ARTIFICIAL TEETH—THEIR HISTORY AND MANUFACTURE.

We were privileged, a week or two ago, to pass through the extensive manufacturing establishment of Messrs. Jones & White, Philadelphia (manufacturers of porcelain teeth), and were obligingly furnished with some items of interest in reference to the history of the art and the progress of the manufacture, which we think will be of interest to our readers.

It is but a few years since human teeth were used in artificial denture, as well as ivory, bone, the teeth of domestic animals, &c.; but the greater durability and cleanliness of porcelain teeth have caused all other substances to be discarded; it being a fact admitting of no contradiction, that no animal growth can long resist the rapid decomposition which all organic substances, devoid of vitality, are liable to, under the combined action of heat and moisture and the secretions of the mouth. To obtain artificial teeth exempt from these objections, it became necessary to seek them from inorganic materials.

The French dentists were the first to introduce mineral teeth; but their progress toward perfection was very tardy. The teeth, being composed almost entirely of clay, were very opaque, too highly colored, and destitute of any natural form. We were shown a treatise on dentistry, published in Boston in 1814, in which occurs the following remark:—"Artificial teeth, of a French invention, have been preferred in Europe, from their being made of mineral substances, and because they do not decay or affect the breath. They are, however, more brittle, less natural and more expensive than the kind in *common use*, viz., those made from the tusk of the hippopotamus." In 1818, or thereabouts, some experiments were made in the manufacture of porcelain teeth in Philadelphia; for the honor of being first in the business there are not less than a dozen claimants. For some years, however, the success attending these efforts was not very flattering, for, as late as 1822, in a treatise on dentistry (published in Boston), the following opinion is expressed:—"Artificial teeth have been formed of various substances; but those which are most perfect are made of the teeth and tusks of the hippopotamus or sea-horse. The mineral or china teeth are very imperfect; they have an opaque, earthy appearance, are brittle, and the sensation they produce when brought in contact with the natural teeth, in mastication, is very disagreeable." It was not until after 1830 that any considerable progress was made; all the teeth made previous to that time being very unsightly in color and shape, and *totally* unlike natural teeth. From that time to the present, the march of improvement has been steady. One after another, the difficulties in the way of imitation of the natural organs, on account of their semi-transparency, their peculiar color and their variety of tints, have been surmounted by perseverance and labor, until it would seem that, in point of strength, beauty of finish and perfect resemblance to nature in form, color and surface, as well as in the almost endless varieties of shape and style, and the ease with which they can be adapted to the great variety of cases which present themselves, and in the ability to resist the hammer in riveting and the blow-pipe in soldering, there is little to be desired.

Having thus glanced at the history and progress of the art, we come now to some details of the materials used in the manufacture and the processes.

The chief materials are:—1. *Feldspar.*—This mineral forms an essential part of most primitive rocks; it is found of various shades of white, blue, brown, red and green, and is composed principally of silica, alumina and potash. That which is white, or nearly so, is the only kind suitable for the manufacture of teeth. 2. *Silex or Flint.*—This substance abounds in almost every part of the globe; it exists, more or less pure, in the form of white sand; the kind best adapted to such purposes being that which is familiarly known as rock quartz or rock crystal. 3. *Kaolin.*—This is disintegrated and decomposed feldspar, and consists of nearly equal proportions of alumina and silica; it is of a slightly yellowish color, unctuous to the touch, and infusible, except with the addition of a flux.

Beside the foregoing, there are fluxes which, though differing from each other in the results produced, may all be described as *glasses;* they are used to determine the point of fusion desired of the different parts of the tooth.

The materials used in coloring are as follows:—1. *Titanium.*—This is a very hard, copper-colored and infusible metal, found in various localities throughout the United States. The crystals are of a reddish-brown color and shining metallic luster. It gives, when ground finely, a beautiful yellow color. 2. *Platina Sponge*—This is formed by dissolving platina in nitro-muriatic acid and precipitating. It gives a gray-blue color. 3. *Oxyd of Cobalt.*—This gives a bright blue color. 4. *Oxyd of Gold.*—This is used to give the red color, in imitation of the gums. These are the principal colors used. Singly, and in different combinations with each other, and with the minor colors, they produce a great variety of shades. About 130 distinct standard shades are made.

Now, as to the process of manufacture:—The feldspar is first submitted, in the crude state, to a red heat, and suddenly thrown into cold water. This is called "calcining," and its effect is to render it more easily broken. All impurities having been carefully removed, it is broken between flint stones, and so rendered fine enough to be put into the mill, which is formed of burr-millstone, with chasers of the same material. It is ground in water, floated off, and allowed to settle. The water is then evaporated, the spar dried and sifted, and is then ready for use. The silex is treated in the same manner. The kaolin is prepared by washing until perfectly free from impurities, and, when dry, is ready for use.

The coloring materials are also ground until reduced to an impalpable powder. These materials are then mixed in proper proportions, and made into a mass resembling putty. This is what is termed "body," and is now ready for the molding room. In this room are employed about 30 men. The molds in which the teeth are formed are made of brass, and are in two pieces—one-half of the tooth being represented on either side. The precise shapes desired are carved out with great care and labor, the holes to receive the platina pins drilled in each tooth, the two halves fitted accurately together, and the mold is ready for use. The mold must be made about a fifth larger than the size desired, to allow for shrinkage. These molds form a very important item in the stock of a manufacturer, numbering in the establishment before-mentioned over 700, making nearly 9,000 different shapes and styles, costing as high for some varieties as $50 per mold. There are from 6 to 24 shapes in each mold. The first operation in the molding room, after greasing the molds, is to place the platina pins (of which there are 10 sizes, differing in length and thickness to suit the different sizes of the teeth) in the molds; this is done very dexterously by means of small tweezers. The consumption of platina in this manner, in the establishment referred to, amounts to 900 ounces per month, which, at $6.50 per ounce, gives an outlay, for this article alone, of more than $70,000 per annum. In the cutting of these little pins, as in almost every other department of the business, great improvements have been made. In their earlier experience, 500 per hour were as many as could be made by an experienced workman. There can now cut to a given size and head 600 per minute! The end that is embedded in the tooth has a head somewhat like the head of a pin, to prevent it drawing out.

To return to the operation of molding. The pins being properly adjusted in the molds, the "point enamel," as it is called (a composition lighter in color than the body of the tooth), is placed in the molds by means of a small steel spatula; the body is placed in them in pieces corresponding to the size of the teeth; the top of the mold is then put on and the mold placed under a press, which compacts the mass. They are then dried by a slow heat. When perfectly dry, the top is removed, and the teeth will now drop out. In this state they are very tender, and require very careful handling. They are now placed on clay slides, and are ready for "biscuiting." This is done by subjecting them to a bright red heat, when they can be handled and cut or filed like chalk. They are now sent to the trimmers' room. In this room more than 20 girls are employed in removing and filling-up imperfections, cutting away the "spare edge" (as it is called) left in molding, and preparing the teeth for the next operation, which is enameling. The main ingredient of the enamel is spar, so tempered as to flow at a less heat than is necessary to vitrify the body; so that, when burned, the body will not have lost its strength by too much vitrifaction, and yet the enamel have the proper gloss. The enamels are put up in jars, colored as desired—blue, yellow, brown, &c.; they are mixed with water about the consistence of cream, and laid on with a brush. After drying, the teeth are examined to remove any enamel which may have run over the edges, smoothed with the finger, and are then ready for the gum room. The gum enamel is substantially the same as the other enamels, colored to imitate the natural gum, and is put on with a brush in the same manner. From this room, the teeth are passed into the gum-trimmers' room, where the edges are dressed with a file, and the arch of the gum made rounding and true with a small, pointed instrument. They are then placed on clay slides, and are ready for the furnaces. These are structures of fire-brick, of which there are 13, holding over a half tun of coal each, with a clay muffler in the center. Beneath and around this the coal is placed, the door-way walled up, and the fire started. They burn three or four such furnaces daily. The early part of the fire is used for biscuiting the teeth, and after the coal is thoroughly ignited and the heat becomes sufficiently intense, the burning is commenced. One slide, holding about 150 teeth, is put into the muffler at a time, and occupies (depending upon the state of the fire) from 10 to 30 minutes in burning. The practiced eye of the burner must detect, from the appearance of the teeth, when they are properly burned. If taken out before they are done, the enamel will craze or crack in cooling; if a little too much done, the surface will be too glossy, and the body will not be strong. When cool, the teeth are removed from the slides, and, if perfect, placed upon wax cards in sets, and are ready for sale.

There are now engaged in Messrs. Jones & White's establishment over 100 persons, nearly one-half of whom are females. They can turn-out, in finished teeth, with their present force, over 200,000 plain teeth per month—of course, not so many gum teeth, as there is much additional labor on these. The amount of wages paid weekly is over $900. Independent of the trade in this country, they are supplying orders for all parts of the world where the advancement of civilization has rendered the *dentist* a necessity.

MAN SCIENTIFICALLY DESCRIBED.

In a recent lecture, delivered before the Royal Society, in London, by Professor Owen, D.C.L., F.R.S., as reported in the *Engineer*, he described man as a specimen of organic nature, as follows:—The fourth and highest type of mammalian brain rises at once, and without transitional rudiments of the hippocampus minor, hinder horn of lateral ventricle, or concomitant lobe of cerebrum protruding backward beyond the cerebellum, to that marvelous structure which is peculiar to our own species. The sole representative of the archencephala is the genus homo. His structural modifications, more especially of the lower limb, by which the erect stature and bipedal gait are maintained, are such as to claim for man ordinal distinction on merely external zoological characteristics. But his psychological powers, in association with his extraordinarily developed brain, entitle the group which he represents to equivalent rank with the other primary divisions of the class mammalia, founded on cerebral characters. In this primary group man forms but one genus—homo—and that genus, one order, called bimana, on account of the opposable thumb being restricted to the upper pair of limbs. The mammæ are pectoral; the placenta is a single, sub-circular, cellulo-vascular, discoid body.

Man has only a partial covering of hair, which is not merely protective of the head, but is ornamental and distinctive of sex. The dentation of the genus homo is reduced to 32 teeth, by the suppression of the outer incisor and the first two premolars of the typical series on each side of both jaws, the dental formula being:—

$$i.\frac{2-2}{2-2},\ c.\frac{1-1}{1-1},\ .\frac{2-2}{2-2},\ m.\frac{3-3}{3-3}=32$$

All the teeth are of equal length and there is no break in the series; they are subservial in man not only to alimentation but to beauty and speech.

The human foot is broad, plantigrade, with the sole not inverted, as in the quadrumana, but applied flat to the ground. The leg bears vertically on the foot; the toes are short, but with the innermost longer and much larger than the others, forming a "hallux" or great toe, which is placed on the same line with, and cannot be opposed to, the other toes; the pelvis is short, broad and wide, keeping the thighs well apart, and the neck of the fe-

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mur is long and forms an open angle with the shaft, increasing the bases of support for the trunk. The whole vertebral column, with its slight alternate curves, and the well-poised, short, but capacious sub-globular skull are in like harmony with the requirements of erect position.

The widely separated shoulders, with broad scapulæ and complete cavicles, give a favorable position to the upper limbs, now liberated from the services of locomotion, with complex joints for rotatory as well as flexile movements, and terminated by a hand of matchless perfection of structure—the fit instrument for executing the behests of a rational intelligence and a free will. Hereby, though naked, man can clothe himself and rival all natural vestments in warmth and beauty; though defenseless, man can arm himself with every variety of weapon, and become the most terribly destructive of animals. Thus he fulfills his destiny as the supreme master of this earth and lord of lower creation."

JOURNAL OF PATENT LAW.

AN AUTOMATIC OVEN—A PATENTEE'S DODGE.

Sellers vs. Berdan.—This was an application by the defendant to the Court of Common Pleas of the City and County of New York, to compel the plaintiff to disclose a patent alleged to have been obtained by him in France.

It appears the plaintiff commenced a suit against the defendant to recover an amount claimed to be due for the construction of an automatic oven with the application of hydraulic power, alleged to have been ordered by the defendant; and to be used in France. It appeared from the papers in the case that Berdan and Sellers both agreed that a new patent would be necessary to protect the former in his right in consequence of the application of the hydraulic power. Defendant alleged that after the completion of the machinery, the plaintiff, without defendant's knowledge, went to London and Paris, and took out patents in his own name for the application of the hydraulic power; thus depriving the defendant of the use of the machinery which he had employed plaintiff to construct for him. The discovery was therefore asked by the defendant, with leave to inspect the patent in order that he might properly defend the suit.

The counsel for the plaintiff resisted the motion on two grounds: first that the existence of the patent was sworn to only upon information and belief; and second, that the taking-out of the patents did not prevent the defendant's use of the one constructed for him by the plaintiff.

The counsel for the defendant replied that a statement of the existence of a document on information and belief, and its possession by the plaintiff, were sufficient—especially when the opposite party came into court and made no denial; further, that, when the plaintiff had obtained a patent which gave him an exclusive right to use an article, he could not set-up that the defendant could use the patented article *notwithstanding*, because the patent was obtained in fraud of the defendant's rights; and that, perhaps, the defendant could compel the plaintiff to assign the patent to him; at least the plaintiff could not compel the defendant to pay for the construction of the machinery which their subsequent acts had rendered worthless.

The court reserved its decision on the argument; but it afterwards decided to grant the discovery.

RAPID STEAMSHIP PASSAGES.—A New York correspondent has prepared a list of the fastest trips made by transatlantic steamers. "The extraordinary passage of the *Vanderbilt* has hardly been noticed in the excitement about the fight. She made the trip from Southampton to New York in nine days, twelve hours and thirty minutes—the shortest western passage ever made. The following table is worth placing on record:—

1851.	Left Liverpool.		Arr. at New York.		d.	h.	m.
Baltic.......	Aug. 6,	4 P. M.	Aug. 16,	6 A. M.	9	19	9
1853.							
Arabia......	Aug. 13,	2 P. M.	Aug. 23,	7.55 A. M.	9	22	55
1854.							
Baltic.......	June 28,	1 P. M.	July 8,	1.15 A. M.	9	17	15
1857.							
Persia......	June 13,	2.15 P. M.	June 23,	6.56 A. M.	9	16	11
1858.	Left Southampton.						
Vanderbilt..	June 9,	7.30 P. M.	June 19,	10.30 A. M.	9	15	0
1860.							
Vanderbilt.	April 18,	6.30 P. M.	April 28,	8 A. M.	9	12	30

Had it not been for adverse winds during the latter part of the trip, the time would have been reduced at least to nine days. We can expect nothing better than this from any ship afloat, except perhaps the *Adriatic*, on her homeward trip in May, or the *Great Eastern*, which will probably cross the Atlantic in June."

THE HEXAGONAL CELL OF THE HONEY-BEE.

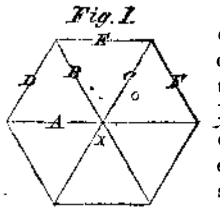
BY W. J. WEEKS.

" The same keen horns within the dark abode,
Trace for the sightless throng, a ready road."

" These, with sharp sickle, or with sharper tooth,
Pare each excresence and each angle smooth,
Till now in finish'd pride. two radiant rows
Of snow-white cells one mutual base disclose,
Six shining panels gird each polish'd round,
The door's fine rim with waxen fillet bound,
While walls so thin, with sister walls combined
Weak in themselves, a sure dependence find."

In common with the equilateral triangle and the square, the regular hexagon can also be united, side by side, to others similar and equal, without leaving intermediate spaces—a property not possessed by any other regular polygon of a greater number of sides; and while it is well-known to mathematicians that the regular hexagon affords greater capacity and strength, in proportion to the quantity of material, than either the triangle or the square, it is obvious to the most superficial obsever, that it is also better adapted to the insect form; but besides these advantages it has another property not common to any other figure, and which may be expressed as follows:—

Fig. 1



In every regular hexagon, the distance from its center to any one of its angles, is exactly equal to any one of its sides. Thus, in Fig. 1, X being the center, any one of the lines, A B C, &c., is exactly equal to any one of the sides, D E F, &c.; this is the crowning beauty of the regular hexagon, and it is this peculiarity which renders it so admirably adapted to the architectural instinct of the bee and other insects, which construct hexagonal cells.

Fig. 2

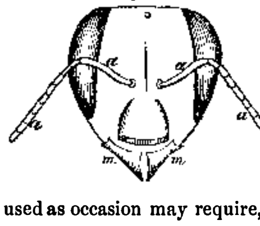
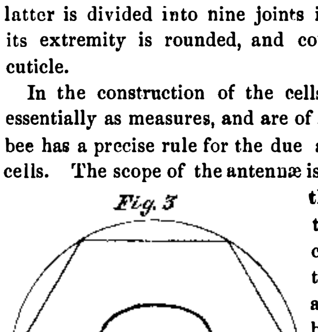


Fig. 2 exhibits the outline of the bee's head, and the anterior portion of it; *a a*, are the antennæ, and *m m*, the mandibles; the latter are hard horny organs, of a peculiar form, and have a lateral motion, they are used as occasion may require, in the various operations of biting, gnawing, compressing, drawing-out, smoothing, &c. They are the mechanical instruments. Each antenna consists of two portions, one end of the shorter is united to the head by a ball and socket joint and the other is articulated with the longer or fore-arm, the latter is divided into nine joints imparting flexibility; its extremity is rounded, and covered by a sensitive cuticle.

In the construction of the cells, the antennæ serve essentially as measures, and are of such a length that the bee has a precise rule for the due and proper size of its cells. The scope of the antennæ is such that, extended,

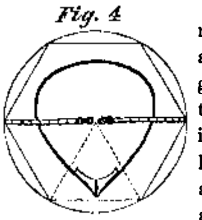
Fig. 3



their extremities can touch any part of a circle in a plain anterior to the head, and again, the articulations being brought together in front, the tips of the fore-arms can in like manner touch any part of a smaller circle; hence, it is obvious that this admits of the reaching of the opposite angle of the greatest regular hexagons which can be inscribed within those circles respectfully, see Figs. 3 and 4.

Practically, the bees construct but two kinds of regular hexagonal cells, the first designed for the embryo worker, has each side equal in length to the forearm of the antenna, and the second, for the embryo drone, has each side equal in length to the whole antenna. Although it might be possible for the bee, by flexing the forearm, to construct a regular hexagon somewhat smaller than the first mentioned, yet such a cell would be useless, as the smallest now constructed is just large enough to admit the body of the adult worker, or the queen in the act of depositing her eggs. The maximum size is also limited; the greatest possible regular hexagon which the bee can construct, is one whose diameter between opposite angles, does not exceed the extent of the antennæ, together with the space of forehead between their sockets; the diameter of the drone cell is less than this by the space just mentioned, as if it were laid out by the sweep of only one of the antennæ, but the greatest diameter of the embryo queen-cell corresponds with the stretch of the two antennæ in opposite directions.

Fig. 4



We may often observe, in the recently perished bee, these organs assuming apparently the very angle of sixty degrees, as shown by the dotted lines in Fig. 4, thus indicating, in the plainest of sign-language, one mode of their capable application. They also serve as delicate and sensitive calipers, both being indispensable, which, during the progress of the work are frequently applied, one upon each side, to the several walls of the cell, until the wax is drawn out to its utmost tenuity compatible with strength.

The intimate relation between the length of the antennæ and the size of the cells was discovered by the author of this article, in the year 1852, he being previously acquainted with the properties of the hexagon. Any one, knowing this relation, may now understand how thousands of cells in a single hive may be all of one form and size, how every individual cell of these thousands may be precisely similar to every cell of the aggregate millions in all other hives, and how, the world over, wherever this species of bee (*apis mellifica*) exists, all its regular hexagonal cells of the two classes—worker and drone—can be exactly equal each to each, for every adult worker in its antennæ is provided with an equal rule and compass. The regular hexagon, with its unique peculiarity, was doubtless a part of the earliest creation of material forms; and in the subsequent production of animal life, Infinite Wisdom supplied the bee with organs adapted to that peculiarity, and endowed it with the instinctive knowledge necessary for their proper application.

CLAY RETORTS.

MESSRS. EDITORS:—Under the head of "Clay Retorts," in your last number (May 12th), Mr. J. P. Kennedy, gas engineer, of Trenton, N. J., states that "many superintendents are under the impression that clay retorts cannot be worked without an exhauster; but this is a mistake—they require the aid of an exhauster no more than those made of iron." Now the question would seem to be, "Are iron retorts not benefited by the use of an exhauster?" In order to demonstrate whether this is or is not so, let such as have experimented give their results. In a small gas-works, where there is generally a superabundance of purifying surface, and where the back pressure is no greater than the pressure of the seal of the dip pipes in the hydraulic main, there is no advantage to be gained by the use of an exhauster. But, where the make or consumption of gas is increasing and the limited purifying apparatus and other causes produce a pressure by several inches greater than exists in the hydraulic main (if only from two to four inches more), the deposit of carbon will soon show itself and accumulate rapidly; in this state of things, the good effects of an exhauster will be quickly apparent.

Having suffered much from the accumulation of carbon by unavoidably great back pressure, I had an exhauster put up, having still the same iron retorts in use. In less than two weeks the whole of the carbon was consumed away, and no more was formed. I worked the same retorts over a year after that, whereas, with the same amount of carbon as they had in them previously, they would not have lasted six months; the change was so great as to be a source of repeated remarks among the workmen. I now use all clay retorts and have had some ovens of threes and fives last nearly three years, with a pressure of from 10 to 12 inches in winter; repeated trials have shown a reduction of yield of gas of from 10 to 12 per cent when the exhauster was stopped, and with the same kind and amount of coal. An exhauster will keep down any back pressure, and the retorts will then bear an increased quantity of coal, from 20 to 25 per cent more to each charge, and burn it off in the same space of time. Nearly all the works of any note in England, Scotland, and other parts of Europe are adopting exhausters.

There are some articles in the late numbers of the London *Journal of Gas-lighting*, in which the report of a superintendent of a small works states the advantages he has derived from the use of an exhauster, and he also recommends it to others. Such is my—

EXPERIENCE.

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