THE HEXAGONAL CELL OF THE HONEY-BEE.

BY W. J. WEEKS.

It has always been a subject of wonder, amounting even to a subtle mystery, how the bee could construct its congeries of waxen cells of such exact uniformity of size and shape, and combining with the least expenditure of room and material, the greatest capacity and the utmost strength. So difficult of solution has the problem seemed, and so unsatisfactory have the theories respecting it appeared, that some *savans* long since began to regard this geometrical feat of the bee as referable only to the divine presence and emanation. It is curious to remark the expressions of various writers in allusion to it, and selections from a few of them will be here presented as introductory to the forthcoming solution.

Dr. Evans has writen the following elegant lines:—

"On books deep poring, ye pale sons of toil,
Who waste in studious trance the midnight oil,
Say can you emulate with all your rules,
Drawn or from Grecian or from Gothic schools,
This artless frame? Instinct her simple guide,
A heaven taught insect baffles all your pride.
Not all your marshal'd orbs, that ride so high,
Proclaim more loud a present Deity,
Than the nice symmetry of these small cells,
Whereon each angle genuine science dwells."

Dr. Bevan says:—"A honey-comb is allowed to be one of the most striking achievements of insect industry and an admirable specimen of insect architecture. It has attracted the admiration of the contemplative philosopher in all ages, and awakened speculation not only in the naturalist, but also in the mathematician, so regular, so perfect is the structure of the cells, that it satisfies every condition of a refined problem in geometry. Still a review of their proceedings will lead to the conclusion (as Huber has observed) that the geometrical relations which apparently embellish the productions of bees are rather the result of their mode of proceeding, than the principle by which their labor is guided. We must, therefore, conclude that the bees, although they act geometrically, understand neither the rules nor the principle of the arts which they practice so skillfully, and that the geometry is not in the bee, but in the great Geometrician who made the bee, and made all things in number, weight and measure. The hexagonal form of the cells in a honey-comb has been regarded, and is indeed now generally acknowledged by philosphers, to be the result of the mechanical laws which influence the pressure of cylinders composed of soft materials. The nests of solitary bees and the *royal* cells in a bee-hive are uniformly circular; and the cells in the pith of wood, which are hexagonal in the central parts, are circular towards the circumference, where there is diminished pressure; hence it is inferred that the hexagonal form is produced by the general reaction of the solid parts on each other."

In the work on entomology of Kirby and Spence, the following remarks occur:—"The most profound philosopher, equally with the most incurious of mortals, is struck with astonishment on inspecting the interior of a *bee-hive*. He beholds a city in miniature. He sees this city divided into regular streets composed of houses constructed on the most exact geometrical principles and the most symetrical plan, some serving for store-houses for food, others for the habitations of the citizens, and a few much more extensive than the rest, destined for the palaces of the sovereign. He perceives that the substance of which the whole city is built is one which man with all his skill is unable to fabricate; and the edifices in which it is employed are such as the most expert artist would find himself incompetent to erect. And the whole is the work of a society of insects! Nor have its mysteries yet been fathomed. Philosophers have in all ages devoted their lives to the subject, from ancient Aristomachus of Soli, in Cilicia (who, we are told by Pliny, for fifty-eight years attended solely to bees), and Philiscus the Thracian (who spent his whole time in forests, investigating their manners), to Swammerdam, Reaumur, Hunter and Huber, of modern times. Still the construction of the comb of a bee-hive is a miracle which overwhelms our faculties."

Other writers, even to the latest, might be quoted without affording any more light in explanation of the mystery, yet the solution is so little abstruse as to be the occasion of much wonder that it should have remained so long undiscovered by the astute philosophers, mathematicians, and naturalists who have, for centuries, successively given it their attention.

[To be continued.]

DEFECTS OF CALF-SKIN LEATHER.

The article which we published on page 67 of the present volume of the SCIENTIFIC AMERICAN, on "dry rot" in calf-skin leather, has attracted considerable attention from all those interested in the leather business. The defect in calf-skin leather which we mentioned is admitted, but there is a difference of opinion as to its cause. One of our correspondents stated (on page 137) that he believed it was effected by the use of resin oil in dressing; while another considered it was owing to a want of moisture and air. A correspondent of the Boston *True Flag* (who states that he is an old currier) quotes our article, and gives it as his opinion that the cause of this leather rot is *potash*. We quote what he says on this head:—

"Now, then, I will tell you the *cause* of this 'rot,' leaving the SCIENTIFIC AMERICAN to furnish the *remedy*. In the first place, French skins are not, comparatively speaking, used in this country. They have been superseded by imitation. The great beauty or peculiarity of a French skin is its glove-like softness. About sixteen years ago, it was discovered that the oil in which deer-skins are tanned—called 'sod oil,' and containing large quantities of potash—would, when mixed with tallow, produce the softness so much desired. The same effect may be produced by a mixture of potash, neatsfoot oil and tallow. Potash is not used in dressing cow-hides or kip-skips. Hence they are not subject to this rapid deterioration. When I was a boy a pair of boots would last me a year. Now from three to four pairs are necessary. Cause, *potash*. I am an old currier, and know the truth of the above statement."

The "old currier" no doubt knows what is used in dressing leather, but why does he make such a *dead-set* against a little potash mixed with neatsfoot oil, by attributing to it the whole blame of the leather rot, when he asserts that the deerskins of the Indians are treated with oil containing potash, and it is well known that these skins are not affected with dry rot? Here is an apparent contradiction to his conclusions. We, however, believe that potash is decidedly objectionable to use for dressing leather, because it forms a soap when mixed with neatsfoot oil and grease. Potash, like every other alkali, acts chemically upon leather and such like animal substances, and tends to disorganize them. If potash is the cause of dry rot in calf-skin leather, the remedy is easily furnished—*don't use it*. The correspondent of the *True Flag* is not exactly correct, however, regarding the use of French calf-skins in our country. We annually import foreign leather to the value of about $3,000,000 (not including gloves), and about $88,000 of boots and shoes.

A correspondent engaged in the manufacture of leather, writing to us from St. Louis, Mo., gives it as his opinion that the defects of calf-skin leather "are due to the excessive use of muriate of ammonia (sal-ammoniac) in the *bate*." This chemical substance when in excess will act injuriously upon the skins, because the alkali predominates in it. This remedy for this, he states, is better management of the skins in the *bate*. No more sal-ammoniac should be employed than will just suffice to neutralize the lime.

MAGNITUDE OF SOUTHERN RAILROADS.

In speaking of the southern railroads and of the prosperity of the southern States, the *United States Economist* says:—If their roads are few and ill-conducted, there is either a lack of capital or of commerce, or of both, or there is an unwholesome adherence to old ideas; if, on the contrary, their roads are numerous and well managed, the inference is clearly legitimate that a large amount of commerce is pressing for accommodation, and that it is under the control of a competent and intelligent people. Measured by this standard, the South has something of which to be proud. We have compiled the following statistics, showing the extent and the value of railroad property in the several southern States. The figures date up to the close of 1859, and show the length of road constructed or in the course of construction, the length in actual operation, and the cost of the roads, including building and equipment:—

States.	Length.	In operation.	Cost.
Virginia	2,058.5	1,525.7	$43,069,360
North Carolina	1,020.0	770.2	13,998,495
South Carolina	1,136.0	807.3	19,083,343
Georgia	1,617.2	1,241.0	25,687,220
Florida	730.5	289.8	6,368,699
Alabama	1,822.4	798.6	20,975,639
Mississippi	445.1	365.4	9,024,444
Louisiana	1,160.0	419.0	16,073,270
Texas	2,667.0	284.6	7,578,943
Arkansas	701.3	38.5	1,130,110
Missouri	1,337.3	723.2	31,771,116
Tennessee	1,434.4	1,062.3	27,348,141
Kentucky	698.4	468.5	18,852,062
	16,824.1	8,794.1	$265,960,842

POLYTECHNIC ASSOCIATION OF THE AMERICAN INSTITUTE.

[Reported expressly for the Scientific American.]

On Thursday evening, the 26th ult., the usual weekly meeting of the Polytechnic Association was held at its room in the Cooper Institute, this city; Mr. Bruce in the chair.

MISCELLANEOUS BUSINESS.

Device for Teaching Children.—Mr. B. Brown, of Huntington, L. I., exhibited an apparatus under the name of the "Primary Instructor," designed for teaching young children to read, spell, cipher, &c. It consists of of a frame abont five feet square, with wires stretching across it, some horizontal, and some vertical. Upon these wires are strung cubical blocks, sliding and revolving independently of each other. At the left side of the frame are four vertical wires, each containing 40 blocks, on three sides of which are pictures of familiar objects, 240 in all. At the right of the object blocks are 10 vertical wires each carrying 40 blocks, in all 400. On each of these last are words, in all 1,200, being the names of objects, and appropriate adjectives and verbs. By this arrangement it will be seen that a picture of an object and its name in a considerable variety of simple sentences may be presented to the child. A small part only of the whole process is here described, but yet sufficient to convey an idea of its construction and use.

Mr. Godwin was well pleased with the apparatu, and thought that it should be recommended by a vote of the club.

Mr. Garvey—The apparatus is to be commended for its ingenuity, but is too complicated for practical use. The common numerical frame, with a few real objects, and a blackboard would be better. The theory is correct but is carried too far.

Mr. Seely had little faith in short cuts to knowledge, and even in such plausible schemes as phonography. The way we were taught to read, the loving mother or the school-mistress pointing out the letters with a penknife was perhaps the best. The letter A may be as interesting an object to a child as an elephant, and the acquaintance with it is more important. Knowledge of strange things is not what children need. The end of education should be to prepare the mind to receive knowledge. The fashion of the present day of cramming all sorts of sciences into a child's little head is altogether wrong.

Castors for Chairs and Sofas.—Mr. Garbanati exhibited (for Dr. Thos. P. Fry) an improved castor. The roller frame is provided with a spring, so that when the chair or sofa is occupied, the spring yields, and the chair rests firmly on its feet instead of on the roller, thus relieving the castor from the weight. The castors cost no more than the common sort, while it is claimed they will operate better and last longer.

The chairman then called up the regular subject —"Iron Buildings."

DISCUSSION.

Mr. Ayres read a paper repeating some of his statements at the preceding meeting, and adding other facts and arguments, in order to present a precise and comprehensive view of the whole subject. The paper gives a history of the use of iron in buildings, claiming for Mr. Bogardus the invention of the first and only successful plan of using cast iron as a substitute for stone and brick. Mr. Bogardus' first iron building was erected in 1848, and was taken down in 1858 on account of the widening of Duane-street.

Mr. Johnson—When was the first fire-proof building erected in this city?

Mr. Ayres—I cannot tell.

A Gentleman—Are there any fire-proof buildings in New York?

Mr. Ayres—Harper's building, perhaps, is nearest being truly fire-proof. The Crystal Palace, although of glass and iron, was easily destroyed, for the reason that the iron was supported by wood, and when the wood was consumed, the iron fell by its weight. The iron in a building should be an independent structure fully capable of sustaining itself and whatever rests upon it. On the question of expansion I may state that Harpers' Building is about 100 feet long and joins at each end with brick buildings. Yet here no effect of expansion has been observed.

Mr. Garbanati—Buildings may be fire-proof, yet their

contents burn, and it may be that in some cases the fact that the walls stand increases the distinction enabling the contents to burn as in a furnace. Buildings do not take fire, but *that which is in them.*

Mr. Ayres—A fire occurred in an iron building in San Francisco, which was full of combustible materials. The building stood firm although everything in it was fiercely consumed. The firemen tried in vain to pull down the building with ropes, and assisted by horses. But the building was finally removed in the proper way, and with no difficulty, by taking it to pieces as it was put up.

Mr. Whittemore—In Chicago we had a very different experience. In one case in particular, I distinctly recollect that the bolts were sprung by the heat and the whole structure came down in a mass.

Mr. Reid—In the London *Mechanics' Journal*, of 1824, there is a description of an iron lighthouse 16 or 18 feet square, with a column and lantern all of iron. The lighthouse was erected on the wharf at Glasgow.

Mr. Johnson—In 1839 Mr. Fairbairn constructed a corn mill entirely of iron; it was erected in Turkey. The walls were of sheet iron of proper thickness, consolidation and bound together by cast iron columns and girders. It had an arched roof of corrugated sheet iron. In Peru, S. A. a custom-house and warehouse, 2 stories high, 70 feet square, with a balcony, have been erected. They were made and set up in Manchester, England. In 1775 Smeaton first applied cast iron beams in the north of England, and up to 1801 little progress had been made. In that year Philips & Sec, of Manchester, built a fire-proof mill; Boulton & Watt executed the work. In connection with the ornamentation of iron the name of Quintin Matsys is remembered by all. In Antwerp there are still remaining many evidences of his skill. At the burning of the Crystal Palace, glass, iron, silver, gold and copper wire melted. If the Cooper Building should take fire it would fall. Cast iron becomes weak and brittle before it melts. A stick of wood will retain its form longer in a furnace than a bar of iron of the same bulk.

Mr. Godwin—About 30 years ago, a large quantity of cast iron columns were brought to New York from England. Long before any iron buildings were built here, Mr. Jordan L. Mott advocated the plan of a building wall composed of hollow cubical blocks, tied together by wrought iron rods.

Dr. Young—Buildings should be so constructed that in case of fire, the fire would be confined to one floor or one room. Cast iron contracts on cooling, and if the cooling is too sudden, it cracks. Pattern-makers generally provide for a contraction of $\frac{1}{8}$ inch to the foot in casting.

Mr. Reid—In England, now, they are proposing to erect an extensive fortification entirely of iron.

Mr. Seely—Without impeaching the statement of Mr. Ayres, that he has not observed that expansion is of any practical account in iron buildings, I am yet not content. The fact and the exact amount of expansion by heat are undisputed, it is also understood that the expansion of iron is irresistible. When the fact of expansion is made sensible and familiar to us in so many ways, it seems strange that it has not been observed in Mr. Bogardus' building. Professor Horsford, by means of a plummet suspended in the Bunker Hill monument, has shown that the monument daily sways back and forth by the heat of the sun. Let a careful test be applied to any iron building, and the expansion must be noticed. The brick walls against which Harpers' Building abuts, must move every day; and if one of them be so rigid as to be unyielding, the effect on the other may be of real practical consequence. In many familiar cases the expansion of iron in ordinary changes of temperature is of practical account and provision is made for it, as in tubular bridges, arches and girders for masonry, &c.

Mr. Ayres—I can only repeat that I know of no instance of iron buildings in which expansion is taken into account. We are erecting an iron building 700 feet long, and we do not think it at all necessary to provide for expansion.

Mr. Seely—Mr. Bogardus so puts together a building that it is a unit with no joints to spring apart or close up. The angles are generally right angles, and the directions are straight. He seems by his plans in the beginning to have anticipated and prevented the injury from expansion. But vary the construction a little, and the effect of expansion would be noticeble.

Mr. Garvey—The expanion of wood by hygrometric conditions is a far more serious evil in a building than the expansion of metals by heat. Wood also expands by heat.

Mr. Seely—Wood expands by moisture only across the grain; in that direction it would do little damage in beams. Wood expands less by heat than metal. Wood is also so yielding as to accomodate itself to the expansion with little injury.

Mr. Garvey—The force of wood swelling by moisture is used in quarrying, and I doubt the statement that wood expands less than iron by heat.

Mr. Garbanati—Wood should be protected by paint so that moisture shall not penetrate it.

Mr. Johnson.—Wood is named in treatises on horology as the substance which expands less than any other, and as the best material for a pendulum when the expansion is not compensated by the ordinary means. At my house I have evidence, every day the sun shines, of the fact of expansion of iron. Under the heat the whole tin roofing is set in motion, and cracks and rumbles as if some one was walking on it.

Mr. Howe has seen in watch stores many regulators of wood. The value of wooden pendulums is well understood by clockmakers.

Dr. Van Der Weyde—The old clock of the City Hall had a wooden pendulum. The rods that are operated by the keys of an organ are always wood. Metal would not answer on account of the expansion.

Mr. Johnson—Nature understands wood-making better than we do iron-making. When a cast iron beam is deflected by a weight, the deflection increases by a continuance of the load, and may eventually break under it; or if the load is removed, the beam will not resume its original form.

The subject ordered for the next meeting is "Expansion."

FACTS IN PHOSPHORESCENCE.—At a recent meeting of the Academy of Sciences, Paris, a paper by Dr. Phipson, on some new cases of phosphorescence was read. The author shows that native sulphuret of antimony or stibine glows with a phosphoric light when it is heated in a crucible to a dark-red heat. When copper, silver, or gold are melted before the blowpipe in a piece of charcoal, they also become phosphorescent at this high temperature; copper, in this case, is seen to shine like the glow-worm, with a greenish yellow light; the effect is striking when the phosphorescence is viewed through a piece of blue glass. The mineral lepidolite, which was not known to possess such a property, is, according to our author, very phosphorescent before the blow-pipe, especially when viewed through the blue glass. Dr. Phipson has discovered, also, that sugar of milk or lactine becomes phosphorescent on being broken or ground down in a mortar—a fact not devoid of interest, as it brings sugar of milk still nearer to other sugars, such as cane sugar and mannite, which are also phosphorescent in the same circumstances. Finally, the author describes what he terms the finest case of mechanical phosphorescence he has ever witnessed. It happens when a certain quantity of large dry crystals of nitrate of uranium are shaken up violently in a glass bottle, through which magnificent flashes of light are seen to shoot. M. Phipson has experimented on a great variety of other salts, but none, except proto-chloride of mercury, gave any light that could be compared to that produced by the crystals above named.

NATURAL HISTORY SPECIMENS.—A pamphlet has been issued giving instructions to persons who may be willing to take the trouble to send specimens of natural history, such as minerals, skins of animals, of birds, snakes, &c., to the great national collection of these specimens which is being made by the Smithsonian Institution. It is requested that the most common species of each neighborhood should be forwarded. The pamphlet of instructions will doubtless be sent to any one who may write for it to Professor Joseph Henry, the secretary.

GRAIN CRADLE FINGERS.—An obliging correspondent, writing from South Groton, Mass., says:—"I would state to your correspondent, G. C., of Georgia, that there is a machine used by A. V. Blanchard & Co., of Palmer, Mass., for dressing grain cradle fingers, which I think is not patented."

A COLUMN OF VARIETIES.

A firm in Savannah has just received an order for 200,000 feet of pine lumber, for the Holy Land. Portions of the cargo are destined for Jerusalem and Damascus. A similar venture made last year was successful. As the Savannah *Republican* truly remarks, "there is something novel in the thought that the palaces of the Holy Land are to be rebuilt with materials taken from the forests of Georgia."……A complete canvas of Cincinnati has lately been made, with a view to obtain information in reference to its manufacturing interest. It appears that there are engaged as operatives in manufacturing and mechanical pursuits, 23,161 men, 1,423 girls, and 949 boys. The value of the aggregate annual production is $66,502,440……It is estimated that no less than nine thousand men will leave Iowa, this season, for Pike's Peak……A building, covering 36,000 square feet, has been erected at Toronto, C. W., for the manufacture of railroad rails……There are now over 2,000 miles of railroad in operation in Canada. The Grand Trunk Railway is certainly a gigantic undertaking. The whole extent of this line is about 1,100 miles. To the construction of this great road, Canada has contributed $16,000,000—the balance of the capital has been advanced by shareholders in England, and the line is now in working order, and at a total expense of $60,000,000 ……We see that the upright stem of vessels, which was first introduced in this country, and which—no longer than when the *Niagara* first visited London—was condemned by the English critics, has been adopted not only in the largest English ships, but also in the navy of France……A hunter of pigeons has done a heavy business this Spring by following the pigeons from point to point—gaining his intelligence by telegraph. He commenced operations some weeks ago in Virginia, and has lately been in Michigan, and at nearly every place where he has stopped he has been very successful. A paper published at Grand Rapids, Mich., dated April 3d, states that in four days he shipped from that place 600 dozen—40 barrels,……The London *Journal of Gas-lighting* in speaking of the recent fatal explosions in the mines, and of the unprecedented series of shipwrecks, intimates that the legislation for the purpose of protecting persons from such accidents has defeated its own ends and tended rather to increase the evil……The famous "purple" of the Romans was a deep crimson….The St. Paul (Minn.) *Times* reports that "recently about three dozen fine fat cattle went down on the *Grey Eagle*, for New York, the first which ever went to that great market from this neighborhood. They were raised in various parts of northern Minnesota, and collected by the shipper. He pays $20 per head, through freight."….One-tenth of one per cent of the atmosphere contains oxygen enough for the supply of the whole present population of the world for 10,000 years……There is a very handsome young fellow in the Indiana Lunatic Asylum, whose self-conceit is said to have become morbid, and is actually the cause of his insanity…… The clipper ship *Andrew Jackson* has recently made the shortest trip yet from New York to San Francisco—89 days and 7 hours—six hours shorter than the famous trip of the *Flying Cloud*……The Savannah *News* describes the performance of the caloric yacht *Marie Louise*, at that port, and says she proved "the entire adaptation of the caloric engine to the propulsion of small vessels."……The schooner *Matilda* recently arrived at Honolulu, from Fanning's Island, with 10,000 gallons cocoa-nut oil, which sold at a good profit. It is estimated that 20 or 25 nuts will make a gallon of oil, which is used for making soap, and for the hair. It is thought that a very large quantity will yet be gathered ……J. Mosheimer, of San Francisco, Cal., writes to us that the first silver ore from the Washoe mines was smelted at his laboratory, and that 40 tuns have been smelted, yielding about $3,000 to the tun. It is the general opinion in California that these will prove to be the richest silver mines in the world……Chloroform has been administered to a child, during sleep, a painful surgical operation performed, and the child allowed to continue its sleep, awaking in the morning unconscious of anything unusual having occurred…… The late prize fight would afford the London *Times* a good text for one of its interesting articles on the physical decline of the Americans……Corliss & Nightingale publish the statement that the "James Steam Mills," of Newburyport, Mass., paid them $19,734.32, as the amount saved in fuel, by the use of one of their engines, during five years.