges have been fired, and then the weapon can be used as a sword or cutlass.

Lawn-sprinkler.—Among recent interesting inventions is a lawn-sprinkler for which a patent has been granted to A. Vandervoort, of Belleville, Canada. The nozzle of the sprinkler is automatically swung through a horizontal orbit and is at the same time slowly moved up and down, through a vertical arc, thereby largely increasing the area of lawn affected by the sprinkler. A flexible tube connects the nozzle to a rotating plug slowly driven, through gear connection, by a water-motor wheel. A thread formed on this plug engages and rotates a worm wheel. The nozzle is connected to cranks on the shaft of this worm wheel, thereby receiving its vertical movement. The speed at which the sprinkler operates is governed by regulating the amount of water used for turning the motor wheel. The base is provided with brace-arms to prevent the sprinkler from tipping under the pressure of the stream of water.

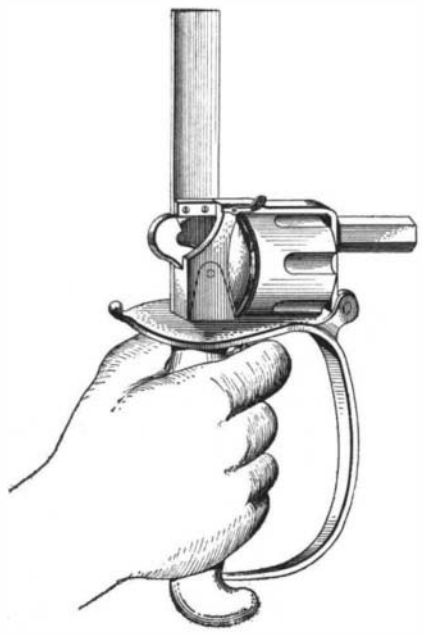
The Inventors' Institute.

Our contemporary The Electrical Age publishes a letter from "An Old Inventor," which calls attention to a matter of sufficient importance to enlist the sympathies and active co-operation of everyone interested in engineering.

The letter very truly states that most inventors are men without means to construct their machines, and suggests that one of the greatest needs of the present day is the establishment of an institution for the assistance of inventors. If a model shop could be established on a self-endowed basis, the writer believes that men of science could easily be prevailed upon to act as governors and pass upon the inventions submitted to them. Just how great the scope of such an institution would be, could be determined only by experience. It goes without saying that, by helping the inventor, science in almost every branch would be rapidly advanced.

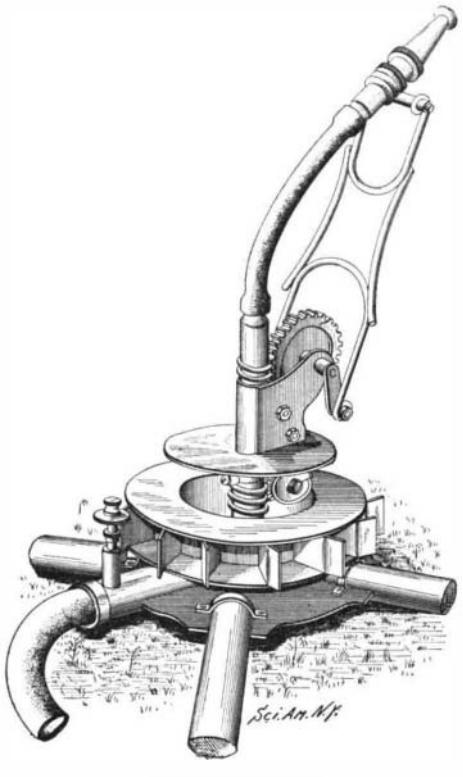
The Qualities an Inventor Must Possess.

There is no pursuit more fascinating than that of an inventor, writes Emil Berliner in the Saturday Evening Post. The inventor is privileged to dip into every calling. If he has the right sort of mind, it is not at all essential that he understand everything connected with the art with which he desires to make himself familiar. He need only take that particular corner wherein the problem that he is after lies, and work it thoroughly. But thorough the work must be. He must



SWORD-PISTOL.

have more than the patience of Job, more than the perseverance of the beaver, more than the industry of the bee. He must work hard, and be content to work for months at a time without making any apparent progress. He must be content to travel over the same field again and again and again, indefatigably. That is the secret of the inventor's success—never-ending application. The idea that an inventor is necessarily a genius is entirely fallacious. Genius for invention is merely the capacity for concentration and for work. Given these qualities, and a power of close observation, and you have the make-up of a successful inventor. He need be no learned scientist, and yet he may be able to work up most valuable inventions in many sciences. He need be no perfectly trained electrician, and yet he may be able to work up a valuable electrical appliance. But always he must be prepared to take advantage of new phenomena, and to know all about



LAWN-SPRINKLER.

the field in which they lie. Many of our most important inventions are the result not so much of deep knowledge as of the power of observation and the ability to appreciate the possibilities of phenomena that the less observing would pass by without seeing.