LIFE IN THE BEEHIVE.

The following is from a recent lecture by Professor Agassiz, at Cambridge, Mass., reported in the New York *Tribune:*

At the close of my last lecture I made some general statements concerning parthenogenesis, a peculiar mode of reproduction by virgin females, first investigated in some families of insects, among which the progeny thus brought forth consists of males and of males only. In the family of phyllopods, among crustacea, this process obtains also; but the progeny in this case consists, on the contrary, of females only. The deportment of these animals at the time of reproduction is so singular, they exhibit faculties so peculiar, that they have been the objects of careful observation. Their seemingly intelligent action, known as instinct, has been compared with the intellectual powers of the higher animals and even with the mental faculties of man himself. A knowledge of the facts is therefore important to a just discrimination between those two faculties, which are considered by some as entirely distinct, while others regard them as modifications of one and the same power. It is often said that the possession of reason places man above the brute creation, to which instinct peculiarly belongs; and yet the facts do not justify such a distinction, as we shall find if we study carefully the lives of some of these creatures.

THE BEEHIVE COMMUNE.

The beehive consists, when in full activity, of one queen, several hundred drones, and many thousand working bees. These constitute a community by which a combined system of labor is carried on, transcending in many respects the most complicated actions of man himself. Their structure shows no organ similar to those by which the mental functions are manifested in the higher animals and in man.

INSECTS HAVE NO BRAINS.

They have no brain proper, nor does their nervous system correspond in any way to that of the vertebrates. In all vertebrates the solid front mass of the nervous system which we call the brain is prolonged backward into a long cord, known as the spinal marrow, from which many nervous threads arise and branch, spreading through the whole organization. The brain and the spinal cord, in fact the whole central nervous system, are inclosed in a cavity, the skull and rachitic canal, separate from those in which the organs of digestion, respiration, circulation and reproduction are contained—the chest and abdominal cavity. For the articulates, on the contrary, to which all insects, crustacea, and worms belong, the nervous system is scattered along the length of the body in a succesion of swellings connected together by threads. The first of these swellings is situated in the head, above the alimentary canal; the rest are at regular distances along the lower side of the body. Thus it appears that the battery from which all volition starts, by which all the acts of life are performed or regulated, through which all external impressions are communicated and acted upon, are very different in these two types of the animal kingdom. It is therefore hardly probable that the life work done by these organs should be the same.

INSTINCTS OF BEES.

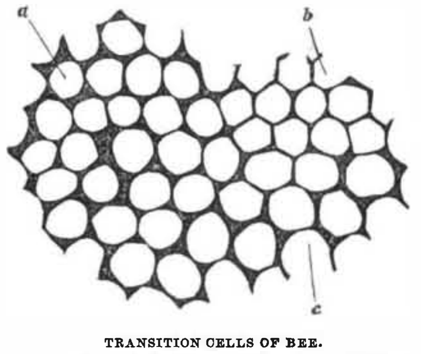
Let us look at some of the acts by which the quality we call instinct is manifested in a community of bees. When such a community becomes too populous for a given hive, the bees "swarm," as it is called; that is, a part of the overcrowded population separates from the rest and goes off to establish a new colony. In such case the emigrants are chosen or form their own band with direct reference, seemingly to the future welfare of the new colony, preserving the numerical proportions characteristic of all prosperous hives. The swarm consists of one queen, some thousands of working bees or undeveloped females, some hundreds of males or drones. This is the normal combination in the bee community, and hives so organized may survive and keep together for many years.

DURATION OF BEE LIFE.

There are reports of beehives a century old. This is, however, probably an exaggeration; for beehives 20 years old are rare, and they do not often survive more than seven, eight, or ten years. When I speak of the life of a beehive, I do not mean to say that the individuals composing it live together for that length of time; indeed, a queen rarely lives beyond three or four years; one of seven years is seldom seen, while the males never survive the summer in which they are born, and the working bees die gradually and are replaced by new ones. But the hive as a community holds together for a much longer period, being constantly renewed by the process of reproduction, and comes at last, like a human settlement, to consist of a variety of individuals born at different times. When a swarm breaks off from an old community to form a new colony, the division is generally due to the appearance of a new queen.

REMARKABLE FACTS CONCERNING THE QUEEN BEE.

The queen bee, usually quite contented with her lot, watching over her progeny, active and patient in the care of her eggs, becomes furious if a rival arises in the hive. She pounces upon her, and they sometimes fight to the death. So well is this understood in the hive that the workers take care to prevent such conflicts by holding back the new queen, just ready to be hatched from her royal cell, till the bees have swarmed. At such a time the workers will stand by the cell, out of which a queen is to be born, ascertain how far her transformation is completed, and, should there be a disposition of the young queen shortly to creep out, they increase the deposit of wax upon the lid which shuts the cell, thus preventing the egress of the royal prisoner. If she tries to break through or attempts to gnaw her way out, the workers crowd around the opening or accumulate such an amount of wax upon it as to frustrate all her efforts. When the old queen has peacefully departed, the new one is set free. What makes this fact more extraordinary is that usually the workers have never seen the birth of a queen or perfect female before; their hive has known but one queen, and yet they anticipate and guard against all the dangers likely to arise from a second. Can it be that these creatures do the right thing at the right time consciously, by means of any faculty similar to our reason?



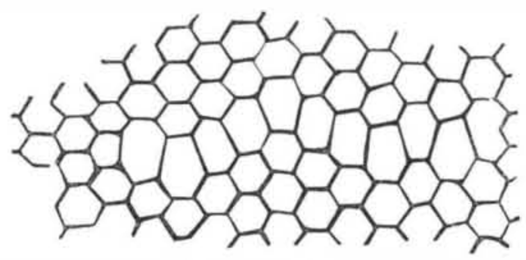
TRANSITION CELLS OF BEE.
a. b. Rows of intercalated cells. c. Drone cells.

CONSTRUCTING THE HONEYCOMB.

The swarm, having escaped, chooses a place for the new colony—a cavity in the rocks, perhaps, or a sheltered notch among branches of trees. The swarm having alighted near a favorable spot, a single working bee—one out of twenty thousand, perhaps—starts from the crowd and lays, not the first stone, but the first piece of wax which is to be the foundation of a new comb. Before swarming, they have provided themselves with an ample supply of wax and food, and are prepared to build their new home.

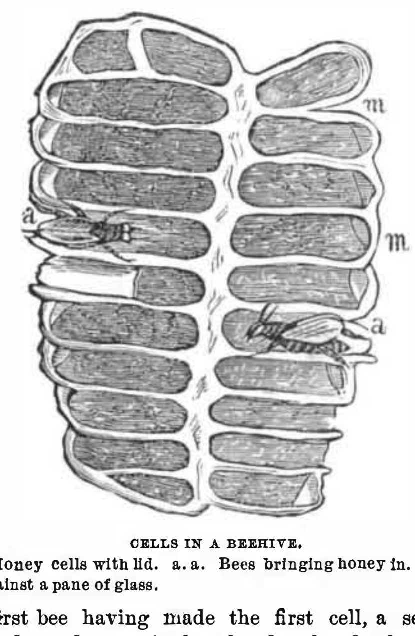
TRANSITION CELLS.
a. Working bees. b. Drones.

The construction of a honey comb, with a double row of cells on opposite sides, dovetailed into each other, and with larger cells for the drones and the special cells for queens, is so well known that I need not dwell upon what every encyclopædia will give. The first cells, being raised upon an uneven surface, are often irregular and may be uninhabitable on that account, but they then make the foundation for perfect cells, whose regularity and precision of form and relation have been the wonder of all ages. The irregularity of the first cells, adapted to the unevenness of the surface, seems only another evidence that these animals work deliberately, not like machines. Dr. Wyman has published a most interesting paper upon the irregularities of the cells in a honeycomb.



WORKER CELLS.
Showing variations in the form and size of the mouth. Copied from Professor Wyman's paper.

I dwell upon the fact that the first cells present every possible variety of shape modified to suit the situation, because it is not generally understood.

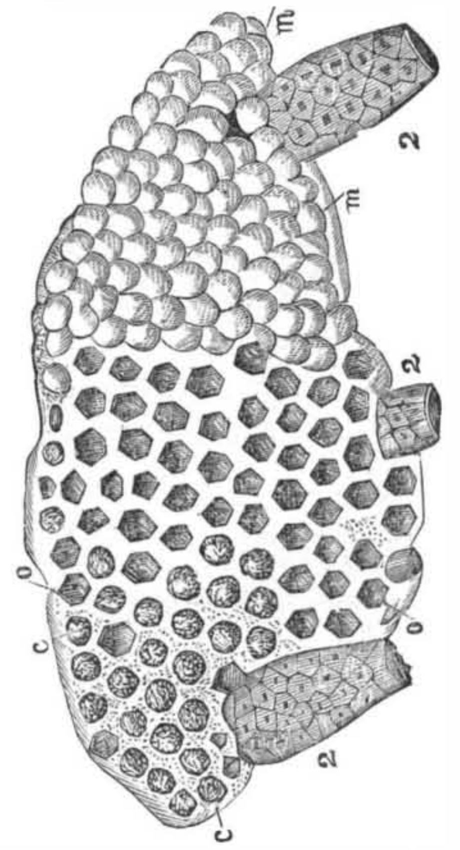


CELLS IN A BEEHIVE.
m. m. Honey cells with lid. a. a. Bees bringing honey in. The whole is seen against a pane of glass.

The first bee having made the first cell, a second bee comes and stands opposite her, head to head; then another at her side, so that the two stand side by side, and the rest follow in definite position, each building a cell around itself until gradually a good sized comb is built, it may be a foot in length and six or seven inches in depth, the width being uniformly that of a double row of cells. All this work is done by the imperfect females or so-called workers. Neither drones nor queen take any part in it. The working bees, on the contrary, are ever active, bringing in supplies for the community, swarming out daily to collect honey, filling the cells, as fast as they are completed, with food, and then closing them to prevent escape, thus securing large stores of honey. The drones meanwhile look lazily on. Sluggish and inactive, they seem to have different temperaments from the working bees.

THE DISTINCTIVE CHARACTER OF THE CELLS.

The honeycomb being sufficiently advanced, the queen now begins to lay her eggs in the cells. Here comes in another marvelous evidence of that power we call instinct. We have seen that a certain numerical proportion is essential to the well-being of a hive. There must be but one queen and at the most two or three queens' eggs, and even then trouble is sure to arise when these are hatched; there must be several hundred drones, and there must be many thousand workers. In preparation for this, the workers have laid out the cells as systematically as if they had been guided by a superior intelligence; special cells adapted for the eggs out of which thousands of imperfect females or workers are to be produced; others somewhat larger, intended for the development of the less numerous drones, and a very few so-called royal cells, still larger than those of the drones, many times larger than those of the workers, and of a very peculiar form, out of which perfect females or queens are to grow.

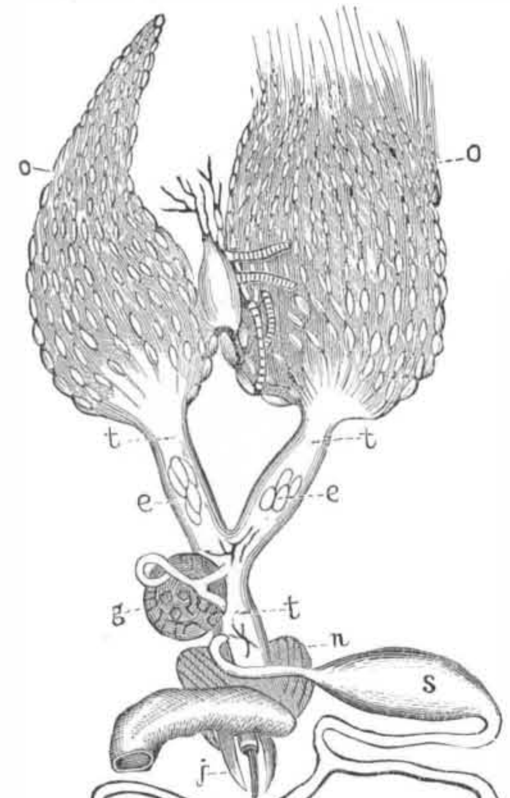


THE THREE KINDS OF CELLS.
m. m. Honey cells, closed. c. c. Cells with young bees, closed. o. Open cells. 2 2 2. Royal cells open.

The queen cells stand out from the rest of the comb, and have a large opening. Two or three such cells will usually be formed in one comb. In old colonies, it often happens that no provision is made for the advent of a new queen, and in that case no royal cells are built; but in a new community several such cells may often be seen upon one comb. Still more perplexing than the impulse, or instinct, or unconscious perception, by which the workers are guided in the preparation of these cells, is the intelligent selection shown by the queen in distributing her eggs among the various kinds of cells. She finds thousands and thousands of small cells, and in these she deposits fecundated eggs out of which nothing but workers grow. In the royal cells, or, as is the case in many hives, in one royal cell, she lays an egg, also fecundated, out of which is sure to grow a perfect female, or, in other words, a queen. The eggs of the perfect and imperfect females do not differ originally; the ultimate difference is brought about by a special mode of nursing and feeding the royal egg, the workers supplying the royal cell, in advance, with pollen from the stamens of flowers and honey; so that when the little grub comes out of the egg, it finds itself in the midst of the nourishment necessary for its development into a queen bee. How do these careful nurses know the amount and quality of food needed by the eggs they have in charge? To this question there is no answer. But there is no doubt of the fact, and they perform their work with surprising economy and accuracy. In the drone cells the queen lays only unfecundated eggs, and these always produce males and males alone. The faculty by which all these acts are performed without teaching, without preceding experience, without any antecedent knowledge of the conditions necessary to the life and growth of the eggs, that faculty we call instinct, in contradistinction to those mental processes involving argument, rational consideration, combination and adaptation, by which acts are performed under full consciousness of all contingent conditions.

THE EGGS, WHAT THEY BRING FORTH AND HOW THEY ARE FECUNDATED.

It may be asked how it has been known that certain eggs were fertilized while others remained unfecundated. The facts have been gradually made out by very careful and connected observations. It is known that with bees, as with most birds, the act of copulation takes place outside of the hive in the air during flight. It happens sometimes that a queen bee, from injury or from malformation, defective wings, for instance, is unable to fly and cannot leave the hive. Under these circumstances she is incapable of fecundation, and yet has been seen to lay eggs, and these eggs invariably produced males or drones. This fact gave the clew, and successive observations proved beyond a doubt that the workers were always born from fecundated, the drones from unfecundated eggs. It remained a mystery how, in the same ovary, a certain number of eggs could come under the fertilizing influence while the rest remained untouched.



OVARIES, ETC., OF BEE.
o. o. Ovaries. e. e. e. Eggs in oviducts. g. *Receptaculum seminis.* n. j. Sting. s. Poison bag.

Siebold ascertained by a skillful anatomical investigation that the special organ of the queen bee, in which spermatic particles are received, has a muscular apparatus which enables her to close or open it at will. This organ, known as *receptaculum seminis,* is placed just at a point of the oviduct or canal through which the eggs are passed when they are dropped from the ovary, half way between the ovary and the outlet of the oviduct. The queen stands on the edge of the cell in which either fecundated or unfecundated eggs are to be deposited. If the former, she has the power to open this receptacle, the organ in which the spermatic particles have already been received, and to allow one or two such particles to come into contact with the egg; if not, she can close the organ and allow the egg to pass out unfecundated. Siebold has shown that eggs cut out above the opening of the *receptaculum seminis* into the oviduct, at which these organs connect, are always unfecundated.

Siebold has investigated a similar set of facts in the history of another species of hymenoptera, a kind of wasp of the genus *tolistes.* In this case, the queens, which are fecundated in the autumn, begin to lay their eggs early in the spring; out of these eggs are born a variety of individuals, workers and males, as in the bee community. By a careful destruction of all the males,which was accomplished without injury to the comb, Siebold ascertained that parthenogenesis obtains in this family also. Plenty of eggs were laid after the males were destroyed, but the perfect insects they produced were always males and never a single female. It is now clearly proved, not only for wasps and bees, but also for a number of other insects belonging to the hymenoptera, that virgin females may produce male offspring without any participation of males.

Scientific Prizes.

The report of the prizes offered by the *Société d'Encouragement pour l'Industrie Nationale* of Paris for 1873, is as follows:

Chemical arts.—Six prizes have been offered: 1. Prize of $400 for the industrial application of distilled water; no candidate. 2. Prizes of $200 for the industrial application of any cheap and abundant mineral product; no candidate. 3. Prize of $200 for a useful application of recently discovered metals; no candidate. 4: Prize of $600 for the artificial preparation of a black compact diamond; one candidate appeared, but, as the experiments of the committee showed that the specimens sent did not fulfil the conditions required, the prize was not awarded. 5. Prize of $200 for a process capable of effecting the prompt and durable disinfection and clarification of sewage; the engineers of the Municipal Service of Paris, commissioned to study the question of disinfection and the application of sewage water, have presented a complete and detailed account of the experiments made, and the remarkable results obtained; as these experiments have been conducted on a very small scale, and, as important sewage works are in progress, the Council of the Society has decided to suspend the award of the prize. 6. Prize of $200 for refining, in France, Bolivian nitrate of soda, and extracting the iodine which it contains.

Economic arts.—Prize of $600 for an apparatus giving an electric current, constant in direction and intensity whose electro-motive force and conductibility shall be comparable to those of a nitric acid battery of sixty to eighty ordinary sized elements, and showing superiority in economy or salubrity over the machines now in use; the prize was awarded to M. Gramme for his magneto-electric machine.

Correspondence.

Deep Sea Soundings.

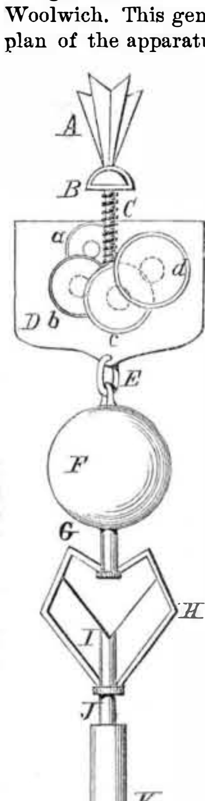
To the Editor of the Scientific American:

Dr. George Robinson, in an article published in your journal of April 19, suggested the idea of dispensing altogether with a line in deep sea soundings, and explained how an apparatus might be so contrived as to re-ascend to the surface after touching the bottom. Mr. Charles H. Lewis suggested afterward that the use of a pressure gage might obviate the difficulties presented by under currents, and by headway or leeway, if sounding is done from a ship. Several other correspondents have agitated the question, but as they are evidently unaware of the many experiments that have already been made to ascertain the depth of the ocean, a perusal of a short article, published in the *Nautical Magazine* forty-one years ago (in 1832), may prove interesting to them and to many of your readers.

Even if the idea of dispensing with a line in deep sea soundings were new, the obstacles described so clearly by Mr. Hawley N. Cargill, of Grand Rapids, Mich., present the real difficulties, namely, the under currents, the immense pressure of water, and the low temperature at a great depth. This correspondent takes a practical view of the matter, and I am as ready as he is to consider the suggestion, by Mr. Lewis, of a pressure gage as perfectly reliable and practical as far as a line could be made to reach; it is so practical, indeed, that it has been in use for many years, and I used it myself in the French navy at least twelve years ago. But to show the ideas of our grandfathers on this subject, here is a copy of the article, addressed by a correspondent to the *Nautical Magazine,* over forty years ago:

"The depth of the ocean is a subject on which many opposite opinions have been advanced; and with the hopes of determining so interesting a problem, a few years ago I constructed a machine, somewhat resembling that by Mr. Massey, but differing from his in not requiring the assistance of a line. The principal obstacles with which I considered that it would have to contend, were seaweed, tides, and under currents, which latter might sweep it away from the place where it was sent down. However, regardless of these, I set to work and completed the machine. My first experiments with it were made in shallow water, and, to ascertain its correctness, I attached it to a line that was marked. The results were most successful; and I was delighted to find it answer so well, for I invariably found the depth of water given by the machine precisely the same as that by the measured line.

"After being satisfied that my plan was likely to succeed, I submitted it to the Admiralty, and to my friend Captain Mudge, who communicated it to a scientific friend of his at Woolwich. This gentleman soon after inclosed me an etched plan of the apparatus, with his remarks on it, informing me, at the same time, that the celebrated Dr. Desaguliers had made an attempt, something similar to mine, with a glass globe; but that, after various essays, he could never recover the machine. This he attributed to drift, or to the bursting of the globe from excessive pressure; but as the trials had been made under many unfavorable circumstances, no positive inference could be drawn from them.



"The following is an explanation of the machine as annexed: A is the vane and flies; B, two connecting swivels; C, perpetual screw; D, plate for the wheelwork; *a b c d,* wheels of different diameters, similar to Massey's; E, suspension ring; F, float glass globe; G, catch with shoulders; H, clasps disengaged by the arm at I, connected with the rod, J J; K, lead to sink the whole; L, foot to the rod, in case of an oozy bottom.

"It will be readily seen that, when the weight is disengaged from the rest of the machine, by the opening of the clasps caused by the rod striking the bottom, it will remain there, and the globe will carry the other part to the surface."

Here ends the article; and as nothing has been heard of the experiments made afterwards by the inventor in deep water, it is probable that he met with no better success than Dr. Desaguliers. The method of adapting a pressure gage to a sounding apparatus must, according to the article in the *Nautical Magazine,* have been invented by Massey about fifty years ago.

LAURENS DE WARU.

Baltimore, Md.

Psychic Force on the Slate---No. 2.--An Exposition.

To the Editor of the Scientific American:

In my former article (on page 195, volume XXVIII) I gave a description of what appeared to be a wonderful phenomenon. After having witnessed the performances of the so-called spirits at several *séances,* I have at last hit upon the way the thing is done. I now give it to your readers that they may not be gulled as I have been. It may be made the source of a great deal of amusement.

Procure a slate and a number of short pencils, also a small table (one with four legs is the best). Cover the table with a cloth, and turn the lights down—this is done for concealment—but explain that spirits will only write in the dark for you, therefore the table must be carefully covered to exclude the light. Grasp the slate with the right hand, lay a pencil near your thumb, hold the slate under the table horizontally, place the left hand on top of the table. At first it is best to sit so that your knees will not be suspiciously close to the table. After holding the slate a few minutes, say that you don't know that the conditions are favorable. Presently throw the pencil off with the thumb or finger, or get it between the thumb and finger and shoot it up against the table, as a boy would a marble. Call attention to it, and say there appears to be something there. Replace the pencil and presently shoot it up again. Do this several times and it will excite a great deal of wonder, especially if you make as little movement as possible. Next place a pencil between your fingers under the slate, rap with it about a dozen times, ask: "Is there a spirit present? If so, rap three times for yes, twice for no." Answer: "Yes." "Can you write?" Answer: "Yes," if the spectators are not watching you too closely; otherwise rap "no," and continue to rap the answers. Now get closer to the table. To write on the slate, hold the pencil between your thumb and finger, and the slate between your third and little finger; rest the slate against your left knee, or between the knees if convenient, or against the side of the table. This will give you more freedom to write. After writing an answer on the slate, shoot up the pencil; turn the slate over, grasp it as at first, withdraw, and, wonderful to behold, the answer is written on the bottom of the slate. Not one in a thousand will suspect how it was done, if you are expert and make no perceptible movement. Always be willing for any one to test; and if they catch you, it will be your own fault, for it is very easy to fail and say the "conditions are unfavorable."

If any person desires to hold the slate with you, for a test, first contrive to draw or write something on the slate; and after turning, hold the pencil under the slate in position for rapping. Ask him to hold the side of the slate opposite you and pull against you. After numerous questions, to which you can rap answers, beg the spirit to write or draw something on the slate. Presently drop the pencil and have the other party take it out. He will think the writing was done while he held the slate. To ring a bell, show a "spirit hand," and perform many other wonders, suspend the slate by holding it between your left knee and the table, or any other way to free your hand. It excites more wonder to withdraw the slate with the pencil in its original position, after ringing the bell, etc.

S. C. DODGE.

Chattanooga, Tenn.

REMARKS BY THE EDITOR.—This is a very clever way to imitate the spirit slate-writing, and for dark *séances* the trick would doubtless succeed very well. But the most accomplished spirit slate-writing mediums now discard the darkness, and do not touch the slate. A bit of a pencil is placed between a pair of slates which are laid on the table. No cloth. The gas lights, in full blaze, illuminate the scene, while the friction of the pencil on the slate may be distinctly heard; and on opening the slates, a written communication thereupon is found.

Prevention of Incrustation in Steam Boilers.

To the Editor of the Scientific American:

We have a backwoods way of cleansing scale out of boilers, down in this section, which may be useful to some of your readers. Introduce a few green hickory poles in at the man hole, and let them boil with the water a day; then blow out about one third of the water. Repeat the process for a few days, and the inside will be as clean as a society shirt, and the hickory poles as brittle as rotten wood.

A.

Eutaw, Ala.

A FLOATING CANNON BALL.—In the pavilion of the Ministry of Agriculture, at Vienna, a floating cannon ball may be seen. Although weighing 50 lbs. it lies like a down feather on a silvery mass, consisting of pure quicksilver from the celebrated mines of Idria; 150 cwt. of this metal is exhibited in a large iron cauldron, offering a sight seldom to be met with, and on it rests the solid iron ball. It was interesting to observe the emptying of the quicksilver into its receptacle. The metal is very cleverly stowed away in bags of white sheep leather, specially prepared for the purpose, each containing 50 lbs. of the mass, the bags being tightly bound round the top, and then put into small wooden barrels, carefully bunged up. Formerly, this liquid metal, which penetrates easily all porous substances, was transmitted in wrought iron bottles of very expensive make.

ELECTRICAL GAS LIGHTING.—A novel device for lighting gas by electricity, lately patented, is made as follows: A glass cup is immersed in liquid; and when the gas is turned on, it enters under the cup and lifts the same, thereby establishing connection with a battery which heats a platinum wire placed over the burner, and thus ignites the gas. Mueller and Meier of Hanover, Germany, are the inventors.