tions, and hastens the filling and capping, which is always more quickly and speedily done at the top than at the bottom. It is more than likely that the future hive will be so constructed that the entire hive, as well as the crate holding the sections, can be inverted at pleasure. This will give all the advantages named above with the least possible expense of time. The changing of the comb does no injury in any way, and is thought, by those who have tried it most, to prevent swarming. Turning the combs over causes the bees to tear down the queen-cells.

The late Mr. Samuel Wagoner suggested that the laying of fecundated eggs (those which develop into females) or unfecundated (those which produce drones) was automatic, and not an act of volition. The small worker-cells, he said, would compress the queen's abdomen, and thus force the sperm-cells from the spermatheca, and the eggs would be impregnated. The larger drone-cells would fail to exert this necessary compression, and so the eggs would pass unfecundated.

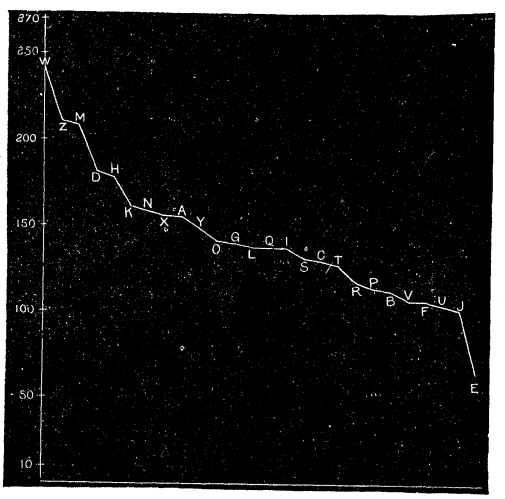
Bee-keepers now generally think that the queen is no such machine. Why the muscular apparatus connected with the spermatheca, except that it is to be used voluntarily to extrude the spermatozoa as the queen may desire? Sometimes worker-cells just started receive eggs which always develop into worker or female bees. Here the cells could not compress the queen's abdomen. The queen also lays fecundated eggs in the queen-cells, which are larger even than the cells which receive the unfecundated eggs, — the so-called drone-cells. That this act of adding or withholding the sperm-cells from the eggs is an act of volition on the part of the queen, is further proved in the fact that young queens, just beginning to lay, often scatter drone-eggs here and there in worker or the small cells. These, of course, produce drones, which only vary from the usual drones in their smaller size, which is necessitated by the smaller cells. This is obviously a mistake, and seldom occurs after the first two or three days of the queen's life. Now, may we not consider this the result of inexperience, the mistake of a novice? The queen has never yet used the complex muscular apparatus of the spermatheca, and at first fails in her attempt to work it satisfactorily. Soon she gains by experience, and makes no more failures. To assert this is no more irrational than to say that a colt will stumble and fall when it first begins to walk.

The observations of Sir John Lubbock and others as to wasps bear directly on this question. He finds that the mother-wasp invariably stocks the cell where the unimpregnated egg — the one that is to produce the male, which is considerably smaller than the female — is deposited with a less number of insects than the one where the impregnated egg which is to develop into a female is placed. Here we see that the mother-wasp not only knows the kind of an egg she is to lay, but she provisions the cells with exact reference to the necessities of the case. As the wasp puts just so many insects in each cell, it is evident that she has learned to count. Who shall be so prejudiced as to say that her waspship does not consider her act in laying the special egg, and does not think and plan her maternal acts looking to the larders of her yet unborn? We all know how close the relationship between wasps and bees is. Now, if a wasp realizes what she is doing as she adds or withholds the sperm-cells, to such an extent that it influences her daily acts, and modifies her performance of daily duties, who shall say that the queen-bee, of higher development and structure, does not think upon her acts as she places the eggs in worker or drone cells? Here, then, is another proof that egg-laying with the queen is a matter of intelligent volition; and far be it from me to say that the queen does not consider the size of her home, the size of her family, and the condition of her larder, as she passes in stately mein over the combs, stocking the worker or drone cells as circumstances dictate. If such volition and discretion are exercised, it makes plain many peculiarities noticed in studying bees. It makes it easy to understand why there is so much variation as to the swarming-habit, drone-production, etc., of different colonies of bees. Each queen has her own notions. A. J. COOK.

LEGIBILITY OF LETTERS OF THE ALPHABET.

MR. JAMES CATTELL has recently published in *Mind* the results of studies upon brain and eye inertia, of which the following will be found of interest. Some alphabets are harder to see than others, and the different letters of the same alphabet are not equally legible. Reading is one of the largest factors in our modern life, but at the same time a thoroughly artificial act. Here, as everywhere in nature, the organism shows its power of accommodating itself to its environment; but the large percentage of children who become shortsighted and weak-eyed, and suffer from headaches, gives us sharp warning, and puts us on our guard, lest these diseases become hereditary. Considering the immense tension put, of necessity, upon eye and brain, it is of the most vital

importance to relieve them by using the printed symbols which can be read with the least effort and strain. Experiments are not necessary to show that books (especially school-books) should be printed in large, clear type; but experiments may lead us to determine the most favorable type. It seems probable that the use of two varieties of letters, capital and small, is more of a hurt than help to the eye and brain. All ornaments on the letters hinder: consequently the German type is injurious. The simplest geometrical forms seem the easiest to see. The lines must not be too thin. We seem to judge the letters from the thick lines, and it is doubtful whether it is advantageous to use thin and thick lines in printing. From all these considerations, it seems that our printing-press has not improved on the alphabet used by the Romans. "Our punctuation-marks are hard to see, and, I think,



quite useless. It seems to me far better to replace (or, at all events, supplement) them by spaces between the words, corresponding in length to the pauses in the thought, or, what is the same thing, to the pauses which should be made in reading the passage aloud. Such a method of indicating to the eye the pauses in the sense would not only make reading easier, but would teach us to think more clearly.

"As I have already stated, not only are some types harder to see than others, but the different letters in the same alphabet are not equally legible." It was found that certain letters were usually correctly read, whereas others were usually misread or not seen at all. Fifty-four series were made with the capital Latin letters: consequently each letter was used 270 times. Out of this number of trials, *W* was seen 241 times, *E* only 63 times. The relative legibility of the different letters is clearly shown in the figure, in which the ordinates are taken proportional to the number of times each letter was read correctly out of the 270 trials.

Certain letters, as *S* and *C*, are hard to recognize in themselves; others are mistaken for letters similar in form, as in the case of *O*, *Q*, *G*, and *C*. The great disadvantage of having in our alphabet letters needlessly difficult to see will be evident to every one. "If I should give the probable time wasted each day through a single letter, as *E*, being needlessly illegible, it would seem almost incredible; and, if we could calculate the necessary strain put upon eye and brain, it would be still more appalling." Now that we know which letters are the most illegible, it is to be hoped that some attempt will be made to modify them. Our entire alphabet and orthography need recasting: we have several altogether useless letters (*C*, *Q*, and *X*), and there are numerous sounds for which no letters exist. In modifying the present letters, or introducing new forms, simplicity and distinctness must be sought after, and experiments such as these will be the best test.

"Experiments made on the small letters show a similar difference in their legibility. Out of a hundred trials, *d* was read correctly 87 times, *s* only 28 times. The order of distinctness for the small letters is as follows; *d*, *k*, *m*, *q*, *h*, *b*, *p*, *w*, *u*, *l*, *j*, *t*, *v*, *z*, *r*, *o*, *f*, *n*, *a*, *x*, *y*, *e*, *i*, *g*, *c*, *s*. As in the case of the capital letters, some letters are hard to see (especially *s*, *g*, *c*, and *x*) owing to their form; others are misread, because there are certain pairs and groups in which the letters are similar. A group of this sort is made up of the slim letters *i*, *j*, *l*, *f*, *t*, which are constantly mistaken the one for the other. It would not perhaps be impossible to put λ in the place of *l*, and the dot should be left away from *i* (as in Greek). It seems absurd, that, in printing, ink and lead should be used to wear out the eye and brain. I have made similar determinations for the capital and small German letters, but these should be given up. Scientific works are now generally printed in the Latin type, and it is to be hoped that it will soon be adopted altogether. At present, however, it is impossible to get the books most read (Goethe, for example) in Latin type."

BLONDES AND BRUNETTES IN GERMANY.

WITHIN the last few years the German government has authorized a commission, at the head of which is Professor Virchow, to collect statistics in