and rights of land owners. Suggestions to this effect have been made and many plans devised, and we now present to our readers a plan which is claimed by the inventor to be the quickest and most comprehensive method of accomplishing the end. All the offense from these establishments arises from the manipulation of the blood and offal.

By the apparatus and processes of Jacob J. Storer, of Boston, these are so handled and treated that no cause of complaint can exist. The accompanying engraving illustrates the revolving deodorizing cylinder, designed by Mr. Storer, for converting the blood and offal into fertilizers. The cylinder consists of a boiler shell lined with fire brick. It is set at a slight incline for the more ready delivery of the dried fertilizer, is supported on friction rolls, and made to revolve by gear or belt. At the feed end of the cylinder is a fireplace in which a fire is maintained for the ignition of the pulverized fuel, which, under the Whelpley & Storer patents, is the principal agent of the work. At the delivery end of the cylinder is a receiving chamber or pit, into which the dried material falls, and whence it is removed by a bucket elevator. Just beyond this pit, and in the base of the smoke stack, is the gas mingling and combustion chamber, having a dome-shaped perforated roof.

This machine is operated as follows: The fire is urged in the first fireplace until it has become hot enough to instantly ignite the pulverized coal, which is injected over it by the pulverizer or blower, as shown in the engraving. The jet of burning pulverized coal, entering the cylinder, quickly heats it to the desired temperature. At the same time, the fire on the grate in the gas combustion chamber has brought the walls of the chamber and the perforated dome to almost a white heat. The cylinder is then put in revolution at the rate of four tuns a minute, and the blood and offal, separately or together, are fed into it by an elevator. The material, as it passes through the cylinder, is exposed to the direct contact of the flame and products of combustion, and to the direct radiation of the hot brick lining of the cylinder. As it contains from fifty to eighty per cent of moisture, an enormous volume of steam and gases is immediately generated. These move forward into the gas-mingling and combustion chamber, and, by the high temperature therein maintained, are decomposed and burned, the perforated dome retaining them sufficiently long for this purpose. There escapes, then, through the perforations of the dome, an intense white flame, of sufficient volume to generate steam for all the purposes of the work, not the slightest offensive odor escaping.

The fertilizer is preferably allowed to discharge from this machine while it still contains from 8 to 10 per cent of moisture. It is found that, notwithstanding the high temperature in the cylinder, it cannot be charred or burned, because of its envelope of steam, while it contains this percentage of water.

A cylinder 4 feet in diameter and 30 feet long treats from 3 to 5 tuns of raw material per hour, converting it into a fertilizer containing not more than 10 per cent of moisture. A cylinder 6 feet in diameter and 50 feet long will treat from 10 to 15 tuns per hour, according to the character of the material, or above 250 tuns per diem.

The capacity of these machines and their rapidity of work are such that one of them will dispose of all the refuse of any one of our large cities, obviating the necessity of an hour's accumulation of raw material about any establishment. A cylinder of 5 tuns capacity per hour, with necessary auxiliary machinery and buildings, can be erected for about $10,000. Works of twice this capacity could be erected for about $15,000.

Most of the offense of slaughtering and rendering establishments arises from the escape of tank steam and gases, from the accumulation of "tank stuff" and blood, and the manner of disposing of the "tank water." The steam and tank water are disposed of inoffensively in the following manner: The tank steam and gases are carried through cold iron coils for condensation. The condensed steam is then passed through efficient filters, while the uncondensed steam and gases—already reduced to a minimum—are carried into a combustion chamber like the one attached to the deodorizing cylinder, and there burned.

The tank water is made to flow through a series of "catch basins." Each series, used alternately, is divided into sets of two or more basins. In the first set the heaviest particles of animal matter are deposited. In the second set the particles of animal matter in suspension are deposited by the application of a proper precipitant, while the third set of basins is furnished with proper filters, for further purification of the water, and from these it may flow into the sewers or streams without contaminating them. The precipitated animal matter—which amounts to 8 or 10 per cent of the weight of the "tank water"—is removed from the basins and inoffensively dried in the cylinder.

By spreading a slight covering of fine charcoal upon the "tank stuff" as soon as it is discharged from the tanks, and upon the surface of the blood in the receiving tubs, the escape of offensive odors is entirely prevented. The same application is made to these, as well as to the dead animals, when they have been loaded into carts or boats for transportation.

For further information, address J. J. Storer, 161 Tremont street, Boston, Mass.

PROGRESS OF THE HOOSAC TUNNEL DURING AUGUST, 1873.—Headings advanced from the east end westwardly, 158 feet; from the west end eastwardly, 93 feet. Total advance during month, 251 feet. Entire lengths opened to September 1, 24,163 feet. Rock remaining to be pierced, 868 feet. Whole length of the tunnel, 25,031 feet.

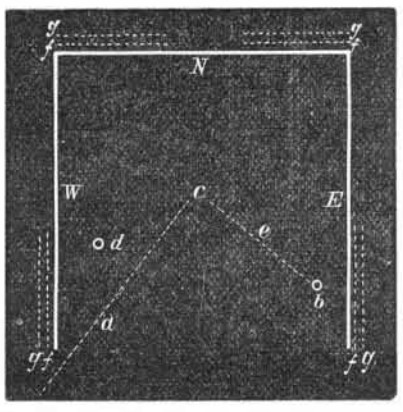
ON THE HONEY-MAKING ANT OF TEXAS AND NEW MEXICO.

BY HENRY EDWARDS, CALIFORNIAN ACADEMY OF SCIENCES.

The natural history of this very curious species (*Myrmecocystus Mexicanus*, Westwood) is so little known that the preservation of every fact connected with its economy becomes a matter of considerable scientific importance, and the following observations, gleaned from Captain W. B. Fleeson of this city, who has recently had an opportunity of studying the ants in their native haunts, may, it is hoped, be not without interest.

The community appears to consist of three distinct kinds of ants, probably of two separated genera, whose offices in the general order of the nest would seem to be entirely apart from each other, and who perform the labor allotted to them without the least encroachment upon the duties of their fellows. The larger number of individuals consists of yellow worker ants of two kinds, one of which, of a pale golden yellow color, about one third of an inch in length, acts as nurses and feeders of the honey-making-kind, who do not quit the interior of the nest, "their sole purpose being, apparently, to elaborate a kind of honey, which they are said to discharge into prepared receptacles, and which constitutes the food of the entire population. In these honey seeking workers the abdomen is distended into a large, globose, bladder-like form, about the size of a pea." The third variety of ant is much larger, black in color, and with very formidable mandibles. For the purpose of better understanding the doings of this strange community, we will designate them as follows: 1. Yellow workers; nurse and feeders. 2. Yellow workers; honey-makers. 3. Black workers; guards and purveyors. The site chosen for the nest is usually some sandy soil in the neighborhood of shrubs and flowers, and the space occupied is about from four to five feet square. Unlike the nests of most other ants, however, the surface of the soil is usually undisturbed, and, but for the presence of the insects themselves, presents a very different appearance from the ordinary communities, the ground having been subjected to no disturbance, and not pulverized and rendered loose as is the case with the majority of species.

The black workers (No. 3) surround the nest as guards or sentinels, and are always in a state of great activity. They form two lines of defence, moving different ways, their march always being along three sides of a square, one column moving from southeast to the southwest corners of the fortification, while the other proceeds in the opposite direction. In most of the nests examined by Captain Fleeson, the direction of the nest was usually towards the north; the east, west, and northern sides being surrounded by the soldiers, while the southern portion was left open and undefended. In case of any enemy approaching the encampment, a number of the guards leave their station in the line and sally forth to face the intruder, raising themselves upon their hind *tarsi*, and moving their somewhat formidable mandibles to and fro, as if in defiance of their foe. Spiders, wasps, beetles, and other insects are, if they come too near to the hive, attacked by them in the most merciless manner, and the dead body of the vanquished is speedily removed from the neighborhood of the nest, the conquerors marching back to resume their places in the line of defence, their



object in the destruction of other insects being the protection of their encampment and not the obtaining of food. While one section of the black workers is thus engaged as sentinels, another and still more numerous division will be found busily employed in entering the quadrangle by a diagonal line bearing northeast, and carrying in their mouths flowers and fragments of aromatic leaves which they deposit in the center of the square. A reference to the accompanying sketch will give a more clear understanding of their course, the dotted line, *a*, representing the path of this latter section, while the mound of flowers and leaves is marked *c*. If the line, *a*, be followed in a southwest direction, it will be found to lead to the trees and shrubs upon which another division of the black workers is settled, engaged in biting off petals and leaves, to be collected and conveyed to the nest by their assistants below. On the west side of the encampment is a hole, marked *d*, leading down to the interior of the nest, which is probably chiefly intended for the introduction of air, as, in case of any individuals carrying their loads into it, they immediately emerge and bear them to the common heap, as if conscious of having been guilty of an error. A smaller hole, near to the southeast corner of the square, is the only other means by which the interior can be reached, and down this aperture, marked *b*, the flowers gathered by the workers are carried along the line, *e*, from the heap in the center of the square, by a number of smaller yellow workers (No. 1) who, with their weaker frames and less developed mouth organs, seem adapted for the gentler office of nurses for the colony within. It is remarkable that no black ant is ever seen upon the line, *e*, and no yellow one ever approaches the line, *a*, each keeping his own separate station and following his given line of duty with a steadfastness which is as wonderful as it is admirable. By removing the soil to a depth of about three feet, and tracing the course of the galleries from the entrance *b* and *d*, a small excavation is reached, which is spread in the form of a spider's web, a network of squares spun by the insects, the squares being about one quarter inch across, and the ends of the web, fastened firmly to the earth of the sides of the hollow space which forms the bottom of the excavation. In each one of the squares, supported by the web, sits one of the honey-making workers (No. 2), apparently in the condition of a prisoner, as it does not appear that these creatures ever quit the nest. Indeed it would be difficult for them to do so, as their abdomens are so swollen out, by the honey which they contain, as to render locomotion a task of difficulty, if not to make it utterly impossible.

The workers (No. 1) provide them with a constant supply of flowers and pollen, which, by process analogous to that of the bee, they convert into honey. The fact that the remainder of the inhabitants feed on the supply thus obtained, though it is surmised, has not been established by actual observation; indeed with reference to many of the habits of these creatures, we are at present left in total ignorance, it being a reasonable supposition that, in insects so remarkable in many of their habits, other interesting facts are yet to be brought to light respecting them. It would be of great value to learn the specific rank of the black workers (No. 3), and to know the sexes of the species forming the community, their season and manner of pairing, and whether the honey-makers are themselves used as food, or if they excrete their saccharine fluid for the benefit of the inhabitants in general, and then proceed to distil more. I regret that at this time I am only able to bring before the notice of the Academy specimens of the honey-makers (No. 2), the other members of the community, except from Captain Fleeson's description, being quite unknown to me. It is, however, my hope that, at a future meeting, I may be enabled to exhibit the other varieties, and to give some more extended information upon this interesting subject. The honey is much sought after by the Mexicans, who not only use it as a delicate article of food, but apply it to bruised and swollen limbs, ascribing to it great healing properties. The species is said to be very abundant in the neighborhood of Santa Fé, New Mexico, in which district the observations of Captain Fleeson were made.

Correspondence.

Hight of the Earth's Atmosphere.

To the Editor of the Scientific American:

In an article on this subject which appears this week in the SCIENTIFIC AMERICAN, No. 7, page 101, under the signature of J. E. Hendricks, the celebrated method, first suggested by Kepler, of determining at what hight the atmosphere ceases sensibly to refract light is explained and illustrated. Nothing can be added to the lucid and compact statement of your correspondent.

I propose, however, to suggest a new method of proving the hight of the atmosphere, which is worthy of attention on account of the precision with which such element in the formula can be determined. The average highest temperature under the torrid zone is not to be identified with the mean temperature, which is much lower, being about 82° Fahr., while the highest temperature is 111·5° Fahr.

Let d = density of air on the hydrogen scale, h = hight above base, p = pressure at base, a = coefficient of expansion per 1° Fahr., and t = average highest temperature at equator. We will take one mile of atmosphere, one inch in thickness, on which to make the experiment and test the formula, so as to estimate the hight to which this atmosphere will extend when all the elements have been applied.

t d p d h

115° Fahr. × 0·002036 × 14·75 × 14·416 = 48·2478. Otherwise arranged for our terrestrial atmosphere: $h = tapd$ = 48·2478 miles; $t = \frac{h}{dpa} = 111·5°$ Fahr; $a = \frac{h}{dpt} = 0·002036$; $d = \frac{h}{tap} = 14·416$; $p = \frac{h}{dta} = 14·75$ lbs.

Hence, it follows that, if we could take a mile of our atmosphere, or any other pure gas of equal density, and subject it to the temperature, expansion, pressure, and density which are now normal to our atmosphere, it would reach an altitude of 48·2478 miles; and the refraction of twilight confirms this result, for it terminates when the depression of the sun below the horizon amounts to 18°, or, more correctly, 17·8°.

It is easy to deduce from this fact that the atmospheric refractive power ceases when the light exceeds 49 miles; for the angle of incidence and also of refraction being each 9°, we have 9 × 69·5 = 625·5 miles; hence 625·5² ÷ 7925 (earth's diameter) = 49·3 miles, hight of refractive atmosphere. Our new formula gives the result 48·2478 miles with much greater precision, and the angle 17·8° more correctly agrees with observation than 18°.

S. BESWICK.

Paterson, N. J.

Pure Air in Cars.

To the Editor of the Scientific American:

The desire of your correspondent F. S. C. for pure air in railroad cars might be gratified by constructing ventilating filters, which should be regulated by the conductor or some other official. The filters should be made of thin layers of raw cotton, kept in place by coarse wire gauze. This, I believe, is the best air filter known. They would require cleaning or removing perhaps once or twice a month.

E. M. G. JR.

Baltimore, Md.