United States Centennial Commission.

INTERNATIONAL EXHIBITION, 1876.

REPORTS AND AWARDS

GROUP II.

EDITED BY

FRANCIS A. WALKER,

CHIEF OF THE BUREAU OF AWARDS.

PHILADELPHIA:
J. B. LIPPINCOTT & CO.
1877.

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SYSTEM OF AWARDS

[*Extract from Circular of April* 8, 1876.]

Awards shall be based upon written reports attested by the signatures of their authors.

The Judges will be selected for their known qualifications and character, and will be experts in departments to which they will be respectively assigned. The foreign members of this body will be appointed by the Commission of each country and in conformity with the distribution and allotment to each, which will be hereafter announced. The Judges from the United States will be appointed by the Centennial Commission.

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Reports and awards shall be based upon inherent and comparative merit. The elements of merit shall be held to include considerations relating to originality, invention, discovery, utility, quality, skill, workmanship, fitness for the purposes intended, adaptation to public wants, economy and cost.

Each report will be delivered to the Centennial Commission as soon as completed, for final award and publication.

Awards will be finally decreed by the United States Centennial Commission, in compliance with the Act of Congress, and will consist of a diploma with a uniform Bronze Medal, and a special report of the Judges on the subject of the Award.

Each exhibitor will have the right to produce and publish the report awarded to him, but the United States Centennial Commission reserves the right to publish and dispose of all reports in the manner it thinks best for public information, and also to embody and distribute the reports as records of the Exhibition.

ORGANIZATION AND DUTIES OF THE JUDGES.

[*Extract from Circular of May* 1, 1876.]

Two hundred and fifty Judges have been appointed to make such reports, one-half of whom are foreigners and one-half citizens of the United States. They have been selected for their known qualifications and character, and are presumed to be experts in the Groups to which they have been respectively assigned. The foreign members of this body have been appointed

by the Commission of each country, in conformity with the distribution and allotment to each, adopted by the United States Centennial Commission. The Judges from the United States have been appointed by the Centennial Commission.

To facilitate the examination by the Judges of the articles exhibited, they have been classified in Groups. To each of these Groups a competent number of Judges (Foreign and American) has been assigned by the United States Centennial Commission. Besides these, certain objects in the Departments of Agriculture and Horticulture, which will form temporary exhibitions, have been arranged in special Groups, and Judges will be assigned to them hereafter.

The Judges will meet for organization on May 24, at 12 M., at the Judges' Pavilion. They will enter upon the work of examination with as little delay as practicable, and will recommend awards without regard to the nationality of the exhibitor.

The Judges assigned to each Group will choose from among themselves a Chairman and a Secretary. They must keep regular minutes of their proceedings. Reports recommending awards shall be made and signed by a Judge in each Group, stating the grounds of the proposed award, and such reports shall be accepted, and the acceptance signed, by a majority of the Judges in such Group.

The reports of the Judges recommending awards based on the standards of merit referred to in the foregoing System of Awards, must be returned to the Chief of the Bureau of Awards not later than July 31, to be transmitted by him to the Centennial Commission.

Awards will be finally decreed by the United States Centennial Commission, in compliance with the Act of Congress of June 1, 1872, and will consist of a special report of the Judges on the subject of the Award, together with a Diploma and a uniform Bronze Medal.

Upon matters not submitted for competitive trial, and upon such others as may be named by the Commission, the Judges will prepare reports showing the progress made during the past hundred years.

Vacancies in the corps of Judges will be filled by the authority which made the original appointment.

No exhibitor can be a Judge in the Group in which he exhibits.

An exhibitor, who is not the manufacturer or producer of the article exhibited, shall not be entitled to an award.

The Chief of the Bureau of Awards will be the representative of the United States Centennial Commission in its relations to the Judges. Upon request, he will decide all questions which may arise during their proceedings in regard to the interpretation and application of the rules adopted by the Commission relating to awards, subject to an appeal to the Commission.

A. T. GOSHORN,
Director-General.

[*Extract from Director-General's Address to Judges, May* 24, 1876.]

"The method of initiating awards which we have adopted differs in some respects from that pursued in previous exhibitions. In place of the anonymous verdict of a jury, we have substituted the written opinion of a Judge. On this basis awards will carry the weight and guarantees due to individual personal character, ability, and attainments, and to this extent their reliability and value will be increased. It is not expected that you will shower awards indiscriminately upon the products in this vast collection. You may possibly find a large proportion in no way raised above the dead level, nor deserving of particular notice. The standard above which particular merit worthy of distinction begins is for you to determine. In this regard I have only to express the desire of the Centennial Commission, that you should do this with absolute freedom, and when you meet with a product which you consider worthy of an award, we desire you to say, in as few words as you may deem suitable, why you think so.

"This, gentlemen, is all we ask of you in the Departments of Awards. Opinions thus expressed will indicate the inherent and comparative merits, qualities, and adaptations of the products,—information which the public most desires.

"Elaborate general reports and voluminous essays, though of great value as sources of general information, give little aid in determining the reliable or intrinsic merits of particular, individual products.

"The regulations which have been published divide the work of awards into three parts:

"1st. The individual work of the Judges.

"2d. The collective work of the groups of Judges.

"3d. The final decisions of the United States Centennial Commission in conformity with the acts of Congress.

"Each award will thus pass three ordeals, which, doubtless, will be ample and satisfactory."

GROUP II.

JUDGES.

AMERICAN.	FOREIGN.
QUINCY A. GILLMORE, New York.	R. H. SODEN SMITH, Great Britain.
ARTHUR BECKWITH, New York.	G. SEELHORST, Germany.
E. T. COX, Indiana.	CH. DE BUSSY, France.
HECTOR TYNDALE, Pennsylvania.	ADOLF E. NORDENSKIOLD, Sweden.
HENRY WURTZ, New Jersey.	K. NOTOMI, Japan.

GROUP II.

POTTERY, GLASS, ARTIFICIAL STONE, ETC.

CLASS 206.—Bricks, drain-tiles, terra-cotta, and architectural pottery.

CLASS 207.—Fire-clay goods, crucibles, pots, furnaces, bricks, and slabs.

CLASS 208.—Tiles—plain, enameled, encaustic; geometric tiles and mosaics. Tiles for pavements and for roofing, etc.

CLASS 209.—Porcelain for purposes of construction—hardware trimmings, etc.

CLASS 210.—Stone china, for household use, for chemists, druggists, etc.; earthenware, stone-ware, faïence, etc.

CLASS 211.—Majolica and Palissy ware.

CLASS 212.—Biscuitware, Parian, etc.

CLASS 213.—Porcelain ware for table and toilet use, and for decoration.

CLASS 214.—Glass used in construction and for mirrors. Window glass of various grades of quality and of size. Plate glass—rough, and ground or polished. "Toughened glass."

CLASS 215.—Chemical and pharmaceutical glass-ware, vials, bottles.

CLASS 216.—Table glass and movable decorative glass-ware.

CLASS 219.—Stained and enameled glass, cut and engraved window glass, signs, lanterns and similar decorative objects.

CLASS 103.—Lime cement and hydraulic cement raw and burned, accompanied by specimens of the crude rock or material used, also artificial stone, concrete, beton.

Specimens of lime mortar and mixtures, with illustrations of the processes of mixing, etc.

Beton mixtures and results, with illustrations of the processes.

Artificial stone for building purposes building, blocks, cornices, etc.

Artificial stone mixtures, for pavements, walls, or ceilings.

Plasters, mastics, etc.

CLASS 517.—Brick, pottery, and tile machines. Machines for making artificial stone.

CLASS 518.—Furnaces, moulds, blow-pipes, etc., for making glass and glass-ware.

GENERAL REPORT

OF THE

JUDGES OF GROUP II.

PHILADELPHIA, December 30, 1876.

PROF. FRANCIS A. WALKER, *Chief of the Bureau of Awards:*

SIR,—I have the honor to transmit to you herewith the awards determined upon in Group II., "Pottery, Porcelain, Glass," etc.

I beg also to present the detailed report which my colleagues and myself have prepared. This report contains:

1. Introductory remarks on the Development of the Art of Pottery and Porcelain in Europe during the past century, and observations on the scope and general character of the present exhibition of ceramic wares.

2. Notices of the collections shown by each exhibitor in the classes of Pottery and Glass, whether commended for award or not.

3. A few special notices of interesting and instructive objects coming within the Group but not shown for competition.

4. Statistics respecting the position and development of the pottery industry in the United States.

5. A report of the results of testing the cements, and of the examination of the brick-kilns, furnaces, and brick-making machines.

6. A report, with careful analysis, of some of the potting materials exhibited in the Japanese Section.

Very respectfully yours,

R. H. SODEN SMITH,

Chairman of Group II.

GROUP II.

POTTERY, PORCELAINS, BRICKS, CLAYS, CEMENTS, AND THEIR MATERIALS, ETC.

It may not be out of place, before making some general observations on the exhibition of pottery and porcelain brought together in the International Exhibition Buildings, to allude briefly to the position and progress of the potter's art in Europe during the last century.

A hundred years ago hard porcelain, which had been developed in Germany from the discovery of Böttcher, had attained perhaps the highest point of its excellence at Meissen. At the same time many other manufactories, more or less important, had possessed themselves of the secret of the manufacture, and were producing in some cases works of considerable importance and merit. The traditions of these, as may be seen by observations occurring in the following report, have not been lost, and in several cases have favorably influenced the present productions from various countries besides Germany. Hard porcelain was also produced in Italy at Capo-di-Monte, and a similar and derived style at Buen Retiro, in Spain,—the products of both localities being marked by very characteristic design and method of ornament; their groups of figures in relief and their vigorous mouldings often showing, despite a certain rococo extravagance, real artistic feeling and a picturesqueness of effect. In England, about the same date, hard porcelain was attempted with fair success at Plymouth, and a little later at Bristol was made excellently well. The Count Brancas Lauragais, coming from France to England, also produced some few examples of a most compact and fine porcelain decorated in the style of Chelsea.

At Sèvres hard porcelain began to be made in 1768–9, and continued to be produced, together with the more celebrated and successful soft porcelain, or *pâte tendre*, until about 1800. In 1804 the eminent chemist Brongniart, then director, unfortunately discontinued the making of *pâte tendre*, and confined the work of the factory to what seemed to him the only true material, namely, hard-

bodied porcelain. Of late years the soft-body has again been used, and with success. The hard Sèvres porcelain has unquestionably great merit for purity of material and singular skill in the potting, but in decorative effect it can, under few conditions, ever compete with the old *pâte tendre*. Hard porcelain was also produced in Russia, at St. Petersburg, as also at Copenhagen and elsewhere, and in these as in other localities the traditions of the last century happily survive.

Passing next to the history of soft or artificial porcelain in Europe, we find it just a century ago at the highest point of excellence to which, as a decorative material, it ever attained. The *pâte tendre* of Sèvres was scarcely approached in its own day for certain qualities of artistic effect, and has never been equaled since. Previously, however, to this chief triumph of a special manufacture, various attempts had been made to discover the mystery of porcelain-making and interesting experiments had been tried,—not without curious results. In 1585, at Florence, Francisco de' Medici made porcelain of artificial body with the aid of a chemist, or more properly an alchemist, who was attached to his service; the art, however, was soon lost, the results being curious rather than successful. It is almost needless to say that examples of this Florentine manufacture, a coarse white body with blue decoration of peculiar character, are extremely rare; they are, for the most part, marked underneath with a rude outline of the *duomo* at Florence, or with the Medici arms containing the initials of the Duke's name and titles.

No further record of soft porcelain occurs until 1671, when Dr. Dwight made at Fulham a porcelain of artificial body,—the first attempt, so far as is known, to introduce any "china" manufacture into Great Britain. The works did not advance, and it was not until about 1740 that the manufacture fairly took root in that country. At that date porcelain of varying quality was produced at Bow, some of a very soft frit, and another variety, dense, heavy, and, for an artificial body, unusually hard,—Oriental porcelain, ground up, being sometimes used in the composition. A little subsequent to the above date the Chelsea factory commenced work, and in its best time, about one hundred years ago, had a great success. Its choice figures, although often deficient in modeling, are the best in texture of any soft porcelain, and the finest vases and other ornamental pieces are richer in color and gilding than those of other European factories,—though wanting in the symmetry and cleanness of line notable in Dresden work, and still more wanting in the refinement characteristic of the highest class of Sèvres.

In 1751 soft porcelain was made at Worcester, and in a few years

was produced there of such delicacy as to be put in competition with Oriental "egg-shell." Many other localities took up the manufacture, which continued with varying success through the period of art decadence in the first forty years of the present century, until a fresh impulse was given and vigorous life again infused into the art in no small degree by the efforts of the late Mr. Minton. In France, however, as early as 1698, soft porcelain was made at St. Cloud. In 1753 the first porcelain was made at Vincennes, and during the following year the works were transferred to Sèvres and taken under royal patronage. The manufacture quickly accomplished its proposed aim, the production of refined and luxurious objects suited to the artificial and courtly life of the period, by no means intended or fitted for daily use, but keeping themselves apart from the grosser works in clay, as though they too, like their masters, were an aristocracy; and in truth, a choice Sèvres vase, of the finest *pâte tendre*, placed among the products that seek to compete with it, has a certain air of refinement, looking a gentleman among a mob. The secret of success was in the employment of the most capable artists then living in France, and these men, though mostly unequal to works of any nobility in art, were wonderfully skillful in decoration and subtle in their conception of what was most fitted to emphasize, by judicious contrast of material, the voluptuous surroundings of a gorgeous and artificial life.

Thus were conceived the pastoral subjects, bright with Arcadian impossibilities, seeming to be made possible by the surpassing dexterity of their artists,—dreams of rose-leaf life, touched with a lightness and fairy-like grace, as though the pencil were unconscious of any severer toil than that of indicating courtly shepherds and languishing shepherdesses. Groups of Cupids and wreaths of flowers were a specially favorite decoration, and occasionally a descent to such sublunary existence as an actual landscape or a sea-view. In the finest specimens the texture, so to speak, of the porcelain is of the utmost delicacy, and the glaze into which the colors sink and blend softly is like satin to the touch. Such examples, when enriched with brilliant turquoise, "*bleu de Roi*," or "*Rose du Barry*," are now of priceless estimation. At many other localities in France soft porcelain of great beauty was produced, but ultimately its manufacture was, for the most part, superseded by that of "hard-body," now the staple production of the French factories. Elsewhere in Europe, as at The Hague, soft porcelain of delicate quality was produced, and at Amstel, near Amsterdam, a medium body of rich appearance was made, but these factories were comparatively short-lived.

Turning next to the manufacture of Pottery* in Europe during the past century, we find that for the most part in the southern countries, as also in France and Germany, the producers were living on the traditions of the past rather than applying new materials or inventing fresh processes. In Spain and Sicily the traditional pottery that had descended from the time of the Romans was still to be found, and the durable remembrance of the long Moorish occupation was seen in the lustred azulejos, or wall tiles, and the large circular dishes still enriched with gorgeous color retaining something of its original Oriental harmony. In Italy, the once celebrated majolica had sunk to the faint reflection of its decorative brilliancy to be found in the productions emanating from the Abruzzi. Now and then a flicker of art would brighten up, as when Volpato made some beautiful white glazed earthenware at Rome in the beginning of the present century. In France, some souvenir of Palissy was preserved, and the rich wares of Nevers were not forgotten, while at Rouen, Moustiers, Marseilles, and elsewhere very decorative faïences, having in each locality some distinctive character, were successfully produced.

In Germany, at Nuremberg and elsewhere, in Franconia and on the Rhine, the traditions of various glazed potteries and of excellent stoneware, *Steingut* or *Grès*, still supported a considerable amount of production, the ancient designs and even the moulds being, in some cases, still in use. In England, the fine red ware, introduced by the brothers Alers and made in the early part of the eighteenth century, was feebly continued, but an excellent white salt-glazed ware of remarkable delicacy was successfully produced. About 1750 Whieldon was at work on his tortoise-shell, mottled, and other wares. With him was, for a time, associated Josiah Wedgwood, and when this remarkable man began to work independently he revolutionized the position of the potter's art in England. It is needless to dwell on the variety of the wares he invented and produced, but it may be well to note that he sought in every way to aid his own fine judgment and perception by securing the aid not alone of artistic excellence but of accomplished scholarship. It is a matter of regret that the house which inherits the name of Wedgwood, and not unworthily represents his energy and enterprise, does not compete in the Exhibition.

Any great success raises a swarm of rivals or imitators, and thus the jasper, basalt, cream, and other wares invented by Wedgwood were copied, and often with success, by Turner, Neale, Adams, etc.

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* Using here the word "pottery" as including all earthenware except porcelains or translucent "bodies."

The impetus thus given to the art of pottery in England was great, and made itself felt on the Continent. At Dresden and Sèvres, objects in the style of Wedgwood's jasper, but in different materials, were produced, and some of these are very elegant. In England a great variety of wares continued in the market, but without originality, till the art-influence which has been at work during the last few years began to tell, and the results of the first great International Exhibition of 1851 became gradually apparent.

At that great gathering England perceived that, however she may have progressed in industrial processes, she lagged behind her chief competitors in industrial design, and since that period resolute efforts have been made to remedy a shortcoming so serious and disastrous. Evidence of the progress made is given in the present Exhibition, but it would have been much more satisfactory if those establishments whose productions are partly displayed by others had themselves entered into the competition, and proved that their resources of production are equal to the display of objects possessing a new and original excellence rather than a remembrance of what has been done in former years.

It now remains to touch on the characteristics of the present Exhibition of Pottery and Porcelain as a whole.

The display is extensive and important, and the field covered is a very wide one. The number of exhibitors, including those of glass-wares, hereinafter reported upon, is 592; of these, 393 are external to the United States and 199 are from the United States. Of the exhibitors from distant countries, some have brought collections of great extent in the number of pieces, and of importance as regards the size and value of individual specimens.

The objects shown include porcelain, of hard and soft body; biscuit, Parian, porcelain-trimmings, and chemical porcelain; various stonewares with colored glazes, with salt and lead glazes; pottery of hard body, called "granite" ware, and the softer "C C," or cream-colored wares; fine faïence of solid body, and soft faïences of a great variety of material and glazes; "Majolica" and "Palissy" wares; terra-cotta for architectural and other purposes; tiles of many varieties, for flooring, wall decoration, ceiling, and roofing,—these are of various bodies, from extreme hardness to the softness of ordinary faïence; mosaics for floor or wall ornament; also bricks, drain-pipes, and fire-clay goods, as crucibles, pots, furnaces, etc. In addition to these objects are shown cements, with specimens of the crude materials, artificial stones, plasters, brick- and tile-making machines. A special report, with results of the testing of these cements, is included

in the following document. There are also specimens of various clays and other materials used in the manufacture of porcelain. A special report, with the results of the analyses of some of the most interesting of these clays, is hereto appended.

In respect of porcelain, Europe is not represented at her best; some of the chief English houses, as has already been stated, have not themselves entered into competition. The great national establishment at Sèvres is but imperfectly represented by certain examples, exhibited as objects of decorative art in the Memorial Building. Neither is the collection from Germany such as might have been expected. On the other hand, the range of representation in the Exhibition is very wide and the variety great.

Oriental porcelain, that is of Chinese and Japanese origin, is represented by collections of great interest, extent, and variety. Most especially the Japanese exhibition is of first-rate value, and it constitutes the most important contribution to the Ceramic Department which has been brought together by any one country. It may not, therefore, be out of place to dwell on the nature of this remarkable display of attractive and gorgeous products of the potter's art.

It must be premised that the Oriental art in porcelain, even where the specimens are freshly made, is, in fact, ancient art. Whatever innovation has been introduced has proved disadvantageous, and just so much as the artists have adhered to the old paths success seems to wait upon them. This is, indeed, not encouraging, but so true does it seem, that the Japanese, despite their wonderful desire for progress and their power of assimilating Western notions, are themselves aware that their art deteriorates when sought to be "improved" by European influence. Another cause of deterioration, however, has been unfavorably at work,—the desire to supply rapidly a foreign and undiscriminating market, and thus inferior productions, carelessly and hastily made, have in large quantities been exported. To purely Western notions, the peculiar influence of tradition on art is not easy to realize. The conception of subject, the method of design, the laws of ornament are in great measure fixed not less than the processes by which the work to be done is carried out. Thus, in India the arts of the goldsmith, to mention no others, are traditional, and in China those of the potter; until recently this has been the case in Japan also, though, owing to the superior energy of the race, not in so marked a degree. Happily, the efforts made to do justice to their country's art, on the occasion of the present Exhibition, seem to have specially drawn the attention of native artists to the danger of abandoning the ancient traditions of their country. The seats of manu-

facture more notably represented are various localities in the provinces of Satsuma and Kaga, and the city of Kiyoto, for stonewares and earthenwares, and for porcelain, factories in the provinces of Ise and Owari, and Arita in Hizen. All have their distinctive characteristics, not so much of material as of style, and all seem to be influenced by peculiar traditions.

The earthenwares known as Satsuma and Kiyoto wares are represented by a very large and varied collection, the work of many producers; the soft, creamy-colored ground, its delicacy of tone, enhanced by the reticulation of minute cracks which pervade the glaze, form a most effective surface on which to scatter the profusion of flowers, birds, insects, etc., in which the ornamentalist delights. These are conceived with a singular power of seizing the salient or most expressive features of each object, and touched with a lightness of hand and felicitous freedom that can scarcely be surpassed. The balance of parts also is preserved in the midst of quaintness of idea and an almost extravagance of freedom. In all the finer pieces the colors, not generally of a high key, are yet sufficiently brilliant and always harmonious. Where the human figure occurs, expression and color alone seem aimed at, and the grotesque manner of delineating the contour and the limbs excites surprise when compared to the truth, as well as the vigor, often notable in the representations of birds, some of the lower animals, and insects.

Among the pieces shown are examples of imitation of ancient works, so ingenious and curiously antiquated in appearance as to deceive a practiced eye. Besides the lessons to be learned from the ornamentation of these attractive wares, the skill of the potters de serves both recognition and study. The moulding is at times of surprising clearness and ingenuity, and the *tours de force*, so to speak, in potting are very remarkable; as, for example, a pair of large cylindrical vases surrounded by a complete case of open-work of oviform outline, even and true in execution. Some of the stonewares are of dense texture, and decorated in a bold, free, and effective manner, the colors being usually in what is known as enamel-painting, somewhat solidly laid on and slightly relieved from the surface.

Of the porcelain, some of the specimens exhibited are, as regards the technicalities of their manufacture, among the most remarkable efforts of the art ever shown. Vases 8 feet high, formed in two portions, are perfectly potted and gorgeously decorated; others about 7 feet high, in blue and white, are splendid examples of skill and of effective decoration. The building up of these great vessels is considered a very difficult feat, and the manufacture of the above-

mentioned vases was, we understand, specially undertaken for this Exhibition.

To European and American potters, perhaps still more remarkable are the large flat slabs exhibited. One of these, described in the report, is nearly 6 feet in diameter, a wonderful example of manufacture in hard porcelain; this is also notable for the beauty and boldness of its decoration of flowers in blue on the white ground. A pair of screens formed of slabs of thick porcelain, 38 by 26 inches, are remarkable, not alone for their fine ground-color of deep blue, with sprays of bamboo in white left out sharp and clean, but for the dexterity with which the method of supporting them in the oven has been concealed, both sides being free from any trace of "spurs" or other methods of sustaining the large and weighty mass during the process of baking. It may have been that the traces of such support were removed, and glaze, fusible at a comparatively low temperature, used to conceal the marks of the rests; in any case, they are rendered fit for use as ornamental screens, and framed so as to show both sides artistically decorated, although by different processes. Other remarkable slabs of porcelain, used as table-tops, have been propped in the oven by ordinary methods.

It is not alone in the unusual size of the specimens that the skill of the Japanese potters is shown, but also in various examples of the utmost dexterity in moulding, in evenness of line, and accuracy of contour of difficult and complicated forms. The conceptions of some of the works have, to Western eyes, a character which is occasionally bizarre, at times almost grotesque; nevertheless, the sense of proportion is satisfied, and the fitness and occasional splendor of the decoration give peculiar attractiveness to the collection.

The exhibition of blue and white porcelain alone would place the Japanese exhibition in a foremost place. The painting in blue underneath the glaze with which these articles are for the most part decorated, is stated to be prepared from native ore containing cobalt, and, for the finer quality, ore obtained from China. The skill and boldness of the decorative designs are often most admirable, showing a complete mastery of the ideas to be carried out, a fixed and certain appreciation of the conventional treatment appropriate to the material and position, and an almost unrivaled dexterity and lightness of hand. The delineations of certain animals and birds have perhaps never been surpassed in their fitness for decorative purposes.

The ware produced in Kaga is capable of furnishing examples of decoration which are very striking, and sometimes splendid. The

ground is covered in part or wholly with a fine red, produced from an oxide of iron; this color being first introduced into Japan about two generations ago by an artist-potter, whose name it bears, and in whose family the art of using the red color skillfully still remains; nevertheless, the work of the present proprietor is not considered equal to that of his ancestor. On this gorgeous ground the most varied and complex designs, often mythological, are applied in gold, and the effect is wonderfully rich. In the inferior pieces, however, and in the imitations of this decoration, the gold is over-burnished, and the excessive glitter mars the artistic effect of the whole. In some of these last the deteriorative influence of second-rate European taste is unfortunately apparent.

It is unnecessary to dwell, in any detail, upon the character of the European productions, but it may be as well to point out that some of these contributions illustrate what has often been observed of the almost inexhaustible fertility of the potter's art in offering new materials or new applications of the old. Many collections of the various wares exhibited prove how wide a field still opens to originality and enterprise in this the oldest art in the world's history. The artistic stoneware of which Mr. Doulton is the originator has proved so attractive and successful a manufacture as to have created many imitators in its own country; the best pieces derive their merit from the art-labor bestowed on them, and prove the possibility, now as formerly, of lifting a common, even rude, material to beauty and value by securing the co-operation of artists. The "Lambeth faïence," also shown from the same locality, but by another firm, is an additional illustration of what may be accomplished with mean materials dignified by art.

It is satisfactory to see that the combination of the products of the potter's art with more ordinary architectural materials is making way, and receiving the attention which it deserves from architects and decorators of the exterior and interior of buildings. In this direction the Exhibition contains much that is suggestive, not only in terra-cotta and in wall and other tiles, but in stoneware for panels, bosses, attached columns, etc.; also in materials for mosaic decoration, either for external or internal use on the walls of buildings. For many centuries the employment of pottery-ware, especially in the form of tiles, has been a chief resource in decoration among the great masters of surface ornament who enriched the mosques of Persia and other countries in the East. Their art, modified, but still effective and splendid, reached Europe through Spain, and still lingers in the traditions of that country; thus we find displayed in the Spanish collection a

variety of mural and other tiles, many of which are capable of successful employment wherever sufficient taste or judgment in their use can be found or cultivated. The use of terra-cotta in Europe for architectural purposes dates from an early period. In the early part of the sixteenth century it was skillfully employed in England, and its great durability and capacity to resist the influences of an uncertain climate have been thoroughly proved. Tints can also be obtained in it which harmonize well with other architectural materials, so that it may become again, as it formerly was, a valuable aid in giving character and finish to otherwise homely structures. The exhibition of terra-cotta, although not as strong as might be desired, is nevertheless both suggestive and interesting.

The considerable and varied collections of tiles for flooring, wall, and other decoration, are an interesting illustration of the revival and comparatively sudden development of an important industry. No great space of time has elapsed since the use of ornamental tiles was a piece of antiquarian curiosity, and a wall decorated with them could only be discovered in some forgotten dairy or obscure passage, where quaint Dutch or rude Lambeth plaques were still allowed to cling to the walls, or perhaps some space could be found where the now prized Liverpool tiles of Sadler & Green were still left *in situ*. At the present day in France, England, and elsewhere, almost every home, where decoration has been attempted, has some portion of its interior walls bright with the gay color and quaint with the clever subjects of modern mural tile-painting. This popular and pleasant art is fairly illustrated in the present Exhibition, and in the following report notices will be found of many specimens, creditable both in design and skill of execution. The encaustic and other flooring tiles include among them examples of thoroughly excellent work, which do infinite credit to the taste and judgment as well as to the great practical knowledge and experience of their producers.

The American contributions of pottery will be found noticed in some detail, not alone from their importance as a manufacturing industry, but also from the sudden and remarkable development to which they have attained. The porcelain exhibited is also specially noticed, illustrating, as it does, the first-rate character of the natural materials to be found in the United States, and the laudable desire to utilize and to do justice to such materials on the part of the manufacturers. It has therefore been thought well to preface the account of the American exhibition with a statement in detail of the position of the industry, especially of its more important seat at Trenton, N. J., and to give statistics, as complete as could be obtained in the time, of

the work being done by the energetic men who are gradually making their city of Trenton the Staffordshire of America.

In conclusion, it is but just to observe on the great importance of the large and varied collections which are included within the scope of this vast Exhibition of what are classed as ceramic products. The brief enumeration of the nature of the objects already made sufficiently shows the width of their scope, and the appended report will, it is hoped, illustrate their variety, interest, and value. In comparison with previous International Exhibitions, some classes of these products are better represented, others less fully; but without going into minute comparison, which could scarcely be profitable, it seems unquestionably important to observe that however the collection of ceramic art may, as a whole, stand in its relation to other great world-gatherings, for the potters of this country it should form an epoch in their art. It should be a point of fresh departure, a season to sum up with impartial scrutiny what has been done, and to look out with ambitious and hopeful energy on the vast field now occupied by their predecessors and rivals, but which is yet capable of a higher cultivation than it has hitherto received.

American potters should not be content with the prize of industrial success: they must utilize this Centennial Exhibition in the manifold directions in which it is capable of teaching them. From rude, ill-made pottery which may appear despicable, beauty of outline and fitness of adaptation is often to be learned; from ill-compounded glazes, poorly applied, are sometimes to be obtained suggestions of excellent color and skillfully harmonized ornament; wares of friable and ill-compacted body may be splendid with artistic design and gorgeous with superb painting. The error or incapacity of the workman may be noticed and shunned, but let the critic beware of slighting the lesson of the artist,—for such workmen are artists unconsciously,—often using by a sort of habit the traditions of their forefathers, sometimes applying, with a species of instinct, their innate sense of color and their native appreciation of the propriety of ornament. If, therefore, lessons can be gained from objects confessedly imperfect, how much more from those which combine consummate skill in technical processes with excellence of form and beauty of decoration? Happily, in these rarer examples the Exhibition is not wanting, and it is to be hoped that not a few among them will find permanent resting-places in either the public or private collections of the country.

In addition to these objects, which from their nature are judged more or less from an æsthetic point of view, and from which valuable lessons in this direction may be learned, there is the varied and im-

portant collection of products of the potter's art fitted for mechanical and scientific use. Respecting these, the very nature and wording of such awards as it has been thought right to give will convey the best lessons to the manufacturers and to others interested in their perfection and consequent utility. Their importance to a great manufacturing country—we allude now to the various fire-bricks, stonewares, chemical porcelains, etc.—cannot be overrated, and they are well, and in some cases very thoroughly, represented in the Exhibition. There is also the class of cements and crude materials, besides the machinery for manufacturing them. Respecting these a special report, as already stated, has been deemed advantageous; and the same is the case with regard to such of the porcelain clays as have been analyzed. They complete the range of the subject, except in the treatment of glass and glass-wares, and it has been thought by the writers of this report that the facts gathered respecting these important matters in the course of their investigations may be of interest and value, if not immediately, at least in the future.

NOTE BY THE EDITOR.—Since this Report was stereotyped its writer has received the following letter, which is interesting because it describes the first serious effort to establish the manufacture of porcelain in America:

"PHILADELPHIA, April 16, 1877.

"DEAR SIR,—In compliance with your request, I give you a few particulars concerning the first manufacture of American porcelain. My brother, William Ellis Tucker, of Philadelphia, was the first manufacturer of porcelain in the United States. He commenced at the old water-works, on the northwest corner of Schuylkill-Front and Chestnut Streets, in this city, about the year 1825. In 1827 he received a silver medal from the Franklin Institute of the State of Pennsylvania, and a similar award from the American Institute of New York in 1831, both of which medals I now have in my possession. In 1828 I commenced to learn the different branches of the business by serving several years' apprenticeship to it. In 1830 my brother connected with his business the late Judge Hemphill, of this city, and erected a large china-factory at the southwest corner of Schuylkill-Sixth and Chestnut Streets, with store-house, glazing-kilns, enameling-kilns, mills, etc. Here they manufactured large quantities of fine porcelain, equal to any in body and glaze, but not in workmanship. My brother died in 1832. In the year 1837 I leased the factory with all the appurtenances, and continued the manufacture for some time, until a store on Chestnut, above Seventh Street, which I had taken, was filled with china-wares of my own make. I then discontinued the manufacture. Accompanying this please find a specimen of porcelain made, painted, and gilt by me in the year 1837.

"Yours truly,

"THOMAS TUCKER,
"111 North Nineteenth Street.

"TO GENERAL HECTOR TYNDALE."

GLASS AND GLASS-WARES AND THEIR MATERIALS, MOULDS, PRESSING-MACHINES, COLORS, Etc.

The exhibition of glass in Philadelphia, however large in the aggregate, cannot be said to equal in many respects the displays made at the Paris, Vienna, and other great Exhibitions. Nevertheless, the gathering together of examples from so many nations could not fail to be interesting and instructive.

Coming within the scope of examination by the writers of this report are exhibitions of all kinds of glass,—table-wares, household utensils, toilet articles, decorative pieces, tiles, lamps, reflectors, and other pieces for lighting apparatus, "flint-" and "crown-"glass discs for lenses, chemical glass, druggists', perfumers', and other wares, jars and bottles of all kinds, common looking- and window-glass of all sizes, clear and silvered plate-glass (some of extraordinary dimensions), mosaics, spun and woven glass, beads, etc. These are blown, cut, pressed, or moulded, engraved, and etched, and are of "flint," "crown," "crystal," green- and lime-glass "metals." There are, besides, moulds and machines for pressing, specimens of sand for making, and metallic colors for staining and painting, glass.

Perhaps no branch of the arts of design as applied to manufactures better shows the modern tendency to the complete assimilation of all national characteristic expressions than does glass-making, or, rather, glass forming and decoration. From widely-sundered nations are here shown wares so similar in form and ornament that they might readily pass for the productions of one maker, so far as those points are concerned. While in a wide sense this unification may lead to broader thought and higher art, it certainly has no slight disadvantage, in causing the loss, or partial loss, by disuse, of national and individual modes of expression.

It is probable that if the same thought, skill, and knowledge of technical processes which characterize the exquisite porcelains and pottery from Japan had been applied to the production of glass-wares, the world would have gained largely by the further exhibition of

beautiful and peculiar expressions of art. That this is not wholly a speculation, and that it is capable of illustration, it is only needed to refer to the beautiful display of glass made by Messrs. Lobmeyr, of Vienna, with other Bohemian manufacturers. This collection shows the effect of careful preservation and artistic culture of national traditional expression in form, color, and design, and it should receive the careful consideration of those who carry the proper pride of pursuit to the production of better work.

There is, perhaps, something in the nature of glass which may prevent its application and use in so wide a field of form and ornament as is enjoyed in works of pottery. The very beauty of the material may injure or destroy the effects of outline and decoration. The almost complete transmission of light may conceal or fail to reveal a definite and delicate outline; or ornament placed upon the limpid object may injure its beauty of transparency and so become a blemish. In transparent glass form is not so striking nor so elegant as in coarser bodies, and this may be owing to its purity. The older Venetian glass-wares may, in part, owe their distinction in beauty of form to their less transparent nature. If, however, this difficulty be real, it should but promote deeper studies of material and keener invention in their application. So long as the Portland vase remains, and the many specimens of elegant ancient glass-ware, we may hope for yet better productions of beautiful works.

To the art museums of Europe we owe the knowledge which, late within this century, has produced industrial work in many branches reaching into and almost ranking with the fine arts. But it is to be regretted that no collections of glass have been made, or at least become widely known, illustrating the progress of the manufacture, by giving objects for comparison, during the last hundred or more years. Owing to this but little is written on this subject, other than technical works or essays upon ancient objects, which throw no comparative light on the productions of the years of this and the last century.

In the beginning of the eighteenth century Bohemia produced engraved and cut glass-wares, of good forms in moderate qualities of "metal," using but little, if any, lead in the manufacture. The traditional forms, decorations, and in many cases the colors, of the Bohemian wares have been carefully transmitted, and are successfully employed at the present time. Great improvements in quality, design, and ornament have, however, been made in that country within the last thirty years, and a further advance seems promising. In Germany, the eighteenth was a century of decadence in manufacture, and the present

century opened with a much reduced and deteriorated production. Until about the years 1820–1825, the glass-wares made in that country were fashioned largely after French models. About that period there sprung up an intense national feeling which, developing in all directions, led to a revival of old German traditions in every branch of art, and among the rest the glass-wares of to-day partake largely of their character.

In the qualities of the glass itself, or "metal," for making wares, great improvements have been made within this century, more particularly in England and in France. In the former country, late in the last century, a clear and dense "metal" of lead, or so-called "flint" glass,* was made, and this "metal," by improved methods and processes, was soon brought to great perfection, and it now yields brilliant wares, usually cut into facet and diamond patterns. Until within twenty-five years it seemed that the manufacturers relied, for effective appearance, more upon the extreme brilliancy of the "metal," which they increased by heavy and refractive cutting, than upon forms and patterns, which were often coarse and absurd. This applies also and as well to the productions of "flint" glass in the United States for the same period. So that in these cases the beauty of the material did actually impede the development of art in an important direction. Since that time, however, great advances have been made towards beauty of design in the wares produced. This glass is very well illustrated by the excellent collection of Messrs. James Green & Nephew, of London.

In France very large establishments have been created, in which improved processes are employed, and great attention has been given not only to quality of material, but also to the side of æsthetics in the manufacture of their wares. It is to be regretted that France is represented in glass only by window-plates and mirrors of excellent character and important productions, but which of course do no justice to the well-known high reputation of French decorated and decorative glass.

From Germany are shown only plates, mirrors, and window-glass, as is also the case in the exhibition from the Netherlands. The same may be said, with one or two exceptions, of the exhibits from Belgium. That country contains a number of important establishments, and one, or more of them, is well known for large production of good wares. Sweden shows an advance in her manufacture, as may be said also of

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* So called because at one time and to a small extent flints were ground and reduced to a powder, to produce what was believed to be a better material, but this process is no longer employed.

Norway. Spain and Portugal each furnishes a collection, and in these countries, in which the other exhibits are so strongly national and characteristic, it is curious to observe, as in the Scandinavian and other countries, how completely this art has employed the almost universal modern types. Italy shows not many, but characteristic examples, illustrating very fairly the traditional form and ornament of Venice. As has been said, Austria is very handsomely represented in Bohemian glass, showing a great advance in valuable qualities within the last twenty-five years.

The exhibition from the United States is a large, varied, and important one from almost every point of view, including, as it does, all descriptions of glass-wares. Manufactories of glass of the coarser kinds were established in this country as early as the war of the Revolution, 1776–1783, or perhaps earlier; but no great or marked advance was made until within the first quarter of the present century, during which period "flint"-glass works were founded in many places. These works rapidly increased in numbers, until, at the present time, there are many large centres of glass industry, all producing large and increasing quantities. The quality, too, has improved in nearly the same ratio, and while there is much room for the application of art-design, the United States may be congratulated in having a well-founded and established "flint"-glass manufacture. In several parts of the country considerable works have been formed for the manufacture of large plate-glass. These are yet new, and the production, consequently, small and but little known, except in the vicinities of the works, where it is in some instances largely employed for windows and sometimes silvered for mirrors.

Of lime-glass there are many large and interesting exhibits from Austria and the United States, but more particularly from the latter country. In this description of glass great advances have been made in the points of brilliancy, endurance, and transparency, and the wares composed of it are sold very cheaply.

Of the wares produced by a new process, and called "toughened" glass, there are no examples in the Exhibition, which is to be regretted, as much interest is felt in what seems to place glass among the most enduring as it is among the most useful of manufactures, and to give it still wider capability of application to the arts.

AUSTRIA.

MAURICE FISCHER'S SONS, *Herend, Hungary.*

Porcelain dinner-, dessert-, and tea-services, and decorative pieces. For the most part a fine, hard body, but varying somewhat according to the style of work; glaze fairly good.

The specialty of this manufactory is the reproduction of the styles of various porcelains, as old Saxon, old and modern Sèvres, Capo di Monté, Oriental, etc.; also a specialty is perforated work of great delicacy, forming an outer case to several specimens of tea-services; this is originally derived from Oriental models. A portion of a service of eight hundred pieces, after the Chinese style, made for the King of Italy, is shown; also specimens of a service, in the Sèvres style, made for the Emperor of Germany, and a tête-à-tête set, made for the Emperor of Austria. A vase of four feet six inches high is shown as a specimen of pottery on a large scale,—it is decorated in a so-called Japanese style. Many of the copies of old styles are very exact, and to persons interested in the reproduction of new antiquities this exhibition has an interest of its own. The rococo wares of the last century are imitated with success, especially as to form, the colors being not so happy in reproduction.

This collection is successful in the general accuracy of reproduction, and particularly of the delicate perforated work.

PORCELAIN WORKS OF THE COUNT VON THUN, *Klosterle, Bohemia.*

Porcelain dinner-, dessert-, and tea-services, and decorative pieces. Body very vitreous, compact, and hard; the glaze fair, and potting fairly good.

Various designs of dinner-services are neat and fitting, the pieces thin and well moulded. A service of about one hundred and sixty pieces, with pale bluish-green borders and dark-grounded panels, elaborately painted in many colors with delicate arabesque designs, is noticeable. The tea-services are specially commendable, being elegant, light, and modest in design,—an artistic scroll pattern being freely used in their

decoration. A dinner-service in white and gold has considerable elegance and clearness of ornament. A biscuit ewer, thirty-three inches high, is shown, the drum of which is decorated in high relief with scenes from the lives of various German Landsknechts, skillfully designed and carried out. A covered tankard, with imitation carved ivory, is cleverly executed, though the design cannot be praised. This exhibition shows, in several respects, the good influence of the Imperial Austrian Museum of Industry and Art at Vienna.

The quality of this porcelain is especially good in tea-wares.

CARL EBERHARDT, *Prague, Bohemia.*

Porcelain flowers, wreaths, crosses, etc. The blossoms are well modeled (the leaves and stems not porcelain). Some of the flowers, as a delicate yellow rose and a white camellia, are successful; the colors fair.

ALOIS KLAMMERTH, *Znaim, Moravia.*

Stone- and terra-cotta-wares, jugs, tankards, pilgrim-bottles, ewers, etc. The stoneware body is pale in color, compact and hard; the glaze sometimes rather thick; modeling of forms generally good, and some moulding good; decorations, both drawn and printed, are of fair and good designs, seemingly new. The imitation majolica is of soft body, and the decorations rather pale in color. A small collection of domestic wares of cheap character and pale-yellow body, having moulded ornaments fit for their purpose in a ware of very low price. Some pieces are shown with brown colors blended in the glaze.

K. LEDERER, *Gablonz, Bohemia.*

Vases, pedestals, pots, baskets of twisted work, etc. Pale and light body earthenware, colored (for the most part with violent red, etc.), gilt, and bronzed.

Manufactured for the South American market.

CARL FRANKE, *Prague, Bohemia.*

Exhibits of porcelain and glass-ware fittings, for druggists' and chemists' use, of which he is the decorator, showing a good manner of fitting up druggists' shops. He claims merit in the style of lettering, finish, and general getting-up for trade purposes.

DAVID & FRIEDRICH RIEDL VON RIEDENSTEIN, *Dallwitz, near Carlsbad, Bohemia.*

Porcelain dinner-services, samples, and tea-wares. Body of medium hardness; glaze white and good; the wares generally resembling the

French of moderate character; decoration of flowers minute, but dry in effect; tea- and tête-à-tête-services of fairly good design, in color and gold; one coffee-service and tray elaborate in decoration, on green ground. Vases and other decorative pieces are shown.

W. J. SOMMERSCHUH, *Prague, Bohemia.*

Glazed earthenware tiles and a stove of soft red body; the glaze even and good. Decorations of ordinary quality, embossed and painted with various subjects; others with well-laid and regular ground-colors.

J. & L. LOBMEYER, *Vienna.*

Table- and dessert-services, vases, jardinières, liqueur-sets, toilet articles, chandeliers, candelabra, mirrors, and ornamental articles. This is the most important collection of glass in the Exhibition. As a rule, the "metal" is of very light texture and brilliant, much more so than is usual in Bohemian glass. Forms, designs, and decorations are generally good and artistic. The engraving is especially good,—well designed and executed. Several services of thin glass, engraved with classic designs (notably one drawn by Professor Hansen, of Vienna), are particularly graceful and commendable; also engraved designs by Professor Storck, of Vienna, are delicate in drawing and execution. Indeed, the good effect of the Art Museum of Vienna is perceptible in much of this collection. Services of light table-wares, judiciously engraved, are singularly brilliant for thin wares. Full services of colored glass are shown; one, opal-tinted and enameled in white and in colors, is of new and handsome forms; another, of very delicate opal tints, blue, and gold, is of rich, lustrous effect; both of these are commendable. A service of dark green, decorated with men and animals in the old German (Thuringian) style, is effective. Pieces decorated in black and gold, in imitation of the manner of Schaper, are curious; a number of large vases and pedestals, in crystal and in colored glass, are graceful in form, but in decoration perhaps rather over-gilt; candelabra and chandeliers of graceful forms and brilliant in lustres; one of these with crystal and colored drops, in an Oriental style, is good. An excellent exhibition of general high quality of glass and decoration.

JULES DE BRUNFAUT, *Vienna.*

Fine spun glass in various articles, as caps, shoes, mats, feathers, etc., which are specially commendable for fine quality and delicacy.

J. SCHREIBER & NEPHEWS, *Vienna.*

Fancy articles and lamp-shades, of bone- and colored glass.

ADOLF MEYRS' NEPHEW, *Winterberg, Böhemia.*

Table-wares of crystal and common glass; also colored window-glass of good quality. This collection is praiseworthy for good quality of table-wares, and for variety of colors in window-plates.

F. E. PALME'S SON, *Zvecevo, Slavonia.*

Decanters, tumblers, etc., of ordinary and useful kinds, well adapted to purposes, at low prices.

C. STÖLZLES' SONS, *Vienna.*

Table-wares and fancy articles, of good quality.

J. A. ZIEGLER'S SONS, *Kreuzhütte, Bohemia.*

Mirrors with fancy frames and heavy, ordinary moulded glass-wares.

ANDREA ZEIGLER'S SON, *Sofienhütte, Bohemia.*

Mirrors and moulded glass-wares of ordinary character.

AUSTRIAN WORKS OF AUSSIG, *Aussig on the Elbe, Bohemia.*

Bottles, jars, etc., of green and other colors, regularly made and uniform.

THE TYROL GLASS-STAINING COMPANY, *Innsbruck, Tyrol.*

Three decorated windows, one with heraldic devices, the others with historic portraits, of fair design and quality of execution; also stained glass in small pieces for churches. This exhibit has a good variety of colors in window-glass.

JOSEF HOYER, *Svetla, Bohemia.*

Table-wares, dessert-pieces, bottles of cut and moulded patterns, etc., of lime-glass. The moulded patterns are very sharp and in close imitation of cut-wares; of good quality of "metal" and at low prices.

COUNT HARRACH, *Neuwelt, Bohemia.*

Table-wares, dessert-pieces, vases, jugs, ornamental pieces, etc., of conventional Bohemian form and decoration. A service of green glass, painted with subjects in the old German manner, is fairly good.

The exhibition is not equal to others made by this well-known manufactory. Prices moderate.

LUDWIG MOSER, *Karlsbad.*

Exhibits goblets, mugs, toilet-wares, etc. The cutting heavy and engraving elaborate. Some opal-tinted glass pieces are fairly good.

CLEMENS RASCH, *Meistersdorf, Bohemia.*

Table-wares, vases, jugs, decorative pieces, etc. Services of green glass are well decorated. Some pieces of fine opal-tinted glass are good. Common bone-glass vases, etc., of moderate quality. Good painting and general good taste are shown. Prices low.

JOS. ED. SCHMID, *Annathal, Bohemia.*

Table-wares, vases, ornamental pieces, etc. The "metal" of this exhibit is very brilliant, clear, and colorless. The forms are largely varied, some new, and mostly in good taste. The workmanship is creditable, showing skill and knowledge. A praiseworthy exhibition.

HERMANN MÜLLER, *Ulrichsthal, Bohemia.*

Table-wares, dessert-pieces, goblets, jugs, vases, and decorative pieces. The "metal" of fair quality. Engraving very elaborate and, in some cases, delicate and tasteful. Designs of form and decoration good.

GROHMANN & KESSLER, *Haida, Bohemia.*

Vases, toilet-bottles and sets, ornamental articles, etc., of the usual Bohemian styles, in great variety of forms and colors,—sixty different tints being exhibited. Specimens of good *Rose-du-Barry*, *Celeste*, and other colors are shown. The taste shown in this collection is not refined, but the production is successful of its kind. Prices low.

FRANZ WAGNER, *Meistersdorf, Bohemia.*

Fancy articles of glass-wares mounted with brass. Some imitations of agates, in table-tops and boxes, are very good. Considerable fancy is shown. The prices are very low.

J. ZEKERT, *Meistersdorf, Bohemia.*

Fancy articles of glass-wares mounted with brass. A small collection of ordinary character. The prices low.

ELIAS PALME, *Steinschönau, Bohemia.*

Five glass lustre chandeliers of brilliant "metal," good cutting and graceful forms. This is a large house, employing 600 to 800 persons in the manufacture of these productions.

FRANZ BATKA, *Prague, Bohemia.*

A large collection of chemists' and druggists' glass-wares of various qualities and forms. Several "metals" are employed which are of good character; the forms are suitable to purposes. Some colored wares, particularly a cobalt blue, are good. Prices low.

ARGENTINE REPUBLIC.

A small, unnamed collection of specimens of yellow and red terra-cotta roofing, flooring, and mural tiles, perforated bricks and architectural pieces, of coarse red body.

BELGIUM.

DESIRÉ BARTH, *Andenelle.*

Pipes of various forms and clays, white, red, and black. This manufactory produces, annually, one hundred and eighty thousand (180,000) francs worth of pipes; prices low,—from seventy centimes per gross upwards.

WINGENDER BROTHERS, *Chokier-lez-Liège.*

Pipes and cigar-holders, moulded and glazed, in various colors and grotesque styles. Prices fair.

COMPAGNIE DE FLOREFFE, *Floreffe, Namur.*

Mirrors of plate-glass of very large size, about 13 by 9 feet, well polished, and silvered very regularly.

SOCIÉTÉ ANONYME DU HAINAUT, *Hainaut.*

A large mirror with beveled edges, well silvered and polished.

SOCIÉTÉ ANONYME DE STE. MARIE D'OIGNIES, *Brussels.*

Large silvered plates, about 17 by 10 feet,—neither of them perfect in surface. These are of exceptionally large size.

SOCIÉTÉ ANONYME DE COURCELLES, *Courcelles.*

Large oval mirrors, beveled, and a large plate of triple thickness,—the latter very straight and clear.

LEON BAUDOUX & CO., *Charleroi.*

Window-glass, plain, colored, figured and cut, in large variety. Some of the "mousselinées," or figured, glass is of very good design. A great variety and good quality of colors and patterns.

E. BAUDOUX & JONET, *Lodelinsart.*

Window-glass of various colors and very large sizes; good in quality.

BENNERT & BIVORT, *Jumet, near Charleroi.*

Window-glass, large sizes, of various colors and good quality, being quite free from impurities.

A. BOUGARD, H. LE BRUN, & CO., *Roux, near Charleroi.*

Window-glass plates, some quite thick and of good quality.

L. DE DORLODOT & CO., *Lodelinsart.*

Window-glass plates of various kinds. Some for church windows are fairly good. Photographers' glasses are of good quality.

DE LOOPER, HAIDIN, & CO., *Gosselies-Courcelles*

Window-glass and cylinders, of the largest sizes and well finished.

J. DESSENT & BROTHERS, *Jumet.*

Window-glass of good ordinary quality and at low prices.

A. FOURCAULT-FRISON & Co., *Dampremy, near Charleroi.*

Window-glass of the largest sizes and of good quality.

OCTAVE HANS & Co., *Jumet, near Charleroi.*

Window-glass of fairly good quality.

C. LAMBERT'S SON, *Charleroi.*

Window-glass of large sizes and good quality. A large house, making 9,000,000 square feet of glass per annum.

L. LAMBERT & Co., *Jumet, near Charleroi.*

Window-glass of large sizes, plain and roughed, of great thickness and good quality.

LEON MONDRON, *Lodelinsart, near Charleroi.*

Window-glass of ordinary quality, from a large and important house.

J. MONNOYER & SON, *Dampremy, near Charleroi.*

Window-glass of large sizes and of fairly good quality.

ALPHONSE MOREL, *Lodelinsart, near Charleroi.*

Window-glass of large sizes and good quality.

A. SCHMIDT & Co., *Jumet, near Charleroi.*

Window-plates, some corrugated for reflectors for hot-houses and for churches, of good quality.

SCHMIDT BROTHERS & SISTERS, *Lodelinsart, near Charleroi.*

Window-glass of ordinary quality.

SCHMIDT, DEVILLEZ, & Co., *Dampremy, near Charleroi.*

Window-glass of very large sizes, of double and triple thickness; one plate of 51 by 31 inches of triple thickness, and one of 53 by 33 inches of double thickness.

SOCIÉTÉ ANONYME DE CHARLEROI, *Charleroi.*

Window-glass of ordinary qualities and sizes.

SOCIÉTÉ ANONYME DE JUMET, *near Charleroi.*

Window-glass of large sizes, of fairly good quality. This company uses the gas furnaces of Boetius.

SOCIÉTÉ ANONYME DE MARCHIENNE, *Marchienne au Pont.*

Window-glass of various patterns, mousselinées and plain, of fairly good quality.

A. BOUGARD, *Manage, Hainaut.*

Table-wares,—small pieces, wines, goblets, etc., of ordinary quality, at very low prices.

SOCIÉTÉ ANONYME DE BOUSSU, ETC., *Boussu, near Mons.*

Table-wares of crystal and half crystal, lamp-glasses, bone-glass globes, etc. "Metal" of the table-wares moderately good, cutting ordinary. Common moulded glass of ordinary quality. Lamp-shades and bone-glass bulbs are good.

BRAZIL.

F. A. M. ESBERARD, *Rio de Janeiro.*

Terra-cotta vases, glazed and unglazed,—some marbled in the glaze; one ornamented with designs in antique style, fairly drawn; open-work baskets, tea-wares, some imitation majolica wares; soft red body with tin glaze, good in form. Water-bottles in style of Hindustani work.

AMARO D. GRILLO, *Rio de Janeiro.*

Vases, red and pale-yellow terra-cotta,—some glazed; body fairly hard; modeling and moulding fair; a design of hanging-baskets shows originality. Vases of a black-bodied, hard ware are shown, also tiles of rather soft body with printed ornament.

Bandeira & Romaguerra.

Large terra-cotta water-filter, with designs of Indian figures in low relief, of red and yellow body, is fairly modeled.

These exhibitions, from a country seeking to develop and advance its resources, are interesting, as showing efforts which should lead to a good success. It is to be hoped, from the varied and valuable clays which exist in Brazil, that pottery of a high order and of a more distinctive character in style and decoration may hereafter be produced.

CHINA.

Imperial Customs, *Shanghai.*

Exhibition of Porcelain.

A very extensive exhibition of vases and various decorative pieces of hard porcelain, but so closely packed together, in the limited space devoted to them, that it was difficult to examine the specimens satisfactorily. This observation applies to the whole of the Chinese collection of porcelain; information, too, was deficient in precision. It is to be observed, also, that the Chinese exhibition is not that of the manufacturers, but of exporters and agents, and it is to be regretted that the specimens were not arranged in the order of places of manufacture. The porcelain is made, for the most part, at King-teh-Chun and decorated at Shanghai. The colors are often somewhat pale in tone and wanting in the force and harmony of the old work. Some pieces of large size, — bottles, bowls, garden-seats, examples of "crackle" and specimens banded, and with handles, etc., to imitate bronze mounting, are shown; also imitation "crackle," printed from patterns on paper. The garden-seats are many of them very good in color and extremely well made.

Examples of splashed or flowing color, in a species of semi-porcelain approaching stoneware, are shown, and in some the colors are rich and effective; these are decorated at Kiu-Kiang.

Vases 30 inches high, decorated with birds, etc., in various enamel colors, price $27 per pair in the Canton market; another pair, 36

inches high, with warlike-figure subjects, $25 per pair; a pair with rich, flowing colors, of brown-red, 36 inches, $20,—are cheap. These are the prices of the Chinese dealers. Some celadon-grounded vases with blue decorations are shown; also examples with ornaments in white over the colored surface,—having somewhat the effect, but coarsely carried out, of *pâte-sur-pâte*. Prices low.

Ho-Kan-Chin, *Shanghai.*

A collection of porcelain of various dates, some very early, of curious and interesting qualities. Among the delicate tea-wares shown are four covered cups, with patterns perforated and filled in with glaze, producing, when looked at by transmitted light, a very elegant effect; these are much valued. Some cups or goblets, of very fine white body, with delicate decoration, are shown; a small tea-pot, of the Ming dynasty, of fine quality of texture and blue color, is shown; a beautiful white tea-pot, stated to be of the earliest date of this fine white porcelain, is exhibited, and many other pieces of antiquarian interest, some possessing fine qualities of manufacture not equaled by the modern works exhibited.

S. C. Rose, *Kiu-Kiang.*

Exhibition of porcelain vases, bowls, bottles, seats, covered cups, cuspidores, etc. Porcelain of the usual body and hardness and of good glaze; various ground-colors are good, as a clear blue, a celadon, a yellow, and a purple; a celadon ground, with blue decoration, is successful; imitations of old "crackle" wares are shown. A pair of large vases, 4 feet 6 inches high, elaborately decorated and with gilt ornaments in relief, but wanting in harmony of color, costs $200 per pair; another pair with pale-yellow ground and greenish-gray ornament is successful. These are stated to have been made for the exhibitor, from designs suggested by himself.

Bean & Jardine, *Kiu-Kiang.*

Exhibitors of porcelain vases and garden-seats, bowls, bottles, covered tea-vases, etc.; for the most part, imitations of former styles; some fairly successful specimens of covered flower-boxes, well decorated with flowers and a beading of various colors, producing a peculiar and noticeable effect.

W. N. Lovatt, *Kiu-Kiang.*

Vases of ordinary forms and decorations, imitation "crackle" wares, etc.

TONG-CHOK-HUNG, *Kiu-Kiang.*

Porcelain vases and dinner-services, incense-burners, etc.; bulbed vases about 3 feet high are good in effect; dinner-services, very elaborately painted, $117 the set.

HENRY KOPSCH, *Kiu-Kiang.*

Dinner-services, decorated for the European market, pilgrim-bottles, large covered bowls, vases, etc.

Dinner-service, with red and gold scroll decoration, not successful; some flowing colors are rich in effect; yellow vases good in ground tones; a screen formed of small plaques, delicate in tint but somewhat pale in color; a large, round, covered box has a fine purple ground, with green and yellow leaf-ornaments.

IMPERIAL CUSTOMS OF KIU-KIANG.

Modern blue wares, "crackle" wares, imitation fruits, pilgrim-bottles, etc. Some of the blue effective, with fine, bold drawing of flowers and birds; imitation "crackle" good; tomatoes well imitated in color; some curious and quaint terra-cotta figures.

Vases of pink ground, with landscape and bird decoration, about 3 feet high, are $50 a pair in Kiu-Kiang.

C. F. MOORE, *Kiu-Kiang.*

Pilgrim-bottles, vases, ornaments, birds, animals, etc.

TIEN-SEN-SENG, *Kiu-Kiang.*

A small collection of vases, of ordinary style of decoration on white ground.

IMPERIAL CUSTOMS OF CANTON.

Dinner- and tea-services, flower-boxes, garden-seats, and various small wares,—some made in the "English-Canton" style, of brilliant but rather crude coloring on obtrusive gold ground, and some in the "French-Canton" style, having a general tea-green color, not inharmonious. On the whole, the decoration has a tendency to crudeness.

HU-KWANG-YUNG, *Hong Chow.*

Boxes, large vases, screens, etc. For the most part ancient, or of ancient models, also some modern wares. Among the former are some of fine quality, as pieces in blue and white of the Ming period; two vases of importance, both good, one of great excellence, in a fine early style, with greens of especial vividness in color and glaze; and

various other examples of early manufacture, both in porcelain and stoneware. In the modern wares, some covered boxes and forms of fruits are good; also some ingeniously-formed and quaint flower-pots of excellent brown, hard, body are very good. Some plaques of wood and lacquer, with porcelain inlaid, are fairly effective. (Wages are stated to be, at the porcelain works of Kiu-Kiang, from 10 to 15 cents per diem.)

FOW LOONG, *Canton.*

Vases of various sizes; some large dinner-services; "crackle" pots, with imitation bronze mounting; a pair of vases, about 5 feet, somewhat gaudily decorated in color and gold, $200 at Canton; others, designed from vegetable forms, have an ingenious character. The whole exhibition has the rather flashy style of the modern Canton wares. Prices low.

TACK LOONG, *Canton.*

A large exhibition of large vases; these, mostly in old styles, are good, especially a pair of "crackle" vases, with bands of intervening ornaments; some of reddish-brown ground are harmonious in tone; the pale-yellow ground of some vases is very pleasing; a few of pale sage-green ground, with colored ornament, are effective. The pieces in modern style are generally open to the same criticism as those of other exhibitors from Canton. Prices mostly low.

E. WADMAN, *Ning-po.*

Collection of ancient porcelain and pottery, containing some fine specimens of old manufacture. The ground colors of some are rich and harmonious, and the exhibition is instructive in various points of view. One vase of fine lavender tone, with flowers in relief; also a purple vase and purple bottle are excellent in tint; a greenish vase, of old style, is very fine in effect of color,—a tint much prized by collectors, partly from its comparative rarity.

DENMARK.

P. IPSEN'S WIDOW, *Copenhagen.*

Exhibition of Art Pottery.

Terra-cotta glazed and unglazed; the body porous, light and well potted; shapes and decorations of modified classic types, from the antique after Thorwaldsen and others; general imitation of the antique is good and effective. Among the objects exhibited are large tazzas, extremely well potted and well designed; decorated plaques in relief are sharp and clear; vases, large and small, are well potted and designs elegant, the drawing good; Egyptian and other styles satisfactory. The ornamentation of these is commonly in black, occasionally touched with dark red, on the uncolored buff body of the ware, and produces a pleasing effect.

Specimens of vases, tazzas, etc., painted in oil colors, with wreaths of flowers, fruits, and similar decorations on a black ground, are effective.

Terra-cotta statuettes and reliefs, after Thorwaldsen and others, are generally well modeled, of a fine reddish-cream-colored body. Prices fair, but not low.

Exhibit important and good.

GEORGE W. HESSE, *Bornholm.*

Decorative and art pottery of classical designs; the observations applied to P. Ipsen's Widow's collection are also generally suitable to this. Exhibit not so important. Prices moderate.

WENDRICH & SONS, *Copenhagen.*

Very good collection of vases, tazzas, etc. Some of black and deep-red color on light terra-cotta ground, with decorations adapted from the antique. Small vases especially commended for elegance of form and design; some few statuettes of light-colored body of medium quality; specimens of terra-cotta plaques painted in oil, and not fired, are shown.

ROYAL PORCELAIN WORKS, *Copenhagen.*

(Exhibited by Thomas Schmidt.)

Biscuit plaques in relief, subjects after Thorwaldsen, are finely modeled, and have great excellence in manufacture, causing regret that the works made in this important manufactory are not more largely represented.

EGYPT.

EXHIBITED BY THE NATIONAL MUSEUM, *Cairo.*

A large collection of goolahs, goblets, candlesticks, ewers, cans, and basins, dishes, cups and saucers, cups and holders (or "fingara"), paper-weights, and pipe-bowls; from Keneh, Sioot, Esneh, and Assouan. Some vessels decorated by Professor Lodi, with colors and gilding, are not fired but fixed by a peculiar process. These objects are of sun-dried clay, also of baked clay, polished or lustred, in red, black, and buff, with incised decoration; all hand-potted. The forms are suggestive—taken from the old Egyptian pottery—and frequently graceful. The body is soft.

THE BAZAAR OF CAIRO exhibits a so-called porcelain dish, decorated over the glaze with blue, green, and pink enamels in relief, with some gilding,—the decoration is in latter Persian style. Also a faïence vase 12 inches high, with cobalt, light-green, and orange-red ornament in Persian style, is very effective. A porcelain vase 26 inches high, with floral ornament worked in relief on the white body, the whole covered with a thick green or celadon glaze,—the body hard and vitrescent. This vase, the property of a mosque, is stated to have been dug up in Egypt 800 years ago. Persian tiles, of a sandy-buff body, with stanniferous enameled coat, upon which patterns are freely traced, with the brush, in cobalt, turquoise, copper-green, and red, and covered with a hard silicious glaze. The outlines are traced in black, with forms derived from the pink rose, forget-me-not, lily, and cypress, and are filled in without regard to the natural colors of the objects; subjects of hanging-lamps, vases, and Arabic writing are introduced, and the whole is a good example of well-distributed colored ornament.

FRANCE.

FAÏENCERIE DE GÍEN, *Gien, Loiret.*

Common faïence* table- and toilet-wares. The body very soft, porous, light, white, and well suited for glazes and colors. The glaze soft and well incorporated, fairly transparent, and good for colors. The forms of ordinary character and suitable to purposes. The prices very low.

Also faïence table- and toilet-wares, printed and enameled, of similar soft body and glaze; the forms very good, resembling old French faïences, beauty showing in some of the designs; the decoration corresponding in style and character, and often rich in effect and brilliant in color. The prices moderate. Decorative objects, vases, jars, bottles, ewers, cornets, clocks, etc., of same body as in the table- and toilet-ware but with richer glaze.

Decorations in the style of Rouen, Moustiers, Marseilles, old faïence of Italy, etc., in original and modified forms and decorations, are in good taste and style. Decorations after nature—animals, landscapes, etc.—are bold and striking. Some pieces decorated in a fine canary-yellow ground are good. The outlines of decoration are often printed and filled up with colors, as in jugs, mugs, fruit-stands, etc. A large collection of pieces is decorated on dark-blue ground with fine artistic effect. This last collection is very brilliant and rich, and is stated to be exhibited now for the first time. Imitations of old Nankin porcelain bowls, jars, etc., are good.

In the case of one manner of decoration in relief, the figures are painted in opaque enamel colors, and in another they are laid on with an opaque white "body," which is subsequently colored and glazed.

This whole exhibition is highly commendable for its artistic value

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* The word *faïence* is used in France to denote "earthenwares" (so called in England), or pottery wares not made of porcelain or translucent "bodies."

and for the successful effort to popularize and cheapen objects of beauty.

AD. HACHE & PEPIN-LEHALLEUR BROTHERS, *Paris.*

Hard porcelain, of ordinary thickness, and very thin table- and tea-wares. Body very hard, dense, light in fabrication, of a very fine white, and well adapted to glaze. The glaze good, fairly incorporated with the body, white, rich, and remarkably clear. The forms suitable, of modern style, are well designed and sharp,—sometimes quaintly original, after designs by Rossigneux. The decoration good, well treated, effective, and often original. The extreme lightness of the specimens, combined with excellent form, is to be praised. The prices, considering the quality, are moderate.

Thick hard porcelain, or "*Limonade*," table-wares; body very hard, dense, rather coarse and white, with a fairly good white and transparent glaze. Prices fair.

Tea-wares of novel reticulated and striated patterns, on the biscuit and finely glazed, are beautiful specimens of the thinnest and finest porcelains. A large table-service, made for Russia for 130,000 francs, decorated in scrolls, medallions, portraits, and flowers, is rich and effective. Three pieces, one centre and two side dessert-ornaments, with dragons in gold and colored in turquoise, of equable tone, are noticeably bold and effective,—the excellent harmony of the gold and bronze used in these pieces is commendable. Decorative porcelain in centre-pieces, baskets, tazzas, cups, saucers, etc.,—the decorations of these are clear and finished. Hard-fire grounds of celadons and grays are exquisite in tint and regularity, and the flowers and other objects painted over these "hard grounds" are neat and clean. The fine translucency of these thin and delicate wares is perhaps not excelled by any made at present in Europe.

The whole exhibition of this important house is original in character, fine in decoration, and shows great skill and knowledge of potting.

CHARLES FIELD-HAVILAND & CO., *Paris.*

Hard porcelain table- and tea-services. Body very hard, vitreous, dense, of fine texture, rather light and white, and the wares good in fabrication. The glaze good and well incorporated, white, rich, and transparent. The forms suitable in design and sharp in outline. The decoration fair and neat, and some examples of the *Rose-du-Barry* pink are good. An advance in manufacture seems observable; the texture of the body is notably good, and, for purposes of commerce,

is to be commended, as are the neat and useful forms of many of the wares.

THIERRY, *Paris.*

Exhibits samples of decorated table- and tea-services, vases, etc. Decoration rich, brilliant, and effective; not entirely original, but neatly and finely done. Specimens of faïence, plates, plateaux, etc., of dark-blue ground, richly decorated in the Limoges enamel manner with colors in relief, are tolerably good.

The turquoise, green, and canary-yellow colors are good.

HAVILAND & CO., *Limoges.*

Hard porcelain table- and toilet-wares, white and decorated; body very hard, though light, white and well adapted to the glaze, which is solid, well incorporated, pure, rich, and transparent. The forms are suitable, some modern, and others adaptations of eighteenth century styles, good in design and sharp. The decorations of flowers, fruit, scroll patterns, etc., are fairly good, and some executed with singular skill by a chromo-lithographic process, producing almost the effect of hand-painting. The gold decoration is generally in good taste, and modeling of handles appropriate and ingenious. One service, painted in purple, with animals, fruits, vegetables, fish, etc., is very good,—the form and decoration commendable. The above-mentioned application of chromo-lithography is stated to be as follows: the designs, engraved on copper or steel, are transferred to stone, and thence to the object, and in this manner a fineness and variation of line are obtained not to be got from ordinary chromo-lithography. This is mentioned as a new process. The specialties claimed by the exhibitor are productions, for commercial and ornamental purposes, in a porcelain of medium body, a body between the very hard and the soft,—made with a view to receive fine colors, and in this respect successful,—giving, however, by the method of decoration, in some cases, the effect of a rather too highly polished ivory. Statuettes modeled by Mr. De la Planche and produced in this body are shown; in those the glaze was occasionally overdone. Terra-cotta vases are shown, decorated with biscuit figures in relief; also plaques, etc., with enamel colors fluxed with the glaze, so as to produce the effect of highly varnished oil-paintings. The effort to attain a forcible effect, though not always in pure taste, deserves commendation as an attempt that may be advantageously applied to architectural decoration.

Examples are shown of a process of using a new application of transparent enamel colors on a hard porcelain, glazed body, so as to produce the effect of Oriental enamel decoration slightly in relief.

These are successful. Among the noteworthy specimens exhibited are a pair of dark purple-blue vases of Oriental form, rich in color; a pair of gigantic covered jars (made as commemorative of the Centennial year of America), about twelve feet high, of terra-cotta, on which are graven and colored American devices and emblems, not commended except as very large pieces successfully potted; and a reproduction of the pieces of a service made for General Washington.

The whole exhibition, from an establishment of importance, employing about twelve hundred workmen, is commendable for quality of hard porcelain, also, and more especially, for the introduction of new technical processes, in some of which considerable success has been attained.

JULES BRIANCHON AÎNÉ, *Paris.*

Nacreous, or pearl-lustred porcelain and faïence. An iridescent glaze is successfully produced, the effect of which may be pleasing when used in moderation and on certain objects. The lustre applied on *Rose-du-Barry* color, in a tête-à-tête-service, has a pleasing effect. Also imitation Palissy and majolica wares are shown. Prices moderate.

J. AUBREY, *Bellevue, near Toul.*

Decorated faïence with tin glaze, in the style of Rouen, Marseilles, etc., and of Italian majolica. Two large vases, over five feet high, of Chinese outline, fine examples of potting, are boldly decorated with masks, flower-scrolls, and arabesques; a large plate, in style of Abruzzi majolica, with Faenza scroll border, is noticeable. Well-shaped flower-stands, gracefully decorated with conventional scroll ornaments.

This exhibition is commendable for freedom and vigor of drawing and for correct reproduction. Prices low.

BARBIZET'S SON, *Paris.*

Majolica and Palissy wares. The well-known artist, M. Barbizet, exhibits an important collection of works, mainly from or after his own designs. The modeling of many of the specimens is of a very high order, and the carrying out of the artistic conceptions in detail excellent and commendable; the potting also is thoroughly skillful. The body used is white and compact; the glaze thin and calculated not to interfere with the delicacy of modeling, but deficient in texture. A very large and elaborate wall-piece, representing various marine fish and animals, as cod, urchins, star-fish, etc., is most remarkable as an example of close observation of nature, great dexterity in modeling, and in overcoming the difficulties inherent to potting,—in effect perhaps is too realistic. Statuettes representing "*Les Incroyables*"

are conceived with much humor, and carried out with admirable skill; others, also in grotesque style, are capital in delineation of humor and in force of expression. A large pedestal, supporting a garden vase, is excellent in bold design and good in color.

The exhibition is highly commendable for artistic effect in pottery.

TH. SERGENT, *Paris.*

Faïence, modified after Palissy and other styles, vases, cups, and small ornamental objects. Body white and compact; glaze generally fair, but sometimes too glittering; colors strong and often well harmonized. A large blue vase is an example of successful color and potting. Some of the modeling is good, as that of a bust of the period of Henry II., and various *aiguieres* and statuettes; these are fairly colored and quite cheap, as are all the wares, some being very low in price. Exhibition, as of a commercial character, is good.

A. MONTAGNON, *Nevers.*

Faïence, in style of old French of Rouen; also majolica in modified Italian styles. Body of red terra-cotta, tin glazed. Vases, ewers, plateaux, plates, garden-vases, bouquet-holders, lamp-stands, etc. Forms of ewers are good, decoration appropriate; some in Moresque and Persian styles. Some garden-seats shown are good. A large jardinière, about four feet long, is well designed and decorated. The designs are bold and extremely well drawn; commendable for potting, design, and painting.

PAUL BLOT, *Paris.*

Exhibits of decorated porcelain services and various ornamental objects. One service with borders in Persian style is rich in effect of color. Various vases of Sèvres porcelain, decorated by him, have considerable elegance and are well executed; the painting is minute and careful.

L. FIOLET, *St. Omer* (*Pas de Calais.*)

Collection of pipes; white body, some decorated in colors; moulding good. Some pipes are shown having very long stems. A large manufactory.

J. GAMBIER'S WIDOW, *Givet, Ardennes.*

Pipes, and some busts in pipe-clay to form the bowls of large pipes; well designed and skillfully moulded. A good material for some artistic purposes. The exhibit is praiseworthy, and from an important establishment.

F. Woodcock, *Paris.*

Porcelain biscuit, flowers, wreaths, bouquets, separate blossoms, brooches, ear-rings, etc., in natural colors; ingenious in design, and showing great dexterity in manufacture. Some large roses, camellias, etc., are crisp and natural. Prices very low.

P. Detemmerman, *Paris.*

Porcelain biscuit flowers, wreaths, bouquets, etc., very well modeled; large bouquets and cut-flowers extremely well designed. A plaque, of white glazed ground, with wreath of flowers in full relief, is of fine and delicate work. Prices very low.

L. Sohn & A. Delabre, *Paris.*

Flowers in porcelain biscuit, wreaths, bouquets, and small blossoms, pendent crosses, and other ornaments, finely modeled and finished; colors generally rich, but the greens less so. A very large bouquet, delicate and well colored. Prices very low.

Souchet & Co., *Paris.*

Enameled glass flowers in natural colors, made with the blow-pipe; colors rich and sometimes tender; orange-blossoms very good. In some kinds of decoration, this pretty product might be utilized with effect. Very cheap.

Eugene Blot, *Boulogne-sur-Mer.*

Red terra-cotta groups and figures, illustrating fishing-life at Boulogne; the material hard, the potting excellent. These figures and groups are highly artistic in design and admirably modeled, and are solely the work of M. Eugene Blot's own hand, except a few contributed by his son. A group of nine figures, called "*Les Pecheurs sur le Port*," with fish of various species, nets piled up, baskets, etc., is specially remarkable. The whole collection is highly commendable for design, modeling, and skillful potting.

E. Muller, *Paris.*

Glazed bricks for mural decoration; very well potted, glaze rather soft, colors green, blue, and brown. Ceiling tiles are ingeniously made to represent, in some measure, a coffered ceiling, and are capable of good decorative effect,—but the colors are heavy.

THE NATIONAL MANUFACTURE OF PORCELAIN AT SÈVRES.

In the Memorial Hall, French Art Department, are exhibited about twenty large and very important porcelain vases. These were assigned, for examination and report, to Group XXVII. (Art).

M. A. PELLETIER & SONS, *St. Just-sur-Loire.*

Stained window-glass of various colors, cylinders, etc. The many colors are specially commendable for uniformity and delicacy of tint and for regularity of manufacture. A large and important house.

PAUL BITTERLIN SON, *Paris.*

Painted decorative windows. A good collection of well-designed patterns. One window of brilliant scarlet ground, with sphinxes and heraldic ornaments, is noticeable; also some with bold scroll ornaments.

APPERT, LENGELÉ, & CO., *Paris.*

A large collection of glass shades, of excellent quality of metal and well formed; of various shapes.

SOCIÉTÉ ANONYME DE ST. GOBAIN, *Paris.*

Plate-glass, clear and silvered, castings for the concentric sectional lenses of Fresnel, skylights for street pavements, window-plates for churches, hot-houses, etc. A pair of glass plates, 257 by 118 inches, are of fine quality, and stated to be the largest ever exhibited. The glass moulded in rings, for Fresnel lenses, are excellent pieces of work, as are, also, many of the heavy and thick pieces made for skylights.

HENRY FROMONT, *Paris.*

Exhibits specimens of his own engraving on glass, done partly in the Exhibition buildings, of various qualities from ordinary to good.

BOULÈNGER AÎNÉ, *Auneiul.*

In a pavilion, near the U. S. Government building, M. DE BERGUE exhibits plain, encaustic, and decorated floor- and wall-tiles. These are manufactured by BOULÈNGER AÎNÉ, at Auneiul, Oise, and are of good quality, particularly the encaustic, which are of hard body and are fairly designed. Some large painted tiles are of moderately fair execution, as are the plain printed and printed-and-filled-up patterns.

GERMANY.

Royal Porcelain Works, *Berlin.*

This manufactory of porcelain stands on a footing quite different and more independent, as to resources, than ordinary private establishments; it exhibits the following classes of productions: Table-, tea-, and dessert-services, and ornamental objects. Body very hard, even, and compact; glaze hard. Dinner-services, of forms of the last century, in various colored borders, with well-painted flowers; dessert-services of same style, some with pierced borders, are well made. Some tea-services of light, neat patterns, are fairly thin and well potted; some forms graceful, but the covers not so well fitted as in former exhibitions. A large collection of decorative pieces,—vases, jars, baskets, groups, figures, plates, cups and saucers, etc. The "Victoria" vase, painted with subject of the Aurora, after Guido, 5½ feet in height; body of the vase brown and gold; handles of porcelain very accurately modeled and fitted, but too nearly resembling bronze in design and effect to be commended. Price, 18,000 marks. The "Germania" vase, with groups of Germania and Borussia, after Heyden.

It may be observed that in some specimens, as the "Charlemagne" vase, after Kaulbach, the colors are more sombre than becomes the material. Other vases, of good forms, show a similar tendency to the use of sombre colors at variance with the subjects, which are generally of a joyous character. The jugs and other pieces, decorated in monochrome, in imitation of old German faïence, are not to be commended, being a degradation of the fine material of porcelain to the coarser appearance of earthenware. Specimens of the style of old Berlin porcelain are painted with bouquets of flowers with much skill and successful effect. Several painted plaques are shown, among them a Saint Anthony, after Murillo by Landgraf, carefully and minutely wrought.

Groups and separate figures, in the style of the old Berlin, are not equal to the works of the last century. Among the large pieces of

difficult and successful potting may be noticed a wine-cooler or cistern, of more than 3 feet by 2 feet 9 inches, finely modeled, but injured in effect by the colors applied to what, in its original design as a work in biscuit, was effective and commendable. Near it are placed two large tazza vases in white biscuit, skillfully moulded and most successfully fired.

Biscuit busts and figures are well modeled and sharp; a few are tinted in delicate colors. A series of large beakers, decorated with architectural subjects, show careful drawing and manipulation; some plates are etched in outline, with figure-subjects, and filled in with color, producing, at a comparatively cheap rate, an effective decoration. In addition to the above extensive exhibition, is shown a large series of chemical wares of great excellence and importance, including retorts, evaporating dishes, gas-burners, crucibles, and various large and important apparatus, well and uniformly potted. These are specially commended for excellence of body and glaze.

The whole exhibition is striking and important. It is to be noted that at these works were first introduced the gas-furnaces or kilns.*

REINHOLD HANKE, *Höhr, Nassau.*

Stonewares, vases, ewers, jugs, jars, tankards, etc. An imitation of the old German style, the "Grès" of the sixteenth and seventeenth centuries; but the blue decoration has been too lavishly used. One piece, 3 feet 6 inches high, is notable for somewhat unusual size in this ware. Prices extremely low.

MERKELBACK & WICK, *Grenzhausen.*

Stoneware jugs, vases, tankards, ewers, etc. Some of them of large dimensions, generally in the style of the old "Grès" of the sixteenth and seventeenth centuries; salt glazed, and decorated with ornaments in relief, etc.; colored with blue, and, occasionally, with manganese brown; the glaze is very hard and the body dense. It is mentioned, as a specialty of this manufacture, that the violet color has been successfully revived. Some of the examples are decorated with conventional scroll ornaments. The prices are low.

JAC. ANDR. KNODGEN, *Höhr, Nassau.*

Household stonewares, gray jugs, mugs, pots, etc., for domestic purposes; body hard and fitted for daily use, and prices low.

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* Specimens of earthenware, drain-tiles, porcelain, etc., are elsewhere exhibited to illustrate the productions of George Mendheim's patent gas-generator kiln.

HUGO LONITZ, *Neuhaldensleben, near Magdeburg, Prussia.*

Exhibits a collection of animals and animal heads,—some of them life-size, for wall and other decorations, as horses, dogs, deer, wild boar, etc.; yellow terra-cotta body of moderate hardness, painted in natural colors and fired at a low temperature. Some of these are artistically modeled and expressive, and colored with judgment. Also red terra-cotta of soft body, in classical forms, tazzas, jars, etc., with ornaments, fairly suitable, in black and slightly fired. Prices very low. Gray stoneware is shown, decorated with figure subjects, in various colors successfully applied, at a comparatively low firing.

TELEGRAPHIC SUPPLY CO. (formerly Hermann Schomburg), *Berlin.*

Telegraph wares and chemical porcelain, insulating supports, evaporating dishes, crucibles and various chemical wares, etc. The body hard and solid. The exhibitor claims excellence for the completeness of the insulating qualities of his telegraphic ware, his double bell-shaped form having been used with great success. Chemical wares fair.

VILLEROY & BOCH, *Mettlach.*

Tiles, floor and wall, some encaustic, others with white body, plain and glazed; various tiles, of mottled and other colors, in imitation of porphyry, marble, etc.; grooved and imitation mosaic tiles; the designs good, generally in subdued tones, and suitable for architectural decoration. This exhibition, from a very large manufacturing establishment, is meritorious for the quality of the tiles, as appropriate, from their quiet colors, to mural and other exterior architectural uses. Prices moderate.

The annual product of this factory is stated to amount, at present, to 130,000 square metres.

ST. GOBAIN GLASS COMPANY, *Mannheim.*

Large mirrors and plate-glass; roughened and polished cast-glass plates; very thick cast plates, some polished, of good quality; also colored plates.

ELIAS GREINER'S COUSIN'S SON, *Lauscha, near Coburg.*

Decorated glass marbles, imitations of fruits, beads, etc. Also examples of enamel colors, which are very commendable for variety and quality.

H. UNDERBERG-ALBRECHT, *Rheinberg, Prussia.*

Wine- and liquor-bottles of several patterns and colors. Are well made and of good quality.

CHRISTIAN WINKLER & SON, *Fürth, near Nuremberg, Bavaria.*

Common blown-glass mirrors, unpolished, and cylinders of large sizes, silvered. Are of fair quality and cheap.

LEOPOLD HEILBRONN, *Fürth.*

Blown white-glass mirrors, polished surfaces, and foliated with quicksilver. This is a useful manufacture and cheap.

I. W. BERLIN, *Fürth.*

Blown half-white glass mirrors, polished surfaces, silvered. At low prices.

BRAUN & REICH, *Fürth.*

Small convex glass mirrors for insertions. These are foliated with lead.

N. WIEDERER, *Fürth.*

Small ornamental mirrors, cut in various forms, beveled and engraved.

JOH. SCHALLER, *Fürth.*

Small, common blown-glass mirrors, framed.

G. VOGEL, *Fürth.*

Small, common blown-glass mirrors, framed.

GREAT BRITAIN.

ENGLAND.

A. B. Daniell & Son, *London.*

Exhibition of porcelain table-, tea-, and toilet-services, and decorative objects, comprising works from the great potteries of Minton, Worcester, and Coalbrookdale.

First, the productions of

The Worcester Royal Porcelain Works.

Body very compact though not wholly vitrified; glaze hard and brilliant. Table- and tea-services of porcelain are noticeable, viz., of Japanese style, rich in color, of dark underglaze blue border, with gold "*aventurine;*" others with white enameled beading on various colors: the old blue Worcester lily pattern is reproduced, in the forms of the early English porcelain-wares; also metallic decoration in relief on dark-blue grounds,—in this, as in several other services, each piece varies in design: also an ivy-wreath ornament in pink monochrome.

Decorative wares of "ivory" porcelain, with inlaid clays, in appearance resembling *pâte sur pâte*, the process being suggested by the Henry II. ware. The body is combined with a portion of "Parian," and thus is produced in some degree the soft and rich effects of this "ivory body." Of this, a Florentine nautilus cup, elegant in design, with nacreous lustre judiciously applied, the decoration being in relief, is very noticeable; also a vase ornamented with applications of various colored clays, in Chinese decoration, with subjects in relief and with underglaze landscapes in blue. Some pieces with flat decorations, also underglaze; tea-services, of perforated work, also of the "ivory body;" small vases, sprinklers, etc., are exquisite in workmanship and design, and admirable as specimens of potting; in a pilgrim vase of the same material, decorated in the Chinese style, the figures in relief and with underglaze colors, the tints are specially soft and good. Also a bottle vase of "ivory" porcelain, with open-work bulb neck, and decorations in the Persian style, in gold and

colors, the latter underglaze, is very effective and successful. Some of these decorative designs are made after the suggestion of Mr. Daniell. A ewer and plateau, in style of the sixteenth century Limoges enamels, with band of a triumphal procession, and plateau with arabesque decoration and masks in "*cinque-cento*" style, designed by Mr. Bott, Jr., is noticed. The works of this manufactory, being artistic and of excellent finish, are costly.

Productions of Minton.

Table-, dessert-, tea-, and toilet-services, of porcelain of medium hardness of body; texture close and dense; glaze fine. Some gold decorations in relief, on white ground and on colors, are well designed and effective. Various border patterns in ground-colors, some beaded, also some in style of Chinese cloisonné and enamels. With these designs Messrs. Daniells are specially connected, having suggested them and superintended the carrying them out. Examples of a process are shown, in which portions of the ground-color and glaze are eaten away into patterns, with acid and mât gold substituted, and this, if necessary, is etched; the colors thus being on the glaze, and in relief, are very effective. The process is sometimes used to give figures of birds, etc., in gold *intaglio*. A fine service with turquoise border and Cupid groups, in monochrome of pink, in centre. A service, made by suggestion of Mr. Daniell, ornamented with begonia leaves, is very boldly drawn and admirably colored,—the work of Mr. Foucheron. Dessert-service, with pierced borders, decorated with delicately painted female heads. Tea-services, of the same general character, are excellent in quality and ornamentation.

Of decorative pieces of porcelain, there are capital examples of the process called *pâte sur pâte*, decorated by Mr. Solon; as a pair of vases, 21 inches high, with subjects of dancing females and Cupids, called the "Race" and the "Victory," with colored clays inlaid; a pair of urn-shaped covered vases of classical design, with subjects of females and Cupids, also decorated with inlaid clays; a pair of vases 16 inches high, of fine, soft, purple-gray tint, are very remarkable for varieties of the application of *pâte sur pâte*, as also for the use of slip and inlaid clays. These are highly commendable for beauty, skill in potting, and the overcoming of great technical difficulties. Also a pair of pilgrim-bottles of dark-bluish ground,—"peacock blue,"—with quaint subject of Cupids building a house of cards, having also various colored decorations in low relief, are very elegant in design and admirable in execution. A pair of vases, salmon-colored, and jasper ground, with allegorical designs, Cupids, etc., have a soft, rich effect. Also a pair

of vases with central band of flying Cupids, representing "Fire" and "Water," are very ingeniously designed and skillfully executed. A pair of vases, illustrating the process of *pâte sur pâte*, designed and executed by C. Toft, with water-lily leaves, are well drawn and carried out with much spirit.

Examples of so-called Henry II. or Oiron faïence. Several pieces of this celebrated ware are reproduced here, viz., two salt-cellars, an aiguière, one candlestick, from the original in South Kensington Museum, and one biberon from Sir A. Rothschild's collection.

The pottery known as Henry II. ware was made in the middle of the sixteenth century at Oiron, near Tours, in France. It is wholly distinct in style and character of ornament, as well as in the method of applying the decoration, from any other known pottery. The body consists of a fine creamy-white clay, well adapted for very delicate modeling; and accordingly, masks, scrolls, conventional figures, and other minute details were successfully executed in it, and aid in giving much of the distinctive character to the objects produced. The plain surfaces were impressed with metal moulds, on which had been cut, in relief, minute diapers, scrolls, and border patterns, often bearing a close resemblance to the ornament of the "Grolier" book-binding. Into the depressions, thus made, various colored clays were rubbed, which, when fired, showed the inlaid designs either in black, rich brown, yellow, or a reddish tint; a few surface colors were also sparingly used. The glaze employed is thin, transparent, and nearly colorless. Ewers, candlesticks, covered cups, salt-cellars, and a large plateau are among the specimens of this ware which have survived the period, of more than three hundred years, since it was made. Some of them bear arms, or other emblems of the period of their origin, as the salamander, the interlaced crescents of Diana de Poictiers, the arms of the Constable Anne de Montmorenci, etc. All are distinguished by originality of form, delicacy of modeling, and singular refinement of ornament.

The value—many times their weight in gold—set upon the few remaining original pieces is doubtless due in no small degree to their rarity; at the same time they must be recognized as the most skillful expression which the potter's art attained of the quaint and ornate style of the remarkable Art epoch to which they belong,—the middle period of the French Renaissance. The time and labor bestowed on the reproduction of this ware render it necessarily a more costly production than would perhaps appear justified by the general character of the objects unless when critically scrutinized.

To continue with the productions of Minton. Vases with the

upper portion pierced, and extremely light in body and decorative in effect, painted in miniature style, are noteworthy. The production of the fine turquoise color, of the greatest beauty, which ornaments many of these fine pieces, is very largely owing to the efforts of the late Mr. Herbert Minton. Vases, cups and saucers, and various objects are painted with great freedom of handling and exquisite skill in color; in these the painting is well blended with the glaze, and thoroughly free from the defective dullness frequently observable in decorations executed on a harder body; also vases in the style of old Sèvres. A "Prometheus vase," about three feet high, turquoise ground with metallic decorations, is attractive. Statuettes of female figures in "ivory" body with celadon drapery are elegant in general effect, though somewhat obtrusively glazed.

Very commendable is the extreme care and neatness of the manufacture of all of Minton's pieces, the edges and supporting rims being admirably finished.

Of earthenware there are samples of dinner-, tea-, and toilet-services of generally good manufacture; decorative pieces of large and striking character; as examples of "ivory" glaze are vases in Oriental design, pedestals, jardinières, garden-seats, etc. Various modifications of modern majolica, as flower-baskets, candelabra, pedestals, life-size animals, garden-seats, fountains, etc. The majority of these are commendable, but occasionally overglazed, and somewhat hard in effect. A pair of full-sized storks are remarkable as successful specimens of modeling and potting. The glaze of the majolica ware sometimes shows a tendency to craze. Large vases, plateaux, etc., of red clay body, painted under the glaze with rich enamel colors boldly and broadly laid on and heavily impasted in the high lights, produce a fine artistic effect. These are the works of Mr. Mussill. A pair of vases, of same body, in Oriental style, with dragons, illustrate the *Sgraffito* or graven style of decoration, in which the subject is traced with a style through the coating or engobe laid over the original ground.

Productions of the Coalbrookdale Porcelain Works.

Tea-services, etc. A "Cashmere" service richly decorated in Indian style with gold and colors, from designs furnished by Mr. Daniell, suggested by the ornament of boxes of native manufacture, is harmonious in tone and rich in effect. Samples of dinner-services, with fine ground-colors, cobalt, maroon, etc., very richly decorated; also with gold ornaments in relief, and colors finely pricked in. Specimens of pilgrim-vases, in which a gorgeous effect of gilding has been aimed

at, and in which the beading ornaments are used with much skill. The porcelain is claimed to be more translucent, compact, and durable than other English porcelain,—the glaze is of first-rate excellence.

T. C. BROWN-WESTHEAD, MOORE, & CO., *London and Staffordshire.*

Earthenware table-, tea-, and toilet-services. Body rather soft, compact, light, fairly plastic; white and well adapted to glaze. Glaze good and hard, fairly incorporated, bluish in color and clear. The forms suited to purpose, are simple and commendable, showing originality, as do the decorations, flower-wreaths, etc., in various styles. Prices low. The "semi-china" is of a harder and finer texture, and forms a handsome ware of more enduring body than ordinary. A cheap service decorated with animals, flowers, etc., in blue, each piece varied; ship's wares ingeniously designed, handles being protected by their sunken position. A great variety of these services, generally in good taste and cheap. Sanatory wares well designed and well potted, one slab with spaces for soap-dish, etc., sunk in it, being 44 by 20 inches; a pedestal and a pedestal basin, forming a cabinet stand, made for Queen Victoria, is well fitted for use. Druggist-wares of white, hard body and good glaze; also mortars and pestles of white, hard stoneware are commendable.

Modern majolica, colors bright, glazing rather overbrilliant. A pair of large vases, about 40 inches high, of modified classic form, are well potted; large garden-pots, seats, vases, etc.; pair of candelabra supported by Cupids, good in design and color; some large plateaux of red body decorated with flowers, birds, etc. Parian statuettes, groups, busts, etc., good in color and satisfactory in texture, —some made for the Art Union of London; a large bust of the Apollo Belvedere is noted as well produced. A pair of life-size swans, cleverly modeled in white earthenware. Mural tiles of white, compressed body, very hard; glaze moderate; designs generally satisfactory and well colored; some, with designs in relief, are noticeable. Porcelain dinner-, toilet-, tea-, and tête-à-tête-services. Body very transparent and white, glaze not hard. Services with colored borders and gold ornaments, drawn in relief and flat, in various designs,—some at very low prices; also perforated borders ingeniously wrought. Of the colors, the pink is good, deep red or maroon fair, turquoise only moderate, canary good, and the dark blue very good. Cups and saucers of many forms and designs, the cable handles ingeniously planned. Porcelain decorative pieces, as vases, jardinières, baskets, candelabra, centre-pieces, etc.; statuettes sharply modeled; a pair, "Bruce" and "Wallace," are good examples of their work; centre-

baskets and flower-pieces of elegant design, by Protat; the Belvoir tripod tazza, modeled by H. Toft, is light in effect and good. Examples of skillful workmanship in objects decorated with flowers in high relief, as vases, jardinières, bouquet-holders, and mirror-frames. The whole collection is creditable and commendable. This firm is the direct successor to the old house of John Ridgway, of Cauldon Place.

THE WATCOMBE TERRA-COTTA CO., *Watcombe, South Devon.*

Red and pale-reddish terra-cotta. Body soft, plastic, and capable of considerable accuracy in modeling; the pieces potted on the wheel are clean and smooth in surface, but scarcely so thin as might be desirable.

Moulded busts and statuettes are successfully potted. Among the statuettes are Hamlet and Ophelia, and Othello and Desdemona; some statuettes have the drapery slightly colored with a fuller tint of red, and the effect is good. Vases and plaques painted on the unglazed body, with flowers, etc., are neat in design; turquoise, brown, and pale yellow are used with effect in the decoration of some examples. A few drinking-cups, glazed inside, are good as a cheap and pretty ware. This exhibition shows the successful production, for commercial and popular purposes, of decorative objects at very low prices.

POWELL & BISHOP, *Hanley, Staffordshire.*

Earthenware dinner-, dessert-, tea-, and toilet-services. Body hard; glaze medium, but rather bluish; forms, some new and appropriate; decoration effective; some of the toilet-ware, as the Etruscan, is good; lustred glazes are used in some cases sparingly and with considerable judgment. Prices are low.

Specimens of porcelain table-, dessert-, and tea-services; small vases, jugs, etc.; the forms fairly designed and in several instances well colored; a pair of vases, about 16 inches high, with biscuit body and glazed figures as handles and in relief, with turquoise color well introduced. White "stone," or "granite," table- and tea-wares; body fair, dense, and hard; glaze and forms good for practical purposes. The exhibition is of fair, useful quality.

W. BROWNFIELD & SON, *Cobridge, Staffordshire.*

Earthenware table-services, toilet- and household-wares. Body rather soft and porous; glaze good. "Plain-printed" and "printed-and-filled-up" plates, of fair designs, in great variety, from 4 shillings and 6 pence to 7 shillings and 6 pence per dozen; designs after Land-

seer, the plates at 4 shillings, are good. Toilet-ware shapes good,—the "Bangor" set, a new form, is appropriate. In ornamental earthenware are some plaques, vases, flower-pots, etc. Some well decorated, after known designs, in flowing colors. A few pieces of modern majolica; some good hard stone tea-wares and jugs, of new and handsome shapes and decorations.

Porcelain dinner-, dessert-, tea-, and toilet-services; body quite translucent and white; glaze soft; a great variety of forms and decorations, for the most part border patterns, are of good character and often effective; dessert-service, with pierced borders, in high rich colors; another with autumnal leaves, etc., of intense colors, brought out vividly by a pale celadon ground. A service with turquoise and dark-blue border and pastoral subjects, by Rouse, is brilliant,—perhaps a little over-elaborated; a toilet set with body-color in celadon, painted with flowers in enamel colors in relief, is striking and successful. A tea-service, with leaves moulded in relief and forming supports or feet, is shown.

Decorative objects,—large vases, jardinières, baskets, centre-pieces, figures, groups, bottles, etc. A pair of large vases, about 36 inches, with flowers in a bold, vigorous style, on brilliant white glaze, painted by Hartshorn; another pair, of the same size, painted richly on celadon ground; also a pair with turquoise ground and decoration in relief are effective. A pair of pilgrim-bottles, with designs from Landseer and landscapes painted by Rouse; also a pair with celadon ground, painted skillfully, with birds and flowers. Statuettes and figures, supporting baskets and centre-pieces, often graceful in design and modeling, are very successfully potted; a group of two boys, carrying a fishing-net, is ingenious, and stated to be a fresh design; dessert-services, one in celadon the other in pink, with white supporting figures, are free and artistic in design and highly commendable. Basket-vases of about 8 inches, embossed and covered with flowers and butterflies, are neat and pretty. Gaseliers are also shown, and lamp-stands of fair designs.

This collection is large and important, and, especially in a variety of useful and decorative porcelains, of considerable merit and of good English character.

BATES, WALKER, & CO., *Dale Hall Works, Burslem.*

Earthenware dinner-, dessert-, tea-, and toilet services, punch-bowls, vases, beer-handles, etc. Body compact and fine in texture; glaze moderate, thin, and well combined; designed with good judgment for cheap wares. Prices low,—plates from 2 shillings and 9 pence per dozen upwards; lustre glazes judiciously used. A dessert-

service with pink borders "printed-and-filled-in" with birds, flowers, fruit, etc., is good; toilet-wares good and cheap. The forms of all these wares are commendable. Sanatory wares, white, and decorated with similar character of designs.

In stoneware are tea-pieces, jugs, etc.; white, salt-glazed, and very hard; also a gray-green stoneware; chemists' and druggists' wares of "C C" body; mortars good. A so-called "jet"-ware, with brilliant black glaze,—effect fairly good and prices low. Photographers' wares and cells for batteries are also shown. A collection of cane and umbrella handles of good manufacture and large variety.

This house is in succession to that of T. & J. Mayer, of Dale Hall.

THE BROWNHILLS POTTERY CO., *Tunstall, Staffordshire.*

Earthen and porcelain table-, tea-, and toilet-wares, jugs, etc. Earthenware of rather soft body, fair glaze, and average quality. Large vases, well potted; tea-pots and other pieces, with turquoise ornament on white in low relief, are good in style. Porcelain tea-wares and decorative pieces, good in texture, body clean and white, glaze hard; decorated pieces moderate in quality; black-glazed, red-bodied ware fairly good. Prices low. Painted plaques with birds and animals, the birds painted by Handcock.

JAMES GREEN & NEPHEW, *London.*

Exhibit porcelain made by Bodley, of Burslem, Staffordshire. Dinner-, dessert-, tea-, and toilet-services; decorations in rich colors; gilding and silvering good; an "orchid" service, painted from designs by Mr. Jones, well drawn and effective as ornament; pilgrim-bottles, vases, centre-pieces, etc., are good. Prices moderate.

CAMPBELL BRICK AND TILE CO., *Stoke-upon-Trent, Staffordshire.*

Mural tiles, and for chimney-pieces, and floor-tiles. Of various bodies, according to uses, from soft body in the mural tiles to very hard body in the floor-tiles; plain and encaustic patterns in relief, or embossed; modern painted majolica, silvered and incised. Some designs good and appropriate, and some .colors vivid. A chimney-piece, with celadon ground and figures in relief, is a creditable piece of decoration.

JOHN MATTHEWS, *Weston super-Mare, Somerset.*

Terra-cotta (chiefly red) vases, garden-pots, and ornamental objects. Body medium, forms ordinary, modeling average. Prices low.

PRICE BROTHERS, *Bristol.*

Yellow stoneware, lead-glazed; water-jars, pitchers, jugs, filters, etc. Body dense and strong, forms very suitable for purposes, and well potted.

JOHN CLIFF, *Runcorn.*

Stoneware. A large still-worm, barrel-taps, fire-bricks, several very large and well-fitted taps, etc. Fire-bricks of good texture and well made.

JAMES STIFF & SONS, *Lambeth, London.*

A large collection of stoneware, salt-glazed and lead-glazed; jars, filters, pigs and pots, battery-cells, preserve-pots, etc. Body hard, and glaze suitable for purposes; surface good; fitting of lids (as the spherical tops and preserve-pots) extremely good; chemical wares good; a few ornamental pieces of stone ware, colored, and beaded in subdued colors, are of fair effect; some terra-cotta of moderate quality.

HENRY DEAN, *Southern Warwickshire.*

Sanatory wares, hard brown stonewares; useful and suitable.

JOSEPH HAMBLET, *Staffordshire.*

Blue brick and "terro-metallic" ware for string courses, quoins, etc. Very hard but not close body; outlines sharp and clean in the sunk mouldings; suitable for the purposes.

THOMAS PEAKE, *Tunstall, Staffordshire.*

Blue brick and "terro-metallic" wares, tiles for pavement and mural decoration, metallic blue tiles and building ornaments; texture compact; red terra-cotta of medium quality; dark-blue ware excellent for solidity of material.

WOOD & IVERY, *West Bromwich, Staffordshire.*

Blue bricks, "terro-metallic" wares, and terra-cotta (red and yellow), well moulded and sharp; paving blocks, hard. Tiles, blocks, brackets, finials, vases, etc. The blue architectural- and paving-bricks are of good quality.

EASTWOOD & CO., *London.*

Portland cement-blocks for testing. Blue brick roofing- and paving-tiles and mural decorations; blue and red ridge-tiles; glazed tiles; white architectural bricks.

The burned wares have a good body, and are well moulded and fired.

DOULTON & WATTS, *Lambeth, London.*

Stoneware, salt-glazed, forming a large collection of various objects for household use and ornament. These objects of "Doulton" stoneware are not produced from moulds, but are made and finished by the hands of artists. Various characteristic methods are employed, as surface modeling in relief and beading, also incised designs of animals, etc., drawn on the clay and the lines filled in with color. The firing is a single process.

Among the objects produced are many for table and domestic uses, as drinking-cups, jugs, tankards, beakers, loving-cups, tea-pots, wall-fountains, water-troughs, pitchers, spittoons, etc.; for decorative purposes are vases, plaques, architectural bosses, bas-reliefs, pedestals, garden-seats, etc. Body compact and hard, flinty in texture; glaze very hard, thin, and even, and successful in effect. The etching on this ware is principally by Miss Hannah Barlow, also by Miss Edwards and Mr. Butler; the beading and artistic embossing by Mr. Tinworth and Mr. Arthur Barlow. Of the former are some good vases by Miss Barlow, with groups of deer, horses, etc.; of the latter is notable the large fountain by Tinworth, 7½ feet in diameter and 7 feet 9 inches high,—a work of artistic merit, both in design and tone of coloring. Also general domestic wares, with salt and lead glazing, as yellow and gray jars, filters, preserve-pots, etc.; body very compact, hard, and well potted; moulding clean; glaze very hard.

Of chemical and manufacturers' wares, there is a striking and important exhibition. A large stoneware acid-jar, of the capacity of 226 gallons, is well potted,—these jars are made up to 600 gallons; also a very excellent condensing worm and receivers, glazed inside with acid-resisting glaze; large taps,—one 8 inches in diameter; an acid-pump with asbestos packing is noticeable.

HENRY DOULTON & CO., *Lambeth, London.*

Sanatory stonewares and terra-cotta sink-traps of improved patent; pipes, sinks, water-closets, air-bricks, segmental sewers, a new joint for pipes, etc.; also blue bricks, for pavements and architectural purposes; "opercular" drain-pipes, in which the tube is divided longitudinally, so as to be severed easily by a chisel, for the purpose of cleaning and replacing.

Red and yellow terra-cotta architectural and ornamental objects, as vases, pedestals, panels, fountains, finials, medallions, statuary, etc. Very hard in texture, and generally satisfactory in color. A large

medallion of a female figure in relief, representing water, by Tinworth, and panels of the four elements, are sharp and clear; garden vases good. This terra-cotta is combined, often with satisfactory effect, with the "Doulton" stonewares above described; the pulpit by Tinworth, in this combined manner, is an important example. A large temple, of about 25 feet in height and 12 feet in diameter, is a structure of remarkable dimensions in this combined material. A font in this manner by Tinworth, also, is good in design, and is noticeable for containing a basin of stoneware of the unusual size of 3 feet 3 inches in diameter. The group of America (one of the corner groups of the Albert Memorial in Hyde Park, London, shown in the Memorial Hall), is a remarkable specimen of pottery, and is stated to be the largest ornamental work in terra-cotta yet produced, being 10 feet square in the base and about 17 feet high. A large statue of the Diana of the Louvre, 10 feet in height, and a vase, "The Amazon," 6 feet by 5 feet, are shown.

Terra-cotta, or "Lambeth Faïence," decorated in colors on biscuit and richly glazed,—the drawings by Mrs. Sparks, Mr. Bennett, and others,—are artistic and free; colors generally well harmonized, but at times too conventional in tone, in vases, amphoræ, plaques, jugs, mugs, etc. A large open mantel-piece, with inserted tiles, gives a fair example of this decorative art-pottery. A large vase, about 5 feet 6 inches high, is also a fine example of potting in this ware.

Minton, Hollins, & Co., *Stoke-upon-Trent, Staffordshire.*

Wall- and floor-tiles. White and colored glazes, embossed, majolica, enameled, tessellated, encaustic (glazed and unglazed), and art tiles. Tiles also applied to flower-stands, etc. The colored body very hard and glaze good, the white body softer and glaze good. Painted panels of birds, flowers, etc., by Dixon, are brilliant in color and effective. An ambitious piece, on a large scale, in sepia monochrome, of the "Young Mother," painted by W. P. Simpson, as are some clever paintings of dogs' heads from life and of various other animals, spiritedly drawn. A life-size mosaic head of Washington, after Stuart, in small pieces with mât surface, containing between seven and eight thousand pieces; mosaics for church decoration; side-panels and pilasters with flowers and other decorations,—some in relief, producing a brilliant effect. Prices of floor-tiles, 6 shillings per square yard up to 36 shillings, according to amount of decoration.

This collection has very high merit, especially in encaustic and various mural tiles, also for variety of designs and artistic work on

panels, etc. Among the artists employed are W. P. Simpson and Arthur Simpson, Buxton for flowers, etc., Dixon for birds, etc.

MAW & Co., *Broseley, Shropshire.*

Wall- and floor-tiles. White and colored glaze, printed, embossed, majolica, enameled, tessellated, encaustic (glazed and unglazed), and art tiles and small ornamental vases. The colored body very hard and glaze good, the white body softer and glaze good; pieces in relief, white-glazed, are finely moulded and effective, the glaze not quite uniformly distributed; a chimney-piece in relief; a good panel of Cupids in relief; a large mosaic, from design by Sir M. Digby Wyatt; architectural vases; pilasters in relief are successful; "printed-and-filled-in" designs for wall decorations are good; panels in monochrome successful. Patent plant-markers and liquor labels; small vases, generally in Chinese form and somewhat in Chinese design and color; several with good "splashed" and flowing colors.

This exhibit is of high quality, especially in embossed and glazed encaustic tiles, and in the general character of the wares shown.

THOMAS ASPINWALL exhibits tiles from R. MINTON TAYLOR, *Stoke-upon-Trent.* (Not for competition.)

Plain, glazed, encaustic, majolica, and mosaic tiles for wall decoration and pavements. Printed subject-tiles are particularly good; a pair of upright panels of Cupids hunting and fishing, excellent in color.

CRAVEN, DUNNILL, & Co., *Jackfield Works, Shropshire.*

Tiles (floor and wall), encaustic (glazed and unglazed), enameled, "printed-and-filled-in," etc.

The plain colors, both on body and in glaze, are good. Glaze unequal in quality. Unglazed encaustic tiles in great variety of designs, suitable for church decoration.

GIBBS & MOORE, *Southampton Row, London.*

A panel of earthenware tiles, as an example of decoration on pottery; a central subject of Amphitrite, with borders including birds, well designed, and various water animals cleverly introduced, showing considerable artistic feeling.

JOHN EDWARDS, *Fenton, Staffordshire.*

Fine white earthenware ("granite") table-, tea-, and toilet-wares; body white, of moderate hardness and compact, shows plasticity of ma-

terial; glaze clear and of medium hardness, with two tones of color,—yellowish and bluish; forms good and useful, of the modern English fashion, well moulded, the covers well fitted, prices low. Decorated wares, of the same body, in various patterns of ordinary character. A hot-water dish and other pieces of good form and fair decoration; sanatory wares and mortars and pestles of a hard, useful body. The wares made in the style of French domestic porcelain-wares, and resembling them in appearance.

JOHNSON & CO., *Ditching Potteries, Sussex.*

Red and yellow architectural terra-cotta of varying hardness. Windows, mullions, and other pieces of gothic styles; ridge-tiles, finials, vases, columns, etc., of good and apparently new designs, well modeled. A window in adapted gothic style, of pale yellow body of uniform tint, is a fair specimen of work; modeling of fruits and flowers, in full relief, sharp and clean.

COLTHURST, SYMONS, & CO., *Bridgewater.*

Bath-bricks, ridge and roofing tiles, air, or ventilating bricks, etc., body good in texture.

GEORGE CHEAVIN, *Boston, Lincolnshire.*

Exhibits of "improved patent self-cleaning rapid water-filters" of yellow stoneware, of fair texture.

CHANCE BROTHERS & CO., *near Birmingham.*

Discs for object-glasses of various sizes, of heavy flint and crown metals, both of superior quality and purity. This is a very important house, and its productions are well known.

JOHN HETLEY & CO., *London.* (Not for competition.)

Glass shades and bell-shaped covers. These are of very fine quality, well made and clear.

KILNER BROTHERS, *London.*

Glass bottles, jars, etc., of good manufacture, in various forms and colors; the stoppers very well fitted.

THE AIRE AND CALDER GLASS BOTTLE CO., *London.*

Bottles, jars, etc.; a large collection of these articles of good quality and well adapted to their purposes.

JAMES GREEN & NEPHEW, *London.*

A large and important collection of glass table-wares, dessert-pieces, liquor-bottles, candelabra, candlesticks, lamps, and ornamental glasses. An exhibition of the finest quality of lead, or so-called "flint" glass, the metal dense and brilliant. The forms are exceptionally good, many being graceful and artistic; the cutting good and judiciously used in decoration; the engraving of excellent designs, and well executed. A large chandelier, composed of lustres, is a very fine specimen of workmanship. Large blocks of glass, cut in facets and mounted very handsomely in gilt metal and with colored glasses, form brilliant table-ornaments. This exhibition is highly commendable. Especially noticeable is a sacramental covered flat cup, or tazza,—a rare specimen, of exquisite form and fine engraving. The glass is cut from around the church symbols used in the design, leaving them very sharp and clear in high relief; the whole is mounted in fine gold, richly and fitly designed for church service.

SCOTLAND.

W. & J. A. BAILEY, *Alloa.*

Brown Rockingham, "splashed," and tortoise-shell-wares, as tea-pots, plates, jugs, spittoons, etc. Body fair, and moderate in texture; glaze soft; forms good and suitable for use; colors, in variegated and tortoise-shell-wares, effective and brilliant. Prices low.

PETER GARDINER, *Dunmore Pottery, Stirling.*

Various small ornamental objects and toys, cups, tea-pots, vases, flower-pots, etc., with black, dark-blue, brown, and tortoise-shell glazes. Very good specimens, in style of the old brown-glazed Sussex wares. Prices very low.

LINDSAY & ANDERSON, *Lillie Hill, Dunfermline.*

Terra-cotta of pale but irregular color; body fair in hardness; moulding average. Garden vases, pedestals, busts, fountains, etc.; a fountain about 8 feet high, in three portions, is cleverly moulded; drain-pipes, fire-bricks, etc.

THOMAS DAVIDSON, JR., & CO., *Glasgow.*

Tobacco-pipes, fair in quality and moulding, of various designs.

W. & J. A. Bailey, *Alloa.*

Glass table-wares, cut and engraved, of good quality, well decorated and finished.

John Millar & Co., *Edinburgh.*

Table-wares, jugs, goblets, etc. A small collection of very good quality of metal and ornament. Some of the engraved glass is of fine form and well executed.

Alex. Jenkinson, *Edinburgh.*

Table-wares and decorative glass. The table-glass of good quality; the forms very good, and the pieces light and thin. Colored glass, in the manner of the old Venetian, is especially commendable for fine color, form, and general effect.

CANADA.

St. John Stone-Chinaware Co., *Quebec.*

White "granite" (stone-china) table-, toilet-, and sanatory wares. Body of medium hardness, heavy and white, with a tolerably hard, fairly incorporated glaze; are like the American wares; of forms suitable but not sharp in outline; the decoration of ordinary character; a dark-blue decoration is noticeable for richness. This manufactory has been established about one year, and the advance made is very creditable for so brief a period. Also "C C," or cream-colored table-, toilet- and sanatory wares of good hardness, dense, heavy, and fairly white; the glaze moderately white. This ware also has a general resemblance to the American productions; the forms are suitable, of ordinary character; the manufactory, as before remarked, is of recent growth.

W. & D. Bell, *Quebec.*

Exhibit tobacco-pipes, ordinary in quality. Low-priced.

Robert Westnote, *Peterborough, Ontario.*

Glazed earthenware filters and large jars. Body rather soft; glaze good; moulding and fitting ordinary.

Smith & Kaye, *Enfield Pottery, Halifax, Nova Scotia.*

Terra-cotta drain-pipes, bricks, jars, chimney-tops, etc. Terra-cotta poor in character as to material and moulding; stoneware wanting

in compactness. These works have been established for many years, and came into the present hands ten or twelve years ago.

INDIA.

The India Museum, *London.*

A small collection of about thirty pieces of pottery, of native manufacture, from various localities in British India, from Allahabad, Hyderabad, Patna, Madras, Bombay, etc. The characteristics of native Indian pottery—putting aside the defects of its material and the imperfections of the technical processes employed in its manufacture—are frequent elegance of form, due to the influence of the Mohammedan rather than the Hindoo element, admirably adapted surface-ornament, and, when glaze is used, rich and harmonious color.

In these few, and comparatively unimportant, examples these points may be noticed, and it would therefore be instructive for Western potters to study them. The water-bottles and the glazed bowl, with elegantly designed fluted cover, illustrate the grace of outline which still belongs to their art, and which is free from the grotesqueness familiar to purely Hindoo thought.

The incised ornament, wherever used, is a model of simple, fitting, and sometimes even of refined decoration, while the more important and elaborate designs traced into the body of the tiles, and made apparent by the darkening of the glaze where it has settled into these incised lines, are altogether admirable; in fact, almost as good as they can be. For color, the few dark-green glazed pieces, varied in tint by the method just described, are quite excellent, wholly free from the crudeness which so often mars green tints in pottery. This color in India ware, sometimes enhanced by black or relieved by a golden yellow, might give a lesson in effective treatment to the artists of almost any factory of porcelain or pottery among Western nations. A warm brownish-yellow, on which is laid an "engobe," or superimposed slip of lighter yellow, is also most successful in color, and, where used on the tiles, is excellent in the judgment and fitness shown in the geometrical surface-ornament so indicated.

It is to be regretted that the small number of pieces brought together do not include other Indian pottery-wares not less effective than those here shown.

GOLD COAST.

Pottery made by the native tribes. A small collection of red and black pottery of old traditional and simple forms, occasionally having

good outlines, with rude attempts at ornament. The specimens have a character which, more or less, recurs in all such examples of the work of uncivilized people; forms fitted for the most primitive uses, and a very rude and imperfect attempt at firing and coloring, or rather staining.

NEW SOUTH WALES.

F. & H. Baldock.

Stoneware. Jars, jugs, filters, covered pots, pestle and mortar, drinking-mugs, etc., are of sound body, fairly potted and well glazed.

VICTORIA.

G. D. Guthrie, *Epsom, Sandhurst.*

Pottery and stoneware; Rockingham tea-pots, jugs, etc.; stoneware bottles, jars, water-filters, etc., of good and useful quality.

Luke Nolan, *Gilbrook Pottery, Brunswick.*

Red terra-cotta drain-pipes and joints (of coarse, brittle body), vases and ornamental pieces.

Commissioners for Victoria, *from Melbourne.*

Vases in yellow terra-cotta of fair body, colored and decorated to imitate bronze, but by means of colors, which are not of hard surface, concealing and injuring a fairly good material.

R. T. Adams, *Melbourne.*

Stoneware, of gray body, moderately hard, in water-filters of fair quality. The exhibitor manufactures "Dahlke" water-filters for the Yan Yean water.

Bendigo Pottery Co., *Sandhurst.*

Gray stone still-worm, good body and fairly potted.

Birmingham & Lacey, *Brunswick.*

Red and white moulded bricks, hard and solid body.

Ferguson & Urie, *Melbourne.*

Stained glass for windows, mostly of ruby color, fairly engraved, and a small painted window with cattle subject.

GLEDHILL, *Melbourne.*

Common coarse green-glass bottles, with a patent arrangement for stoppers.

MELBOURNE GLASS BOTTLE WORKS CO., *Melbourne.*

Common green-glass bottles of ordinary quality.

MOUNT & CO., *Melbourne.*

Lamp-shades, bell-glasses, jars, etc., of common quality and ordinary forms.

ITALY.

G. ASCIONE & SON, *Naples.*

Modern majolica, in the style of the sixteenth, seventeenth, and eighteenth centuries. Forms imitated from good models, and with some success; colors and drawing fair. Also imitations of ancient Greek vases of good design; the decorations not so successful as the forms. Some large specimens of successful potting in the style of Abruzzi ware are well executed. Some plateaux on a large scale, decorated with considerable freedom in sixteenth century style, and some garden-seats of fair design.

BENUCCI & LATTI, *Pesaro.*

Modern majolica, reproductions of the sixteenth and seventeenth centuries, as wares of old Pesaro and other makes. Oviform vases with snake handles, painted with Scriptural and mythological subjects in style of Urbino, etc., are commendable for general effect of color and drawing. Salt-cellars and cups, of modified sixteenth century form, are good in color. The glaze on these specimens is occasionally over-brilliant. Reproductions of work of Maestro Giorgio, of Gubbio, with yellow and ruby lustres, are imitated with considerable success.

JAFET TORELLI, *Florence.*

Modern majolica memorial-plates, of original designs, with portraits

and ornamental borders; drawing good but colors somewhat crude. Terra-cotta groups and statuettes, in the style of Clodion and others, produced with considerable skill; seated statuettes of Michael Angelo and some others are good; recumbent glazed figure of a female, apparently in imitation of certain antique works, composed of various colored marbles.

Torquato Castellani, *Rome.*

Vases and large plates, ewers and tazzas, reproductions of majolica of the fifteenth century. Some specimens remarkable for close similarity to early work,—two oviform vases are commended on this ground. Good drawing and careful adherence to the effect of the ancient work are commendable. It is to be observed that the colors, used in the decorations of these samples, are stated to be the same as those traditionally employed among the Italian potters of the *cinquecento* period.

The Farina Company, *Faenza.*

Large and important exhibition, consisting of reproductions of majolica, Della Robbia, and other early Italian potteries; various specimens showing the recovery, to a certain extent, of the ruby lustre, and an artistic feeling in its use; pilasters in the Renaissance style; chimney-pieces and vases, of large sizes and elaborate character, combine freedom of handling with considerable merit of design. A table-top, of about 30 inches diameter, is harmonious in color and artistically executed, and is commended for design. A reproduction of *Sgraffiato* ware is highly commendable. Prices of all this ware are fair.

Cesare Miliani, *Ancona.*

Plates, vases, pilgrim-bottles, a large centre-piece, and other specimens in the style of the early sixteenth century, lustred and colored with moderate success; small figures representing Sicilian costumes, colored and uncolored, are modeled with considerable skill of design and great nicety and care in finish. A number of imitation wicker-baskets in light earthenware, not specially notable, as also a few examples of very coarse printed earthenware of low prices.

Emilio Bertini, *Pisa.*

Earthenware samples of a new process of decoration overglaze, of a cheap character, in which photographs are used for reproduction. The result not satisfactory.

ANDREA BONI, *Milan.*

Artistic terra-cotta statues, statuettes, fountain-ornaments, busts, vases, garden-seats, etc. A hard red body, the surface not fine; modeling somewhat spirited but wanting in accuracy of outline; not uniformly successful in the firing. A figure of a faun representing Autumn, one of a set of the four seasons, is commended as a work of considerable spirit,—designed by Del Mayno and modeled by Pelitti. A fountain-group, of two children under an umbrella, is of quaint design and pleasing. The above specimens are produced at a cheap rate. Mr. Boni exhibits, also, some specimens of imitation stone tiles of fairly good quality.

A. CASTELLANI, *Rome.* (Not for competition.)

A valuable, interesting, and instructive collection of early lustred wares and Italian majolica, systematically arranged, commencing with wares of the Sicilian-Arab period and continuing until the time of the Abruzzi painted wares.

Among the early specimens are some of Eastern type, rich in color and lustre, forming links between the Arab and the Spanish-moresque art, and though occasionally rude in execution, are good in design and most effective in color. A small vase of splendid purple color, lustred, shown among this class, is apparently of Persian origin. Next in order are the large dishes, or plateaux, of Spanish-moresque manufacture, brilliant with red and golden lustres, most effectively employed and giving examples of a decoration bold and rude in execution but gorgeous in result. This forms a most suggestive style of ornament, which has been imitated by modern makers with considerable success. These wares having been early carried to Italy, suggested or stimulated the manufacture of similar earthenware in the northern cities.

In the early part of the sixteenth century, there arose at Gubbio the manufacture in which Maestro Giorgio Andreoli seems to have invented the splendid ruby lustre, with which his name was associated until his secret was lost and the art died out. Some valuable examples of his work are shown, one dated 1525. These are suggestive examples of the use of rich colors in the decoration of pottery, and deserve the careful study of artist-potters. The manufactures of Caffagiolo, Urbino, Faenza, and of Venice are also illustrated by examples, many of which are characteristic and some important,—among these are plates decorated by known artists. About the year 1600, these subject-pieces began to lose something of their fine qualities of

color and execution, and, soon after, a decadence can be traced which was not checked by the Abruzzi and Neapolitan schools of majolica painting. In these latter a lavish profusion of subject prevails, the figures are freely drawn but feebly colored, relieved often with gilding; and in many examples landscapes, treated with picturesque effect, form the chief part of the decoration. This style lasted to the end of the eighteenth century. It is sufficiently represented in this well-selected and judiciously-exhibited collection.

LUIGI OLIVIERI, *Venice.*

Mirrors, candelabra, beads, mosaics, etc. Some mosaic tables, various designs, of rich effect; a pair of candelabra, of old Venetian style, are elaborately finished.

T. OLEVOTTI, *Venice.*

Glass beads, mosaic tables, spun-glass, mirrors, etc. Tables of Roman style; necklaces of beads, in imitation of satin, etc., are good.

DAVID BEDENDO, *Venice.*

Beads, spun-glass, tables, mosaics, etc. Mosaic table-tops of several styles, rather too highly colored. Mosaics, in antique styles on gold ground, are good.

FERRO & COMPANY, *Venice.*

Vases, wine-goblets, flagons, etc. The traditional styles of the Venetian glass are well preserved in this collection, and the examples exhibited are good.

G. B. ROLANDI, *Milan.*

A small exhibit of table-wares of cut-glass. The "metal" of moderate quality; forms and cutting, mostly in flat flutes, of ordinary character. Also specimens of moulded- or pressed-glass of common quality.

JAPAN.

[NOTE.—The numbers are those in the Japanese Catalogue.]

No. 19. MIKAWACHI-YAKI, *Mikawachi, Arita, Province of Hizen.*
Exhibited by the KORAN-SHA.

Porcelain. A few vases, and cups and saucers; brownish-red ground and gold ornaments; quality moderate; prices high.

No. 20. Y. FUKAGAWA, *Arita, Hizen.*

Porcelain. A large collection of vases, jars, flower-holders, large circular dishes, etc. Special productions of this manufactory are very large pieces, as vases, plateaux, or circular dishes, etc. One pair of vases 8 feet high, potted in two pieces, one portion being nearly 6 feet, painted in blue, hard-fired, and decorated with red, gold, and lacquer in low relief,—subjects of monstrous animals, flowers, etc.; also a pair of vases about 5 feet high, with hard-fired blue medallions and red ornaments, fired in a muffle specially constructed for these vases; two plateaux, or circular dishes, upwards of 3 feet in diameter, one in blue, boldly drawn, with subjects of swimming fish; the other of same size, with peonies and other flowers, leaves, and pheasants. These very remarkable pieces are of most uncommon size to be made on the wheel, and are fine examples of skillful manipulation and artistic ornament.

Pair of vases 7 feet high, each made in two pieces, of full flowing outline and strong in design of form and decoration, are remarkable specimens of potting. Subjects, water-plants, well drawn, both as to detail and broad general effect, in monochrome, under-glaze, in the style called "*sometsuki*," with rich cobalt blue,—various tones managed with address. Handles formed by the conventional lion of Japan, in green. Neutral purples and greens pricked into the panels and scrolls, on the upper and lower parts, with discrimination. These noble vases are very highly commendable,—they were made and decorated from designs by Mr. K. Notomi. A pair of vases, about 5 feet, by a student of Mr. Notomi, rich in color though rather

faint in design of subject. A large plateau, about 36 inches, the ground covered with scale-like forms (the conventional wave-form of Japan), heavily impasted in fine sea-green, divided by black lines; two dragons, male and female, are rolled around the disk,—a bold and beautiful work of great merit, from design by Mr. K. Notomi.

No. 21. S. FUKAOMI, *Arita, Hizen.*

Vases, flower-pots, tea- and coffee-services, etc. Forms graceful; very minute and delicate decoration in the old styles; body vitrescent; glaze of a slighly greenish tint, produced by the use of lixiviated wood-ashes; some examples of small saucers, moulded with much dexterity by hand, are shown, well painted with flower-sprays. The productions of an eminent potter, who ranks among the four best in Arita. The exhibition is a good one.

No. 21 *bis*. K. TSUJI, *Arita, Hizen.* (Formerly potter to the Emperor.)

Vases, cups and saucers, saki-cups, bowls, etc. Cups and saucers very light, and having perforated handles, made with much skill; some of the open-work handles are made by moulding and cast in plaster of Paris, a process quite recently introduced into Japan by himself after the Vienna Exhibition. The powdered gold ornament is used with taste. The open work is free from the clumsy effect which occasionally, owing to the doubling of the body, deteriorates from its appearance, and, notwithstanding the solidness and thinness of the material, is so minutely and skillfully executed as to compare with any work of the same character produced in any other country.

No. 22. CHAKI-SHOSHA (*Tea-set Manufactory*), *Kiyoto.* (Not in competition.)

Old stoneware, tea-jars, tea-measures, etc., of ancient manufacture, stated to be in some cases about four hundred years old; usually dark monochrome glazes, and mostly of rude potting; the more ancient pieces hand-potted.

No. 59. KIRIU-KOSHO-KUWAISHA, *or First Manufacturing and Trading Co., Tokio.*

This, also, is a collection of ancient pottery and porcelain, earthen- and stonewares; bottles of coarse gray stone and earthenware, said to be about twelve hundred years old. The collection has been made with the object of illustrating the history of the art of pottery in Japan, and possesses much archæological interest, though, in general, the objects are more curious than artistic.

No. 23. TANZAN SEIKAI, *Kiyoto.*

Porcelain and earthenware, the latter yellowish and called "Awata" ware, its body very soft, but refractory; glaze feldspathic and hard. Vases, flower-pots, table- and tea-services, and decorative pieces. Some of the colors are very bright, and, owing to the attempt to introduce European tints and to imitate European combinations, sometimes lack the harmony of the native art.

No. 24. KINKOZAN-SOBEI, *Kiyoto.*

Vases, flower-pots, coffee-services, and decorative pieces of yellow earthen- or "Awata" ware. Some large pieces are minutely and skillfully painted; a bamboo-pattern tea-service, made by hand, is an example of very excellent potting and of ingenious design. The small pieces are cheap.

No. 25. TAKAHASHI DOHACHI, *Kiyoto.*

Vases, flower-pots, tea- and coffee-services of porcelain and yellow earthen-, "Awata," ware; porcelain body very hard, but not especially close; glaze thick, moderately incorporated, and bluish. The porcelain decorated in a peculiar manner with gold ground and figures in relief; some brown-glazed vases; also gold-grounded vases of wicker-work patterns, designed in German style; tea-wares, well made and potted, but in modern European style, and the colors often modified, not to the advantage of Japanese art, by Western taste; some cups and saucers are shown, with patterns scratched, or graven, on the body and filled in with glaze. Prices not low. Examples of a process are shown, which is known in Europe but introduced into Japan by Mr. K. Notomi, of reservation of design on the ground, by means of material which gives way in the firing and leaves the ornament clear on the body or glaze.

This exhibitor is of a family who have been porcelain-makers for two hundred and thirty years, and are very celebrated in Kiyoto.

No. 26. SHIMIDZU ROKUBEI, *Kiyoto.*

Vases, bowls, tazzas, tea-ware, bottles, etc., with bright colors on brilliant white ground, somewhat affected by European taste; some, pricked in with red and gold, have a rich effect. Subjects roughly painted in a style called "Topa-ye," after a priest who is popularly stated to have lived in Topa some hundreds of years ago, and who invented this style of painting, which is bold and sometimes grotesque.

No. 27. KANZAN DENSHICHI, *Kiyoto.*

Porcelain vases, tea- and coffee-services, incense-cases, etc. Some in imitation of bronze inlaid with gold; also in style of Indian designs, on a dead or mât ground, over which are drawn flowers, etc., in gold, with rich and at the same time quiet effect; some with brilliant colors on very white ground; pair of vases, with flowers drawn in blue and enriched with gold and green veining of the leaves, producing a peculiarly soft effect; tea-service of tea-pot, sugar-bowl, cream-ewer, and six cups and saucers, with rich red ground and partly burnished gold,—price in Japan, $15. Examples of vases are shown, in which some colors are used unglazed mingled with other colors highly glazed, the effect being successful.

No. 28. WAGE KITEI, *Kiyoto.*

Pottery and porcelain. "Awata" vases, cigar-stands, tea-services, and ornamental pieces, with embossed ornament of flowers, birds, etc., in relief; the porcelain also ornamented in relief, some with grotesque monkey handles. A pair of large vases, 24 inches high, of "Awata" ware, with raised ornaments and flowers in full relief around the base, are very rich examples of effect in decoration,—price, $45 per pair. Covered bowls with stands are well made and decorated. A red ground, with dull gold ornament, finished with burnished details, is used successfully on the "Awata" ware.

No. 35. SEIFU YOHEI, *Kiyoto.*

Vases, cups and saucers, etc., of porcelain. Pair of white vases, with applied vermiculated ornament in relief, having a somewhat opaque lustrous glaze, 20 inches high, $40 per pair, are well potted and handsome. Prices rather low.

No. 29. MASHIMIDZU ZOROKU, *Kiyoto.*

Vases, flower-pots, bowls, etc.; some painting in blue, with good glaze, successful,—for which blue color the Kiyoto manufacturers are celebrated; the specimens are heavy and not well potted; pieces with celadon glaze of thick consistence, on a coarse body, are also shown; a vase, of form derived from bamboo, is good. The body of these wares is made of a comparatively impure clay, overlaid with a better material. Prices low.

No. 30. SHIMIDZU SHICHIBEI, *Kiyoto.*

Porcelain tea- and coffee-cups and saucers, jugs, etc. Rather coarse

body and glaze; color moderate; not well potted. A jug of rather graceful leaf design, forming part of a tea-service, is priced at $3.50 in Japan.

No. 32. Z. YEIRAKU, *Kiyoto.*

Porcelain vases, bowls, flower-pots and -holders, bottles of dark-red ground and gold ornament; also a fine bronze ground, with imitation inlaid ornament. It is stated that the grandfather of this exhibitor, named Zengoro Yeiraku, obtained from China the iron-red, or "Bengara," color now used by his descendants and by various others; examples of this splendid and effective color are shown in a pair of vases, the gold ornament on which is skillfully drawn, and etched with much taste; neat forms of tea-ware and a good celadon ground are shown.

No. 31. SHIMIDZU KAMESHICHI, *Kiyoto.*

Earthenware tea- and coffee-sets,—"Awata" ware of pale-cream color. As the glaze of all "Awata" wares crazes universally, they are therefore ill adapted for ordinary domestic use, but being copies of Satsuma potting, they are very popular in Japan

No. 33. CH. TSUJI, *Kiyoto.*

Tea-wares, boxes, and small pieces of "Awata" ware, of harder body than the preceding; glaze crazed as usual; decorations of fish, fruits, insects, etc., some in relief, delicately painted, well designed, and elegant in effect; a soft, shaded pink color is used with good judgment.

No. 34. TAIZAN YOHEI, *Kiyoto.*

Vases, flower-pots, tea-sets, etc. Some large and important pieces; a pair of vases 24 inches high, painted boldly and well, with fish- and flower-ornaments,—price, $30. Others of the same general character equally successful in decorations,—one pair with fowls and flowers, very well executed; a pair of vases 24 inches high, well painted with landscapes and enriched with cloisonné enamel on both sides, producing a very decorative effect, cost $35. Also some tea-wares decorated in excellent taste.

No. 10. KASHIU SAMPEI, *Igano-mura, Province of Awaji.*

Pale yellow earthenware called "Awaji" ware; of a soft body with hard glaze; vases, flower-stands, and small pieces; the specimens thin and well potted, and carefully and minutely painted. Also a hard, almost porcelainous body of medium glaze,—a tripod bowl, well painted with tree, peony, iris, mallow, etc. This collection is praise-

worthy for the neatness and delicacy of decorations, and for hard body of stoneware. These pieces have for the most part been shown at Vienna.

No. 11. Ch. Minoda, *Tokio.*

An interesting collection of ancient pottery, vases, flower-pots, bowls, etc. Not for competition.

No. 14. Shitomi Sohei, *Yokka-ichi, Province of Ise.*

Porcelain, earthen-, and stoneware, the last called "Banko-yaki," after the inventor, of an unglazed, hard, strong body; the pieces, which are of various colors, drab, dark- and light-brown, and reddish, are potted by hand, not thrown or moulded, are tough and very light; some of the handles are perforated. Also in same material are vases and other specimens, in which two or more colored clays are blended together throughout the body, producing a singular mottled or marbled effect, called "Mokume" ware; in some pieces, white porcelain clay is inserted by perforation of the body, inscriptions being thus inlaid so as to show through the entire thickness of the vessel; tea-wares are shown of extreme thinness, the handles or knobs being made movable on a pivot; modeling very skillful; the enamel colors on white slip are stated to be a peculiarity of this factory. Prices not low. Cheap and poor imitations of this ware are abundant.

No. 15. Y. Mori, *Yokka-ichi, Province of Ise.*

Earthen- or yellowstone-ware dishes, etc., cleverly decorated with flowers, etc. "Banko-yaki," or ware, is of hard body. Not cheap. Is the successor to the inventor of "Banko-yaki," who was his ancestor, and whose manufacture he continues; he was the master of Shitomi Sohei, the preceding exhibitor.

No. 16. M. Nakayama, *Kuwana, Province of Ise.*

Porcelain, "Banko-" ware, and marbled wares. A dish with crayfish and crabs, very cleverly executed; some other pieces, especially marbled and "Banko" wares, decorated with judgment; porcelain not good. Prices very low.

No. 17. Kato Gosuke, *Tajimimura, Province of Mino.*

Porcelain small pieces decorated in blue,—a specialty of this house; potting not good, but some painting delicately finished; the wares are well decorated in fine blue color on very translucent white body.

No. 12. T. MIYAGAWA, *Ota, near Yokohama.*
No. 13. Y. SUZUKI, *Yokohama.* All the work of the same maker, MAKUDZU-KOZAN.

An important collection, in porcelain and earthenware, of vases of various forms and sizes; some also in biscuit porcelain, and several with objects in full relief; also specimens of tea-wares, well made and decorated. Some biscuit decoration, of elaborately-wrought figures, foliage, etc., is mixed effectively with the ordinary colored and glazed ornament; also a vase and pedestal in imitation of white coral, very ingeniously wrought; a pair of vases decorated with grotesque figures of the deities of wind and thunder in low relief, richly colored; also a vase in imitation of coral, glazed, with figures of animals skillfully executed; a pair of jar-vases (with biscuit flowers of life-size, some in full relief) inclose in their interior other glazed and decorated vases; another pair is ornamented with imitation palm-leaf fans, very cleverly represented, the handles being in relief, and the ribs shown through the texture by a process similar in ingenious effect to that of *pâte sur pâte.* Earthenware, a modern imitation of Satsuma ware. A set of three large pieces, the centre one being a "koro" or incense-burner, with recesses in the sides, in which are figures of some of the seven deities and their companions, are elaborate and excellent specimens of great skill in potting; they are also richly decorated. Price, $150 for the set; cheap considering the remarkable character of their workmanship and decoration. Pairs of vases, 15 inches, painted in low relief with fish, crabs, etc., admirably delineated, $15 per pair.

The various processes of this porcelain manufacture are extremely remarkable and ingenious, several of the pieces being apparently unique in character and of very difficult execution. The earthenware, also, shows originality of conception and complete mastery of difficult processes of moulding and potting. Prices very low for the quality. This collection is worthy of study for invention and great ingenuity and skill in potting.

No. 36. M. MARUNAKA, *Kanazawa, Province of Kaga, Exhibitor.*
G. WATEYA, *Maker.*

White porcelain or hard white stoneware, flower-pots, vases, coffee- and tea-sets, tea-jars, bowls, etc.; hard, dense, coarse body; feldspathic glaze; moderate in designs and in general character of decoration; rather coarse, strong colors used, as green and purple, and not always

harmoniously; gilding also somewhat crude. Pair of vases 16 inches high, $9 per pair.

The creamy color of some of the Kaga wares gives the effect satisfactorily of the so-called "ivory" porcelain. In the province of Kaga, it is stated that the European influence has not yet penetrated so much as elsewhere. Prices low.

No. 37. Y. YOSHIDA, *Maker.* *Same Exhibitor.*

Porcelain, or hard stoneware, of same general character as the preceding,—a large dish, of coarse body, boldly decorated with flowers, etc., price, $1. Prices low.

No. 38. P. AWO, *Maker.* *Same Exhibitor.*

Porcelain, or hard stoneware, of similar character,—vases, flower-pots, tea- and coffee-services, large dishes, vases, etc.; many decorated with much gilding on the "Bengara"-red ground; ornament of some pieces raised and tooled; effects of decoration not remarkable for harmony of color.

No. 39. T. HEKIZAN, *Maker.* *Same Exhibitor.*

Porcelain, etc., as before,—cups, covered bowls, etc.; rather coarse in quality; much gilding on the usual "Bengara"-red ground; some ornament effective; cups and saucers of same character, of red and gold ornament, are fairly good and cheap at $7 per dozen.

No. 40. S. SEIKAN, *Maker.* *Same Exhibitor.*

Tea-jars, coffee-sets, etc., of same material,—a large tea-jar painted in compartments, the ground being the "Bengara"-red and gold; on this piece is seen a stippling process, used by this and other Kaga decorators, in which the ground is covered with minute dots of color, laid on with the point of a fine pencil and delicately graduated, so as to produce the effect of a soft and equable tint. Price, $30.

Tea-wares, of European forms, are neatly decorated on badly-potted pieces.

No. 42. T. SHOZA, *Maker.* *Same Exhibitor.*

Similar ware,—tea-jars, flower-pots, small drinking-cups, etc. A large tea-jar, of 17 inches, is a fair example, the "Bengara"-red ground-color being judiciously used; a characteristic piece in the old style of work, boldly decorated, price $15. Prices cheap.

No. 43. A. SETZUZAN, *Maker.* *Same Exhibitor.*

Similar wares,—vases or beakers, coffee- and tea-sets, and drinking-

cups. Beaker-shaped vases, about 9 inches high, richly decorated with "Bengara"-red and gold, and medallions elaborately painted, at $9 and $13 per pair, are very cheap; tea- and coffee-sets of moderate quality and painting; gilding somewhat lavishly used.

No. 44. S. HARUNA, *Maker*. *Same Exhibitor*.

Vases, tea-services,—tray with folded corners, etc.; the "Bengara"-red-colored ground used richly and successfully in combination with other good colors. A pair of vases about 12 inches, representing snow-scenes, are very ingeniously treated and expressively painted. Price, $20 a pair. Pair of 11 inches, outlined in red and gold, $24 a pair; tea-ware elaborately painted, showing good work, often minute and delicate.

No. 45. MUNEAKI, *Maker*. *Same Exhibitor*.

Similar ware,—coffee- and tea-sets; forms good, handles cleverly moulded, painting and gilding fair.

No. 46. K. UTSUMI, *Maker*. *Same Exhibitor*.

Similar wares,—vases, flower-pots, cups, etc. Vases, about 20 inches, decorated in silver and gold on black ground and on "Bengara"-red, in diaper-pattern, clouded with delicate stippling, and having a vigorously drawn dragon coiled about the body of the vase; an effective and characteristic example,—price, $35 a pair. A large vase, 20 inches, with same red ground and gold: subject, a priest under an umbrella, in a landscape freely and skillfully painted; altogether a most characteristic specimen. Price, $35 a pair. Other pieces with gold rather over-burnished and used somewhat lavishly.

No. 48. CHIUJI, *Maker*. *Same Exhibitor*.

Similar wares,—tea- and coffee-services, well potted and beautifully decorated, some in old style; tea-sets of fine native forms, delicately painted in medallions; a tea-service with twelve cups and saucers, $20, is cheap.

No. 51. K. SHINODA, *Maker*. *Same Exhibitor*.

Similar wares,—large handled- and other vases, flower-holders, tea-sets, bowls, etc.; decoration notable for precision in drawing and sometimes very effective. A group of warriors on a vase, about 20 inches, is excellent in color, but the whole effect injured by excessive use of too highly burnished gold,—price, $70 a pair. Tea-service, well designed and richly decorated with flowers, etc.; a good rose-color, carefully graduated, advantageously modifies the effect of

the otherwise too brilliant gilding,—the service, with twelve cups and saucers, $33.

No. 52. HIYOCHIYEN, *Tokio*.

Decorator of porcelain-ware, mostly from Arita, some from Awari. Vases, flower-pots, jars, coffee- and tea-sets, fan-shaped plaques, etc. Decoration generally of the finest character of porcelain-painting in Oriental style. Among the artists employed are Schira-Ku and Shindzan. Some of the designs for vases have been furnished by Mr. Notomi: among the latter a pair of covered vases, about 12 inches high, with sea-side subjects of dashing waves and spray cleverly indicated, the handles, formed as cray-fish, most skillfully modeled; knobs representing the octopus,—price, $43 a pair. Also other vases, with fish, etc., are admirably painted,—$19 per pair. Another pair, about 12 inches high, with quails flying and sunning themselves, are exquisite examples of skillful decoration, the touch of the painting being singularly expressive,—$24 per pair. A tea-service of good design, decorated in a very quaint manner with tortoises in various actions, expressed with the utmost humor, playing musical instruments, traveling, dancing, etc. A set of fan-shaped plaques are admirably decorated with figures; the subjects vigorously sketched and brilliantly colored. A vase, in imitation of inlaid-metal, is a curious example of success in giving the effect of gold-damascening.

A pair of vases, about 12 inches, of exquisite and novel design; female figures are very delicately painted in rather faint colors, and over them, drawn very closely, thin parallel hair-lines of dull gold. The effect is as seeing—perfectly but faintly—through a screen of thin bamboo strips. To enhance the effect, other figures are strongly painted over, or as if outside, the screen. This collection is admirable for decorative painting and for a high artistic feeling for color and design, with considerable invention.

No. 9. R. NAKASHIMA, *Kagoshima, Province of Satsuma*.

Vases, tea-jars, bowls, coffee- and tea-sets, etc.,—the productions generally known as Satsuma wares. A cream-colored body, almost like stoneware, but the glaze rather soft, and, as a rule, "crackled" or "crazed" with a net-work of minute cracks. A very extensive and important exhibition, embracing a great variety of specimens, many of unusual size; the decoration in color is often minute, but almost always vigorous and effective; the drawing of birds, fish, and other animals very clever; the human figures bold but usually grotesque. The colors, mostly in secondary and tertiary tones, are

effectively brought out by the delicate creamy ground, due to the material of which this celebrated pottery is made.

Among conspicuous pieces may be named a pair of large vases, about 5 feet high, the whole surface incised by hand, so as to represent flat woven-, wicker-, or basket-work, over which the subjects, of birds, etc., are freely painted. These vases stand on bases of dark glazed color, ornamented with rock-work, water, and tortoises, in full relief. Price, $450 per pair. Another pair of the same general character, about 3 feet high,—price, $45 per pair. A pair of vases, 25 inches high, formed of a central cylinder, decorated with flowers, etc., around which is a pierced shell of very perfect open-work, at a distance of about 2½ inches from the central core, very perfectly potted. Price, $40 per pair. A pair of large cylinder vases, more than 3 feet high, painted with bamboos, etc. Price, $75 per pair. Large covered jars, the handles of the covers being modeled to represent a tigress and cubs, remarkable for skillful potting and clever decoration. Price, $130 per pair. The originality of design shown in the handles and accessories of the specimens is notable and commendable. Tea-wares are shown of a fair style, some well decorated.

The general character of many of these specimens—and among them some of the most striking—is in a great measure derived from imitation of ancient models. A few of these are so closely followed as to be deceptive, except to the most practiced eye. This exhibition is of very high character.

No. 58. KIRIU-KOSHO-KUWAISHA, or FIRST JAPANESE MANUFACTURING AND TRADING COMPANY: *Exhibitor of Wares made at Owari and Hizen, and decorated at Tokio.*

Porcelain and pottery, the former hard and very white. Vases, jars, tea-wares, etc., in great quantity, forming a very extensive and interesting exhibition of various forms and styles of decoration.

A great many large vases of similar general form, on which romantic and historical figure-subjects are drawn with much spirit by an artist named Masumoto-Senko. These are called, as a general name, "*Bakimono*" subjects. The same artist has also decorated a pair of vases, with large swimming fish, brilliantly colored. Many examples occur throughout this collection in which the drawing and coloring are very striking; the use of gold is also especially skillful, being employed in three manners,—on large spaces or fields, either as mât, or burnished or powdered, with raised bright gold o naments, forming a background to the painted subjects, besides the ordinary method of leaf decoration. In some cases the effect of the figure-subjects is

marred by overcrowding of the groups. An unusual color shown may be noted as a successful imitation of the clouded tint of tortoise-shell.

The "Bengara" color is used, but not so successfully as on the Kaga ware. This collection is artistic and spirited in decoration.

No. 56. KAWAMOTO MASUKICHI, *Maker.* T. IIDA, *Nagoya, Province of Owari, Exhibitor.*

A very extensive and remarkable collection of pieces, chiefly blue and white, some of which are among the longest shown in the Exhibition, and one at least, namely, a table-top of nearly 6 feet diameter, is a surprising piece of potting, unfortunately broken in transit.

The decoration of these pieces is often of a very high artistic character, and evinces consummate skill in the designs. Especially must be mentioned the flower decoration, on a large and bold scale, of the above-mentioned table-top. The design for this was furnished by Mr. Notomi.

Table-tops and screens, of fine deep-blue ground evenly applied, with bamboo patterns, are most effective. These screens are very curious examples of ingenious potting, being flat slabs of massive porcelain, about 3 feet by 2 feet 6 inches, decorated on both sides, —one side fine deep blue, with bamboo design left in brilliant and clear white, and a delicately-written inscription equally clear, and on the other side are larger medallions, with white ground and blue ornament, on a base of fine green and diapered gold. $60 each.

A table entirely composed of porcelain, the stem and feet in one piece, the top in another, richly painted with fish, etc., in rich blue; a very large and finely-made vase, of upwards of 6 feet high, is a grand example of the potter's art, and is boldly and successfully covered with flower decorations in the well-conventionalized style of Japan. Price, $80.

Large flower-pots, some nearly 3 feet in height and diameter, painted in blue on white ground, are most effective pieces and admirably manufactured; others in deep blue with white flowers in low relief. These flower-pots are of very solid construction, and are fired with singular success.

The decoration of this house is mostly deep blue on white and "*bleu de Roi*" ground.

This collection is highly commendable for potting on a very unusual scale, accomplished with admirable skill and success; also for very fine color and decoration. Prices very low.

No. 57. GOSKE, *Seto, Owari. Same Exhibitor.*

Porcelain of hard, white body and glaze; small pieces, tea-jars, flower-pots, boxes, etc., in blue and white, occasionally touched with delicate tints of pale green and pink, used with judgment. Among the patterns is a diaper derived from the form of the scales on the tortoise's back, called Kami-no-ko; also a pattern imitated from the ancient Chinese "May-flower" ornament. Very cheap.

No. 57. HANOKÉ, *Seto, Owari. Same Exhibitor.*

Porcelain, of hard white body and glaze. Tea-wares, small pieces, and boxes in blue and white; also a large and very remarkable piece in form of a drum, on a stand, surmounted by a cock, emblematic of a state of peace and contentment in the country when the drum, called "Tai-ko," which was beaten by persons wronged as an appeal for justice, remains unused and becomes a perch for the fowl.

Tea-wares of very elegant forms and beautiful decoration, in blue for the most part, but also delicately united with pale pink and touched with pale green. The forms and style are native. Price, $3 for tea-pot, sugar- and cream-jug. Cups and saucers of same, $1:50 per dozen; also plaques for introduction into carved furniture, a bowl painted boldly, with insects, etc., of about 9 inches diameter, at $1. Prices low.

No. 18. S. FUKIHARA, *Tokio.*

Cloisonné enamel on porcelain. This method of decoration, which has only been employed to any extent during the last few years, is an imitation, as exact as can be accomplished, of the well-known process long used on a copper or brass ground both in China and Japan. The method of fixing the dividing metal wire into cloisons, of filling them with enamels, and the general treatment of these wares, is as nearly the same as the difference of the bases will permit. The adhesion of the wires to the porcelain is much less certain and the application of the process to this material more laborious and costly.

The specimens shown consist of vases, boxes, tea-cups, trays, etc.; a few on a large scale, one vase being upwards of 2 feet in height. The ground-colors are generally successful, a delicate lavender tint is specially to be noted; the decoration copied, as above stated, from metal-work, for which it is generally more fitted, is nevertheless harmonious in tint and effective.

No. 53.* SHIPPO-KUWAISHA, *Nagoya, Province of Owari.*

Collection of vases, boxes, cups, etc., of the same general character as the specimens exhibited by Mr. S. Fukihara, of Tokio. In some of this Nagoya work silver cloisons are also employed, and inlaid portions of the same metal used with good effect. One vase, ornamented with marine animals, as the octopus, prawn, etc., is a most remarkable specimen of skill in carrying out a difficult design in this not very tractable material.

A small unnamed collection of terra-cotta figures, glazed and unglazed, enriched with variously colored material; some not fired. These very curious figures for the most part illustrate Japanese legends, and are modeled with singular power of expression and much humor. The characters thrown into the countenances and attitudes are very forcible and quaint.

It will not be out of place to introduce here a few statements as to some of the effects of the Vienna Exhibition of 1873 upon the manufacture of porcelain in Arita, and as to the character of the production of porcelain and earthenware in Arita, in Kioto, and elsewhere in Japan. Although the Arita porcelain had been awarded the diploma of honor at the Vienna Exhibition, yet the manufacturers of that place, as they became acquainted with the condition of the manufacture in other countries, acknowledged the defects of their own system of working, and recognized the necessity of a complete change in their mechanical and technical processes. Moreover, the reports made by members of the Vienna Commission had impressed upon the minds of those manufacturers the advantages which large establishments have over smaller ones, in the employment of machinery and in the organization and subdivision of labor.

Thus impressed, Mr. Tetsuka, an energetic, practical, and patriotic man, labored for three years with great assiduity, and finally succeeded in associating with himself the three largest manufacturers in Arita, viz., Mr. Fukagawa, Mr. Fukaomi, and Mr. Tsuji, under the title of the "*Koran-sha.*" These four united houses have formed a company, and will erect large works provided with all the foreign improvements, machinery, etc., for the production of porcelain of high quality. Mr. Fukagawa is an excellent potter, and produces some of the largest pieces known in Japan, of which some superb specimens are

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* The excellent catalogue to which these numbers refer was published by the Japanese Commission to the Philadelphia Exhibition. It contains much valuable and interesting information as to the manufactures of Japan, and is well worth study.

shown in this Exhibition. Mr. Fukaomi manufactures smaller articles of artistic designs and peculiar finish, and Mr. Tsuji was for many years potter to the Emperor, furnishing the Imperial household, having a specialty of thin and light wares. As regards decoration, the *Koran-sha* will preserve the Japanese character of their art, which is due to the composition of subjects as well as to the technics of painting. The associates of the *Koran-sha* have shown their respective exhibits at Philadelphia, in accordance with the above statement. Their articles are characterized by good and often by remarkable workmanship and knowledge. More attention than formerly has been given to forms which are mostly purely Japanese. In the decoration not more than four or five enamels are employed that were used in former times. The colors have all been manufactured in Arita by improved methods and of purer materials.* The style, without being a mere copy of old pieces, is based upon the pure Japanese manner of ornamentation.

In comparing the usual Arita (Hizen) porcelains which are found in the shops of Yokohama with those exhibited at Philadelphia, it will easily be seen that a very decided advance has been made. It may be truly said that no collection of Japanese porcelain has ever been shown outside of Japan, and never even there as offered for sale or open to the public, at all comparable with the exhibit made in Philadelphia. It is, however, to be regretted that so few pieces of the fine under-glaze, cobalt-blue ware, called "*Sometsuke*," are shown, this ware being very highly and justly esteemed in Japan.

From Kiyoto are exhibited two kinds of ware, viz., porcelain, and a fine pale-yellow earthenware, called "*Awata-yaki*." The materials for the porcelain are brought from other provinces; those for the *Awata* ware are found in the vicinity of Kiyoto. Some of the manufacturers produce both kinds of these wares; generally, however, they make but one. The porcelain is made on quite a small scale and in pieces of moderate size, vases rarely exceeding 18 inches in height. The *Sometsuke* ware made here enjoys a high reputation, being freely and well painted. Of this ware but little is shown in the Exhibition, and the *Seiji*, or celadon-grounded ware of this place, is also poorly represented. The Kiyoto manufacturers are also celebrated for reproducing almost all kinds and styles of Chinese and Japanese wares.

The *Awata* ware described in this report, and as now made, is thought in Japan not to have been improved in quality, design, or decoration. The introduction and free use of foreign enamel colors

* The vitrifiable colors employed are mostly of transparent enamel.

have deteriorated the value and beauty of this ware by leading to over-ornamentation, to the nearly total loss of the original native character. The wares of Mr. C. Tsuji are in good contrast, in this respect, with almost all the other collections from Kiyoto, being lightly and judiciously decorated, and in more characteristic style. The same remarks as are applied to the *Awata* apply also, but in a less degree, to the *Awaji* wares here shown, which are hardly equal to those exhibited in Vienna and elsewhere.

In concluding the report upon this almost, if not quite, unrivaled exhibition of Japanese porcelain and pottery, it may be said that the specimens of modern porcelain shown seem to be of variable hardness of body, and the glaze does not generally appear so closely incorporated with the body as in the best European varieties.

GRAND DUCHY OF LUXEMBOURG.

UTZSCHNEIDER & JANNEZ, *Wasserbillig.*

Terra-cotta paving-tiles, pale-yellow and black. Body hard and sonorous, forms simple and sharply moulded. The black body resembles the "blue brick" or "terro-metallic" body of England. Prices very low. A large manufactory, employing several hundred hands.

MEXICO.

ALEXANDER CASSARIN, *City of Mexico.*

Specimens of very hard porcelain, body rather coarse; some forms good and unusual; several colors bright, showing considerable technical skill. Specimens of porcelain decorated with subjects after Meissonier and others, creditable for spirit of execution. Vases of a light porous biscuit body of Moorish design; pottery of red body with glittering black-glaze, from Aztec designs, made by the present Indians of Mexico. A red earthenware vase of coarse body, curiously inlaid with fragments of glazed pottery or porcelain; terra-cotta objects painted in oils with Mexican ornaments.

Tiles of hard brick-clay, sharply moulded, good body, various colors of subdued tones.

THE NETHERLANDS.

P. GOEDEWAAGEN, *Gouda.*

Pipes and cigar-holders. An excellent exhibition of various kinds of clay pipes of white, black, and red clays; some with very long stems; carefully and accurately moulded; some with twisted shanks; miniature pipes shown as illustrating minute care in the manipulation of the clay.

RAVENSTYN BROTHERS, *West Raven, near Utrecht.*

Tiles with colored subjects and marbled patterns; some also painted in the style of old Dutch designs, neatly and cleanly done and in good color.

H. C. VON HEUKELOM, *Utrecht.*

Tiles for roofing, and drain-pipes, fire-bricks; some bricks glazed in black, and fourteen differently colored bricks for pavements are shown.

C. G. L. KOELEMAN, *Beijmen.*

Bricks and tiles, some glazed; of ordinary and better quality; also drain-tubing; green and yellow glazes are well used on the tiles.

R. FONTEIN, *Franeker.*

Roof-tiles of red terra-cotta and blue brick; soft bodies and of ordinary make and character.

J. J. B. I. BOUVY, *Dortrecht.*

Window-glass, sky-lights, door-plates, lenses for ship-lanterns, etc. Some window-plates are bent in various forms, showing good workmanship; the lenses are also of good quality and commendable.

NORWAY.

Von Schwarzenhorn, *Christiania.*

Hard porcelain of vitreous body, heavy, of good color and fitness for glaze, bearing some resemblance to Limoges porcelain. The glaze is of good solidity, fairly incorporated and colored, transparent, and of average quality as regards adaptation to colors. The forms are generally good; some specimens are printed in black and brown with subjects after Tiedemand, others are painted over the printing. The decoration generally suitable to its purpose and minute and careful as far as copying from the works of native artists goes.

Wm. Gram, *Christiania.*

A series of about twenty pieces of German and Flemish stone-wares. Krugs, tankards, and other pieces exhibited as specimens of the sixteenth and seventeenth centuries pottery. A collection illustrating fairly the style and manufacture of this ware.

The Christiania Magazine.

From the *Hurdal*, *Biri*, *Hodeland*, and *Hevig* glass-works. Table-wares of all kinds, window-glass, lamps, etc. Cutting fair but glass of ordinary quality and styles. Prices very low.

PERU.

Guillermo B. Cohille, *Lima.*

A curious collection of ancient Peruvian pottery, consisting of red, yellow, and black specimens of soft body, unglazed.

The generally grotesque character of this pottery, by which it is best known, is occasionally relieved by the recurrence of pieces elegant and classical in outline,—a few such pieces are here shown; the incised ornament on some of the specimens is very curious and some-

times suggestive; occasionally ornament is also executed in low relief. The moulded human figures and those of grotesque animals are typical of this species of pottery, but they are wanting in the power of expression which some semi-civilized people have contrived to give to such works.

PORTUGAL.

Antonio d'Almeida da Costa & Co., *Oporto.*

Terra-cotta architectural pottery, vases, drain-pipes, and bricks. Body of the terra-cotta very soft, the color delicate; balustrades fairly designed and moulded; statuettes of Indians, etc., fairly good; vases plain white and marbled patterns; large vases, about 25 inches high, with cream-colored glaze, roughly ornamented with blue, sold at $3.85; floor-tiles of soft body, plain and encaustic, at from $1 to $3 per hundred; glazed tiles of ordinary patterns; a pair of large lions in glazed terra-cotta; a series of large figures and groups in terra-cotta, painted in natural colors, are cleverly modeled and expressive; drain-pipes in gray stoneware, with mottled glaze, of hard body.

Joao do Rio, Jr., *Oporto.*

Soft yellow terra-cotta floor- and wall-tiles, some with patterns in relief, others with blue ornament, glazed, from $2 to $4 per hundred. Statuettes of nearly 3 feet, with white tin glaze, in the early Italian style of Della Robbia, are good and very cheap,—one of Penelope, priced $6, is well designed and successfully executed.

Manuel Cypriano Gomes Mafra, *Caldas da Rainha, Estremadura.*

A considerable collection of vases, dishes, baskets, animals, imitation Palissy pieces, etc. Well modeled from nature. A large circular dish, with various fish, etc., in full relief, is very good and cheap; also an oval dish with cray-fish is remarkably well modeled and manufactured; small imitation wicker-work baskets, very delicately and minutely executed. This exhibition is of original character, with good expression in the work. The prices are very low.

José Alves Cunha, *Caldas, Oporto.*

Yellow earthenware and terra-cotta, some in the manner of Palissy, also figures of bulls, pigs, etc., basket-work, grotesque tea-pots, etc.

Designs peculiar, sometimes humorous and attractive. Prices low. (The workmen of these exhibitors, according to the information of the Commissioner, receive, the men, from 30 to 60 cents per diem; the women, 10 cents; and the children, 6 cents per diem.)

JOSÉ GÖNÇALVES DA VITTORIA, *Arada.*

Black pottery-ware,—jugs, pots, tea-pots, bowls, inkstands, water-bottles, crucibles, etc.; the forms good; prices very low; stated to bear fire well for cooking purposes. This and the following exhibition show good forms in the commonest pottery.

CANDIDO COIMBRA, *Ossella.*

Black pottery-ware of similar character to the last preceding, but the surfaces rather superior.

JOAO DA ROZA MARQUES, *Extremoz.*

Red pottery, very light and porous, for water-coolers, for which it is extremely well adapted, with incised and sometimes slightly painted ornament; a rude decoration is also produced by inserted fragments of white quartz in knobs in relief; of traditional forms, good and often elegant; pottery fair. Coolers holding nearly a gallon are sold for 5 cents each. The prices are very low. Another illustration of good forms in coarse pottery.

ANTONIO DA COSTA LAMEGO, *Lisbon.*

Terra-cotta vases, tiles (glazed and unglazed), baskets, bricks, etc. A large garden-vase of fair design and moulding; the tiles very soft but cheap.

SILVA & SANTOS, *Oporto.*

Terra-cotta figures representing various national characters, painted in oil-colors, and costumed with imitation cloth, etc.; cleverly modeled and expressive. The prices low.

MIGUEL CAMPOLINI, *Oporto.*

Red terra-cotta vases, flower-pots, water-filters, etc. Also a small exhibition of figures in the same style as those shown by Silva & Santos.

ALBERTO CYPRIANO MARTINES, *Lisbon.*

Architectural pottery, earthenware, bricks, tiles, and drain-pipes; cream-colored and black-glazed terra-cotta; good architectural scroll-ornament,—pleasing in color but somewhat wanting in sharpness.

LUIS NEUVILLE, *Abrigada-Manufactory, Lisbon.*

Drain-pipes of hard stoneware with mottled glaze, fire-bricks, etc. An important manufactory on a large scale.

PEDRO ANTONIO MARQUES, *Aveiro.*

Common domestic wares for ordinary use, very cheap.

JOSÉ PAULODE MIRO, *Tejolo.*

Tiles and bricks of red soft body of ordinary character. Prices very low.

BOIM & CO., *St. Michaels, Azores.*

Domestic wares,—jugs, tea-pots, tiles (blue and in relief), black glazed wares, spittoons, etc., of ordinary character.

EMANUEL CONQUIJ, *St. Michaels, Azores.*

A collection of coarse, red terra-cotta large water-jars, pots, drain-pipes, etc., of ordinary body, good forms, and very cheap. Pitchers of about 8 gallons at 10 cents; 5 gallons for 3 cents; of 2 gallons, 4 cents; and covered jars of about 3 gallons for 6 cents. (The wages of labor at this manufactory, as stated by the Commissioner, are: for men, from 28 cents to $1; for women, 12 cents to 20 cents; children, 3 to 5 cents.)

MANUFACTORY OF VISTA ALEGRE, *Aveiro.*

Porcelain dinner-, dessert-, and tea-services, vases, and other ornamental pieces. Body very compact and vitreous; glaze good, hard, and well incorporated with body; potting and forms moderate. This exhibit shows an advance.

JOHN SCOTT HOWARD.

Earthenware dinner- and toilet-services. Body rather soft, glaze fair. Large vases are shown; printed patterns in imitation of English style; forms passable. Prices moderate.

ANDRÉ MICHON, *Oporto.*

Cylinders for common window-glass and shades, of ordinary quality.

FABRICA DA MARINHA GRANDÉ, *Oporto.*

Glass table-wares, lamps, bottles, etc., of ordinary character; the metal of common quality; cutting rich on heavy forms.

CABO MONDEGO COMPANY.

Cylinders for common window-glass, of ordinary character.

RUSSIA.

BANAFEDI, *Saint Petersburg.*

Terra-cotta with soft yellow body and brilliant enamel; colors laid on the body; many specimens decorated with characteristic designs in traditional Russian style, very effective; vases, dishes, plaques, tiles, etc. Exhibit small but instructive.

KORNILOFF, *Saint Petersburg.*

An important manufactory is represented by a small collection of plates and cups and saucers, from original and often rich designs. It is to be regretted that this large establishment has not sent a more considerable exhibit.

LAVRETSKI, *Saint Petersburg.*

Two yellow terra-cotta groups,—a boy holding a monkey, and a boy and girl with bird; gracefully conceived and fairly modeled; material soft. These are the original designs and modeling of the artist, who is also exhibitor.

ART AND INDUSTRIAL MUSEUM, *Moscow.*

Yellow earthenware of soft body, decorated in brilliant enamel-colors, with various designs of ancient Russian character, from the eleventh to the sixteenth centuries; many of them effective, and all having a certain character of quaint vigor and originality; dishes, jugs, goblets, tiles, plaques, etc.

CASIMIR CIBULSKY, *Cmielow.*

(In Agricultural Hall.)

Stone tea-wares, pots, jugs, jars, etc., of hard, gray body, but not vitreous; glaze hard, and, on outside, of a rich brown color, and inside white. Forms good, rather uncommon, and useful for purposes. Also some yellow terra-cotta flower-pots, etc., painted with subjects in national costume. Prices exceedingly low.

Two unnamed exhibits from Russia form a small and mixed collection of porcelain and yellow earthenwares. The porcelain is of a coarse, hard body and glaze, rather dark in color, forms ordinary, and decorations rude. In earthenware are small household and decorative pieces. The body is quite plastic and fairly hard, of fine, clear, yellow color, with rich glaze. Forms good and uncommon; decorations, in painted flowers, etc., are better than ordinary, and in good taste. Pieces are made thin and light, showing good potting.

SPAIN.

PICKMAN & CO., *Seville.*

Pottery called "opaque porcelain." Body white and compact, but soft, and glaze soft. Dinner- and dessert-services,—forms of ordinary modern style, printed and painted in rather dull colors; metallic lustres employed in some cases, fairly well. Prices moderate.

Vases, flower-pots, and other pieces, decorated in high colors; letters for signs; tiles of soft body and glaze, but effective in bright color, with copper and other lustres skillfully used with a view to color and decorative effect.

ANTONIO GIMINEZ, *La Rambla, Cordova.*

Pottery of soft cream-colored unglazed and porous body, chiefly for evaporating. Water-vessels with characteristic decoration of ornaments in high relief, produced in clay, the same as the body, having a peculiar and fantastic effect. Prices low.

ANTONIO LEON, *La Rambla, Cordova.*

Exhibition of the characteristic soft pottery, made for the same purposes as the preceding exhibit.

MIGUEL ALJAMA, *La Rambla, Cordova.*

Exhibition of soft pottery similar to the foregoing.

COMISION PROVINCIAL DE BURGOS.

Water-jug with high sharp blue points in the body of the ware, called the "porcupine."

From Alcora.

White earthenwares for domestic purposes, with a rich glaze, but soft; among them the traditional barber's basin.

FRANCISCO G. MONTALBAN, *Seville.*

Common earthenware for domestic uses. White, soft body and glaze. Large dishes and other vessels, painted rudely, but often effectively, in a few strong colors, in the style which is a continuation of the Moorish work of the fifteenth and sixteenth centuries. These wares are remarkably cheap; a dish of 25 inches in diameter, painted with the above decoration, costs only 35 cents, and small dishes of the same character 18 cents per dozen; also, common white printed earthenware very cheap. Tiles are shown with quaint designs, some drawn in blue with Scriptural figure subjects, adapted from old Spanish masters. A good exhibition of national characteristic pottery, and exceedingly cheap.

JUAN OLAGO, *Trujillo, Caceres.*

Porous earthenwares of red body for water-jars, sold at a remarkably cheap rate; also white- and brown-glazed wares for ordinary domestic purposes; some coarse bottles, but of good form, holding more than a quart each, are sold from 14 to 18 cents per dozen.

REMIJIO BUENO, *Caceres.*

Coarse red wares, often of a very good form and of singular cheapness; a large vase-like jar of antique outline, priced about 3 cents.

FRANCISCO CLEMENTO HERMAN, *Carcegenta, Valencia.*

So-called "artificial stone" and soft-bodied tiles, with glaze in imitation of veined marble.

MIGUEL NOLLA, *Meliana, Valencia.*

Encaustic tiles of varied colors and patterns for pavements, of fairly hard body, in two colors of clay; shaped for tessellated or inlaid floors. The exhibition is small, but the manufacturer produces a great variety of patterns of good design.

MANUEL VERALTA, *Seville.*

Red tiles of ordinary character, very cheap.

—— LLEVAT, *Reus, Catalonia.*

Plain and encaustic tiles of moderate body and various colors, for tessellated or inlaid pavements; ornaments, in two colors of glaze, sharply defined.

MANUEL DE SOTO Y TELLO, *Seville.*

A large exhibition of earthenware glazed tiles, for wall decoration, of various shapes and rather complicated outlines made up into large and striking panels, the colors effective and often well disposed; some with geometrical diapers in low relief, others composing large painted subjects, boldly designed and drawn,—among them a spirited architectural piece; also a vigorous scroll-pattern.

SALVADOR DIEZ, *Manises, Valencia.*

Tiles, colored and glazed, of soft earthenware body, with flowers and geometric subjects. Prices very low, beginning at $1.60 per hundred.

FRANCISCO FABREGOS & CO., *Castellon.*

Tiles of same character as preceding, sold at low prices.

R. GONZALEZ, *Valencia.*

Glazed tiles of various patterns.

MACIA SANTIAGOS & CO., *La Bobila.*

Roofing- and flooring-tiles of rude manufacture and moderate glaze, but with colors which are capable of producing harmonious and picturesque effects, particularly for out-door use among foliage.

JOAQUIN BARELLA, *Barcelona.*

Red and yellow floor-tiles, soft body fairly made and fired; outlines clean and surface smooth.

THOMAS FERNANDEZ, *Trujillo.*

Pilgrim-bottles of ordinary red unglazed ware, and evaporating vessels.

JOSÉ FERNANDEZ, *Trujillo.*

Red ware for ordinary use, of similar character as preceding.

UNKNOWN EXHIBITOR.

Terra-cotta balustrades and other pieces for architectural uses are fair in quality.

TRUBIA GOVERNMENT WORKS, *Oviedo.*

Fire-bricks and screw-caps for telegraphic purposes.

A. FARRES & CO., *Barcelona.*

Glass table-wares, lamp-glasses, etc.; metal of fine quality with rich cutting and engraving on good forms.

MODESTO CASADEMUNT, *Barcelona.*

Glass bottles, shades, and window-glass of ordinary character.

SWEDEN.

RÖRSTRANDS COMPANY, LIMITED, *Stockholm.*

Fine earthenware, or "opaque china," decorated table-wares. Body of medium hardness, light, white, and well adapted to glaze; resembling good English earthenware. Glaze solid, white, and clear, of medium depth and richness, fairly transparent, and fitted for colors. Forms generally imitations or adaptations of those of eighteenth century. Designs and decoration fairly good, mainly from the same sources. An advance seems to have been made, and the result compares well with the products of a similar character of other factories. The prices are low, and the ware closely resembles porcelain and is commendable.

The "white stone-china" is very hard, compact, and fine; the glaze durable and good, and in other respects the ware is satisfactory.

The earthenware of second quality in table-wares has a body of medium hardness and a somewhat bluish glaze; the forms are good. Decoration resembles ordinary English printed and enameled wares. The prices are low.

In earthenware decorative pieces a good exhibit of vases, etc. Some very large pieces, generally well potted, colors decidedly good, designs not generally commended as original but with some good forms; prices moderate. A very large and really elegant chimney-piece and stove of fine body decorated in pale-blue turquoise and gold, with centre vase and ornaments in relief and a pair of large candelabra to match,—a good specimen of a well-made and neatly-decorated household stove at very moderate price. Majolica

and Palissy ware, called by the exhibitors "Northern Majolica" and "Palissy," of numerous designs, many being repetitions or adaptations of those well known. The body compact with good glaze, very brilliant. Prevailing tone of grayish-green, not fine or rich but harmonious and pleasing; in modeling fairly good. A large chimney-piece with stove is well modeled and effective; its glaze perhaps rather too brilliant. Prices low.

Biscuit-ware, Parian, etc. Some moderately good Parian statuettes, etc., and some biscuit porcelain, not remarkable but cheap. A few specimens of biscuit of a new body, having a soft ivory-yellow tone, with decorations in relief in mât gold, and effect pleasing, are commendable.

Porcelain tea-wares are shown. Hardness of body above average, light and thinly made, plastic, and fairly adapted to glaze and colors. The glaze is solid and well incorporated, not brilliant in color but well applied and of medium richness, with a fair capacity for colors. It resembles that of English porcelain. The forms are suitable to purpose and fairly designed. The decoration also is not obtrusive. The ware bears a general resemblance to some French porcelains. It is not cheap. Some decorative pieces are shown, but these are not remarkable.

GUSTAFSBERGS COMPANY, *near Stockholm.*

Parian statuettes and vases. Body of good creamy tint and fine texture; modeling of the more important pieces good, but the figures show irregular shrinkage in firing, and are not very sharp. Biscuit vases and flower-stands with delicate open tracery well made but not of distinctive character. Majolica and Palissy wares of compact body and of gray tones of color, fairly good but not harmonious in effect; the designs mostly not original. Large vases of fine white earthenware not showing any remarkable points but elaborately decorated.

Earthenwares for table-services of ordinary quality of body; texture light; color white, resembling ordinary English wares. The glaze well incorporated, of fair color, not rich. Forms suitable to purposes and of fair design; some of northern character and decorated with "Runic" interlaced ornaments. There seems to be evidence of advance in the productions of this company, and efforts have been made to engage artists of repute. At Rörstrand the success which results from chemical skill in manufacture is greater, but more considerable art efforts are made at Gustafsberg.

Porcelain table-wares are also shown of a fairly hard and vitreous

body of average weight, white color, and good adaptability to glaze. The glaze is solid, well incorporated, rich, and transparent. The forms are suitable, having somewhat the character of the eighteenth century and of fair design, as is the decoration. A very large vase is exhibited, of about 48 inches height, ovoid form, scroll handles, dark-blue ground, with belt of ornament on gold ground showing a procession of figures representing the provinces and products of Sweden; drawing and design fine, but colors not well developed in the fire. Also a large vase of light-blue ground of same form is well potted.

HÖGÄNAS COAL-MINING COMPANY, *Höganäs.*

An important exhibition from extensive works, producing goods to the value of nearly $400,000 annually. Terra-cotta vases, pedestals, jars, drain- and sewer-pipes, garden-seats, etc.

Terra-cotta moderate in body and in colors, moulding fair; animal heads shown are fair specimens of moulding, presumably original. Also a large vase of brown marbled ware of good form and successful execution.

A dark-gray terra-cotta-ware for architectural decorations in imitation of "*pietra dura.*" A column of this material is good in general design and moulding, the fluted drums composing it fitting with accuracy; all specimens being clean in moulding and sharp in outline. Stoneware (salt-glazed) pots, covered jars, water-barrels, etc., of serviceable character and quality. A leaf ornament beneath the handles is introduced with judgment and executed with precision.

Fire-bricks and pieces for grates, etc., excellent in work and in refractory qualities. The whole exhibition is good.

OSTRAND, *Helsingborg.*

Large jars of stoneware of hard, solid quality, serviceable in form and texture.

REYMYRA COMPANY, *Reymyra.*

Glass table- and dessert-wares, druggists' bottles, etc. The table-wares are of fairly good quality of metal, the forms are often good, and the cutting suitable to purposes. The prices of these are low. The chemical ware is good and well adapted to uses. A very extensive manufactory, with large annual products.

FREDERICK BRUSEWITZ, *Limmared.*

Glass table-wares, druggists' wares, bone-glass, etc. The glass is of ordinary qualities at very low prices. The bone-glass, mugs,

etc., painted in the taste of the country. The druggists' wares are adapted to their purposes. This house was established in 1748, and is of much importance.

TURKEY.

FERHAD, *Salonica.*

Cups and saucers, bowls and covers, pipes, etc., of dark body, stained black on surface, and ornamented with designs in silver, or white metal, laid on in low relief in elegant patterns.

ALI AGHA, *Roussiouk.*

Same character of wares, but superior in quality.

ISMAIL OUSLA, *Jerusalem.*

Red terra-cotta stained black, tea-ware, pipes, etc., with incised patterns of characteristic designs, are good in style and decoration.

BEKIR AGHA.

Red terra-cotta coffee-wares. Small pieces, but well designed and ornamented with incised patterns; extremely well harmonized with the forms.

MEHMED, *Constantinople.*

Red terra-cotta pipes, bowls, coffee-cups, etc., with surface polished on the wheel and ornamented with gilding; decoration used with skill and good effect.

HOUSSEIN OUSTA, *Dardanelles.*

Yellow earthenware, for the most part green glazed; vessels for domestic use, of ordinary material but having among them some good and artistic forms,—bottles, bowls, animals, etc.

YANIU, *Yorghi.*

Yellow water-bottles, touched with colored glazes. Prices very low.

TUNIS.

The Bey of Tunis exhibits a small collection of terra-cotta vases, bottles, water-jars, mugs, etc. The body is very light and porous, sometimes coarse, of pale-red and creamy tint,—in some cases both clays being used in the same piece,—and but slightly baked. The ornament of incised patterns is rather rude in design and execution, but bears traces of a better origin in art. A water-jar, about 2 feet high, is of the oldest and most elegant traditional type of Oriental form,—a very elongated ovoid, with a rather long neck, handled on two sides. Vases covered with pale-yellow and green glazes, showing well the incised ornament underneath, are very harmonious and quiet in tone, and give another instance of good and instructive effect produced with the simplest and coarsest materials. A large round vase, with more elaborate and better incised designs, serves as a drum,—the bottom being left open and covered with parchment,—and is a good specimen of fine effect produced by a rich green glaze used over incised patterns.

UNITED STATES.

AMERICAN POTTERY.

The important collection of pottery from the United States, being the first ever shown in any International or even in any national Exhibition, appears under conditions which justify a general preliminary notice. In this first display the collection is one altogether unlooked for and surprising in its magnitude, even to those acquainted with the immense advance made within the last ten years by the potters of the United States. The large space taken by them in this Exhibition is fully and closely occupied by wares of excellent body and glaze, of their own production, showing a high quality attained, and a great value of material in what may be called almost a new "body" in pottery-wares.

Coarse and bulky wares were manufactured in the United States at

an early period, probably reaching back to the middle of the last century. As early as 1760–1770 potteries of a better class were established, and gave such promise of success that Wedgwood, the eminent potter, expressed his apprehension of the effect of these upon the English "trade and prosperity." In 1769 works were begun in Southwark, Philadelphia, which existed for several years. Of this, however, it is regretable to say, but little is known. During the war with Great Britain, 1812–1815, numerous potteries were established for making coarse domestic wares, even including some for making "C C," or cream-colored wares, which after the conclusion of that war were closed, as their productions, neither in price nor quality, bore comparison with imported wares.

From that time until about the year 1830, no efforts were made to enlarge the number of potteries other than those for making such kinds as could not be imported profitably because of their cheapness and bulk. About the year named a porcelain-manufactory was established in Philadelphia, in which was practically shown the possibility of making in commercial quantities a hard porcelain, of good and serviceable quality, by using only the materials found abundantly in many parts of the United States. This serious attempt lasted for several years. The products were white and decorated table- and tea-services and ornamental pieces. These were sold at reasonable prices by an establishment in Philadelphia dealing mostly in them. The sales at one time reached to a considerable amount for the period. The "body" of this porcelain was sound, brilliant, and of great toughness, with a hard glaze. The decorations were not so successful, owing to the difficulty of procuring proper artists, and perhaps to the lack of educated taste among the general buyers. These decorations were mostly of flowers and other simple subjects, somewhat stiffly painted in rather dull colors. This manufactory closed after a few years, leaving considerable loss to the enterprising and praiseworthy founders.

Subsequently, and at intervals, other hard-porcelain-works, on lesser scales, were established, generally for the production of door-plates, door-knobs, etc., and for cups and saucers and other small pieces. Among the most notable of these were works at Green Point, N. Y., and at Philadelphia, between the years 1845–1855. These enterprises had generally indifferent commercial success, leading to failure. At the present time, however, there are a few porcelain-works firmly established, making these small pieces, together with very thick and heavy wares for table-use in restaurants, etc., with fair pecuniary success. From these it is hoped may arise large and

valuable manufactures, in which finer form and decoration may be developed when art-museums shall have been established and the influence of art-culture shall be more felt at the centres of industry.

During this period there also sprung up throughout the country many additional potteries, making gray- and yellow-stone, and "Rockingham" wares, etc., which generally met with success when properly conducted. As early as 1850 many of these coarser potteries were successfully established at Trenton, N. J., at East Liverpool, Ohio, and elsewhere.

At Trenton, about the year 1854, an effort was made to produce finer wares,—at first by imitating to a certain extent the English "white granite" wares, of which very large quantities were and still are imported into the United States, they being entirely plain or undecorated. After some failures and great losses, by persistent and praiseworthy efforts this important manufacture was well established in the year 1866, becoming an entire success about the years 1870–1873, and the resulting product is the present white granite "body" of the United States. Following this came other successful manufactories at Liverpool, Ohio, and at other places, until at the present time many "granite" potteries are in operation in several States of the Union.

It is to be regretted and condemned that in the early manufacture—in obedience to a supposed necessity—the trade-marks of well-known English houses were stamped upon "granite" wares, and in so far some of these laudable efforts and deserved successes were stained with misrepresentation. At the present time, however, this bad and mean feature is nearly abolished, and the makers' names and addresses are used, much to their honor and credit. The character of this now well-known and excellent ware is so nearly the same, as produced by almost all the manufacturers, that a general statement of its qualities will pretty closely serve to describe the production of each pottery.

Firstly, then, as to "body." It is very white, hard, and dense, being partly vitreous; and, for earthenware, having but little porosity and showing great plasticity of material. It may be rather too hard for the production upon it of the finest soft under-glaze colors, particularly in printed patterns (which are now made in these wares mostly by printing over the glaze), though this will doubtless be amended if necessary. From time to time, as may be required, many pieces of a moderately hard porcelain are baked in the same kilns and at the same firings with these wares, showing the high degree of heat attained in this manufacture. The American "white granite" more nearly

resembles the hardest English white earthenware than any other "body," but is harder than that, although not so hard as the vitreous "ironstone china" made many years ago by Mason, and afterwards by Messrs. Morley & Co., and others, of Staffordshire, England. The entire freedom from spots, of iron or other impurities, is quite remarkable in this white granite body.

The glazes are generally of good medium hardness, varying somewhat with the different makers; they are well incorporated with the body, and show but little tendency to "craze" (or crackle); indeed, it is claimed by the American manufacturers that their glazes are more free from this defect than those of the wares of other countries. They are full and transparent, with good capacity for receiving colors, quite equal to any observed, more particularly in the hard-fire colors, which in these glazes and upon this body come out very evenly and richly. It is to be regretted that a trade demand causes both "body" and glaze to be too much overcharged with blue, thereby injuring the color of the wares and of the decorations placed upon them, and this, too, at an additional cost of manufacture.

The forms of these wares are, with a few exceptions, made with a view to popular sales, being copied or adapted generally from the French and English. They are suitable for their purposes, and the ornamentation of handles and covers is fairly good, but as a rule rather more care might be taken with the fitting of covers. It is to be regretted that so large a proportion of this really excellent body and glaze should be devoted to the use of heavy, thick, and coarse cups and saucers, plates, dishes, and other pieces demanded by hotels, restaurants, and even by private families throughout the United States. Several pieces, however, of remarkable thinness and delicacy, made by Mr. Isaac Davis, of Trenton, are exhibited, which evince a high degree of plastic quality in the body (the same as that used for the heavier pieces), and very considerable skill in potting; these are specially commendable as an advance in taste, and as a clear demonstration of the value of the "body."

The decorations as a rule are, as might have been expected in so young a manufacture, deficient in originality, being copied mostly from the English or French. Generally they are suitable for their purposes, but are not of a high order, and are often overdone; but there are some exceptions where good taste and judgment are shown. Some modeling done in Trenton is clean and careful, evincing considerable skill and knowledge.

The prices of these wares, particularly of the larger pieces, are low in relation to the cost of labor in the United States. The pro-

cesses employed in this manufacture are of the most improved kinds, and the potteries, many of which were seen by the judges, are remarkably well arranged, very orderly, and highly commendable. All the materials used are found in the United States, and generally within a short distance of all the works throughout that country.

There are now in the United States a large number of pottery-works of all kinds, and these, excluding terra-cotta and brick potteries, having an aggregate capital of about $8,000,000 to $10,000,000, employing 12,000 to 15,000 persons, and giving an annual product of $8,000,000 to $10,000,000. Of these, the "white granite" and "C C" wares have 30 manufactories with 110 kilns, having a capital of about $3,000,000, employing about 3500 persons, paying them $1,200,000 yearly wages; using from 50,000 to 75,000 tons of coal, and about the same amount of other material annually, and producing about $3,000,000 of wares per annum. The average prices of labor at these "white granite" potteries are: for common labor per week, $9; for boys and girls per week, $3 @ $4.50; for kiln-work per day, $2.25; for pressers (journeymen) per day, $2 @ $3; for jiggermen (journeymen) per day, $2.50 @ $3.

The average prices of materials used are as follows: china clay per ton, $16 @ $22; ball clay per ton, $7 @ $8; feldspar per ton, $18; flints per ton, $16 @ $17; coal (anthracite) per ton, $5 @ $5.50.*

These statistics were kindly furnished by Mr. Brewer, a well-known potter of Trenton, N. J. It may be said in conclusion that, practically, the future results of the exhibition of the large collections of porcelain- and pottery-wares in Philadelphia remain mostly with the potters of the United States. It is believed that a powerful stimulus will be given to their art, lifting it beyond the level of ordinary commercial purposes to the plane of beauty, and of a higher utility.

JAMES CARR, *New York City.*

Exhibits of white and decorated "granite" table- and toilet-wares; vitreous stone tea-wares, and white-bodied ware decorated as majolica, not artistic. Parian busts and statuettes modeled after designs by Mr. Edge, the material fair. Some tentative specimens of "*pâte sur pâte*" on stoneware body, also of "*email ombrant.*"

COXON & CO., *Trenton, N. J.*

White and decorated "granite" table- and toilet-wares. Decoration not artistic. Some few pieces of porcelain, the body of English char-

* In July, 1876. Since that time, however, the cost of coal has been very greatly reduced. February, 1877.

acter, showing great capacity of the materials, and giving hopes of future success. These were burned in the "white granite" kilns of this firm.

CHARLES BULLOCK, *Trenton, N. J.*

A few pieces of porcelain of moderately hard body, of compact texture and good glaze. The decorations are of fair ordinary character. This ware, in making which some bone-ash was employed, was burned, together with white granite wares, in the kilns of Messrs. Coxon & Co., Trenton. Small as this exhibit is, it serves to show the good qualities of the materials used, and the possibility of a future valuable production and a commercial success.

CITY POTTERY COMPANY (YATES, BENNETT, & ALLEN), *Trenton, N. J.*

White and decorated "granite" table- and toilet-wares. Decoration not artistic in character; colors not well blended with the glaze. Some white fruit-dishes with perforated edges.

JOSEPH H. MOORE, *Trenton, N. J.*

White "granite" table- and toilet-wares, and "C C" wares. Specimens of biscuit and Parian, with fine flowers in high relief, are delicately modeled.

WILLIAM YOUNG & SONS, *Trenton, N. J.*

White and decorated "granite" table- and toilet-wares. Turned and "dipped" jugs and bowls, of "C C" body, are very good. Also specimens of white and decorated porcelain hardware trimmings of medium hardness of body are good.

MERCER POTTERY CO., *Trenton, N. J.*

White and decorated "granite" table- and toilet-wares are commendable for general form and good body; colors not uniformly well fired; gilding by a special process, successfully employed, though at times too lavishly. Centre-pieces of perforated work successfully executed.

ISAAC DAVIS, *Trenton, N. J.*

White and decorated "granite" wares, of excellent, close-grained body and good glaze. Commended for comparative thinness of some wares, showing an improvement upon a general fault of these potteries. Good forms of tea-wares; decorated pieces elaborate, and some tolerably well turned out. Large vases in two pieces about 50 inches in height. Salvers and bowls, remarkable as specimens of good

potting in a stubborn material; some good specimens of hard-fired coloring. Some of the glazes on the table-wares may be considered as too soft for purposes of general use; some specimens of Parian and biscuit; also sanatory wares. A specimen of fine blue color is shown and commended.

GREENWOOD POTTERY CO., *Trenton, N. J.*

White and decorated "granite" table- and toilet-wares. Colors well incorporated with the glaze, especially the green, purple, blue, pink, and a rather strong orange.

AMERICAN CROCKERY CO., *Trenton, N. J.*

White "granite" and decorated table- and toilet-wares of fair body, good forms and glaze; decoration neat and praiseworthy; effect satisfactory.

GLASGOW POTTERY CO., *Trenton, N. J.*

White and decorated table- and toilet-wares. Body good and decoration fair; gilding by etching process and pen-gilding good. Specimens of wares decorated with clouded or flowing colors in very hard glaze.

ASTBURY & MADDOCK, *Trenton, N. J.*

White sanatory and plumbers' wares are good. Specimens of porcelain jugs; a decorated table-top in "granite"; also porcelain-wares for chemical purposes, cheap and generally good. It is observed, however, that the glaze of these chemical wares is admitted to be not free from lead.

OTT & BREWER, *Trenton, N. J.*

White and decorated table- and toilet-wares; some forms new, body and glaze good. A service called "Darwinian," of white "granite," modeled by Broome, is of a design more ingenious than meritorious in an artistic point of view.

Services painted in colors with views of the Exhibition Buildings; Parian figures, vases, busts, plaques in relief, and toilet-wares. Some of these are commendable for design, especially the plaques, modeled by Broome, which show graceful conceptions of figures.

LAUGHLIN BROTHERS, *East Liverpool, Ohio.*

White "granite" table- and toilet-wares, from works established within three years. Body of a good average quality, and stated as guaranteed against crazing.

DRESDEN POTTERY WORKS (BRUNT, BLOOR, MARTIN, & CO.), *East Liverpool, Ohio.*

White granite table- and toilet-wares, some ornamented with original designs of grasses and other wild plants in low relief. Commendable for design and fair moulding; body and glaze average.

SPEELER POTTERY CO., *Trenton, N. J.*

Brown Rockingham and yellow wares; large bowls, spittoons, pans, tea-ware, etc. Rather heavy in form, but of a solid and durable character.

PHILADELPHIA CITY POTTERY (J. E. JEFFORDS & CO.), *Philadelphia, Pa.*

Brown Rockingham and yellow wares; large jugs, bowls, tea-wares, garden pedestals, etc.; also green-glazed wares, and imitations of Chinese lacquered ware. Form of some pieces of tea-ware satisfactory.

C. FRIESE, *Philadelphia, Pa.*

Terra-cotta garden ornaments, flower-pots in rustic style; aquarium fittings, gas-fire pieces, etc.

S. & W. BAGGOTT, *East Liverpool, Ohio.*

Brown Rockingham and yellow wares, of average quality.

UNION PORCELAIN WORKS (THOMAS C. SMITH & SONS), *Green Point, N. Y.*

White porcelain table-wares and hardware trimmings, decorated porcelain tea-wares, plateaux, jugs, and vases. Body very hard and strong, heavy, not showing plasticity, yellowish-white, and well adapted to glaze and colors. The glaze good as to solidity and incorporation with body and of medium transparency.

Design of tea-service of Japanese character shows colors reproduced with some success, but the forms and general decoration are not commended. Considering the short space of time since the establishment of this manufacture of hard porcelain, the remarkable density and hardness of the body is to be noted, and it is gratifying to see the creditable success of its production at a price which, all things considered, is fair.

MOORHEAD CLAY WORKS, *Philadelphia, Pa.*

Terra-cotta vases, pedestals, and chimney-tops. Body rather deficient in hardness, not well fired, and wanting in uniformity of color.

Large painted finial open to similar criticism; moulding not good. Glazed sewer-pipes of fair average hardness.

R. C. REMMEY, *Philadelphia, Pa.*

Chemical stoneware, large still and worms, receivers, and jars, fire-bricks, etc. Well adapted to purpose and cheap. Evaporating basins of coarse porcelain; glaze and body not thoroughly homogeneous. Wares cheap.

JOHN FRITZ, *Philadelphia, Pa.*

Terra-cotta garden vases, rustic baskets, flower-pots, aquarium fittings, and gas-stove pieces. Not above average quality of design; surfaces painted, but not burned, and therefore ill suited to their purposes; body wanting in hardness. Wares cheap.

F. GOSSIN, *Philadelphia, Pa.*

Terra-cotta vases, pedestals, statuettes, and statues; some forms imitated from the antique. Body wanting in compactness; moulding fair. Statues inartistic; red vases somewhat superior in design and moulding, but wanting in hardness; painting on terra-cotta in imitation of bronze, granite, or other material is generally to be condemned.

HEWS & CO., *Cambridge, Mass.*

Fancy painted terra-cotta battery-jars and flower-pots; various pieces, being covered with painting in oil, are therefore open to same criticism as the preceding. A few small vases of red terra-cotta are of good forms, but not well potted. Also similar examples in Agricultural Hall.

MCELROY & CO., *Philadelphia, Pa.*

White clay tobacco-pipes of good quality, well moulded and of useful and various forms. Commendable for quality and as an advance in manufacture.

M. PERINE & SONS, *Baltimore, Md.*

(In Agricultural Hall.)

Terra-cotta flower-pots, vases, hanging-baskets, etc. Coarse common body, of rude forms and decorations. Wares cheap.

N. U. WALKER & CO., *Wellsville, Ohio.*

Terra-cotta vases, pedestals, chimney-tops, and glazed sewer-pipes. Body of the latter good; other specimens poor in design and quality.

O. O. BOWMAN, *Trenton, N. J.*

Terra-cotta chimney-tops, statuettes, vases, pedestals, hanging-baskets, flower-pots, fountains, rustic baskets, etc. Hardness of body pretty good; moulding poor, the painted vases and rustic-work not in good taste.

HARVEY & ADAMSON, *Philadelphia, Pa.*

Terra-cotta pedestals, vases, statuettes, animals, hanging-baskets, drain-pipes, chimney-tops, etc. Hardness variable; firing good, color fair, modeling poor, and moulding of vases passable; figures bad. Ingenious method of exhibiting the various sizes of drain-pipes.

GALLOWAY & GRAFF, *Philadelphia, Pa.*

Artistic terra-cotta large vases and pedestals, statues, fountains, etc. Among them may be noted a full-sized reproduction of the "Apollo Belvedere"; also of Bailly's "Echo"; of Canova's "Dancing-Girl"; of Gibson's "Psyche"; of the Warwick vase, and others of classical design; generally well potted and moulded, and of pleasing color. Among the fountain vases are some of large diameter, good as evincing skillful command of material and showing, by equality of surface and evenness of line, the difficulties of firing overcome with creditable success. One large Centennial vase in three pieces, 5 feet 6 inches in height, is commended for good workmanship in details of ornamentation, but is open to criticism in design. One specimen is shown of a process of staining the surface of the terra-cotta with a deep-red tint; but this color is not fixed by firing. The whole collection is commendable as artistic, and compares not unfavorably with some European works of the same character.

A. HALL & SONS, *Perth Amboy, N. J.*

Rockingham and yellow wares of good body; also specimens of a hard body resembling fire-clay covered very successfully with a glaze of rich flowing colors. Commendable for excellence of material and effect, and as likely to lead, if carried further, to a successful description of decorative pottery.

Also fire-bricks of good texture and well fired, some stained for architectural decoration. These bricks have a high reputation for their refractory properties.

GEORGE C. HICKS & CO., *Baltimore, Md.*

Fire-bricks, large retorts, terra-cotta garden vases, etc. Good material and manufacture, well adapted to the purposes for which they are made; the terra-cotta of exceptional hardness.

JAS. L. JESSEN (EMPIRE CHINA WORKS), *Green Point, Brooklyn, N. Y.*

Porcelain hardware trimmings, knobs for doors and drawers, escutcheons, caster-wheels, lemon-squeezers, knife-sharpeners, paint-cups, mouth-pieces, etc. Porcelain of a very vitreous, hard body, glaze of medium hardness, showing bubbles; objects generally well fitted for their purposes.

ARTHUR BECKWITH, *New York, N. Y.*

A small collection of painted tiles, not for competition. Subjects, "Cleopatra's barge on the Cydnus," painted on twenty rather large tiles; "Pompeian Assembly," on six tiles; various separate tiles with figures and animals. In these, the work of an architect, many successful tones are attained, and several subjects are treated with considerable spirit.

LEBANON BUILDING AND PAVING BLOCK CO., *Lebanon, Pa.*

(On main walk leading to Agricultural Hall.)

Paving-tiles made of slag, sharp moulding with enduring surface, and of neat patterns. The furnace slag varies in composition: these tiles, therefore, require careful selection.

STEELE BROTHERS, *Philadelphia, Pa.*

This house exhibits in the Art Annex a considerable collection of table-wares and dessert centre-pieces of ordinarily good commercial style and character of decorations. Also a collection of engraved glass-wares of very fair form and quality, well suited to their purposes.

BEVINGTON & WINTERS, *Philadelphia, Pa.*

(In the Art Annex.)

A collection of decorated porcelain and earthenwares. The decoration is of ordinary and heavy style; rather dull in color.

THE WOMEN'S PAVILION.

In the collection contained in the Women's Pavilion is exhibited a series of specimens of painting on porcelain. These are the works

of amateurs, often imagined with considerable taste and carried out with care. The difficulties inherent in the processes of porcelain-painting obviously require a devotion to the labor and an experience difficult for amateurs to practice or acquire. Here it is obvious that considerable efforts have been made, and a beautiful and graceful art has been essayed in a manner which cannot but lead to much acquaintance with its requirements, and a higher appreciation of some of the masterly works which the Exhibition has brought together from distant countries.

Figure groups, some taken from the works of well-known masters, flowers, birds, etc., are among the subjects. The best of these are often too pictorially treated, and are sometimes more notable for elaboration in careful detail than for precision in drawing.

The following ladies have contributed to the Exhibition:

Miss Röhnsholdt	Copenhagen, Denmark.
Mrs. M. J. Wood	Pittsford, Vt.
Miss Annie Lee	Boston, Mass.
Mrs. Thomas Dale	Paterson, N. J.
Miss Alice H. Cunningham . .	Boston, Mass.
Miss Ellen Robbins . . .	" "
Miss Laura M. Marquand . .	" "
Miss Isabella James . . .	Cambridge, Mass.
Miss S. H. Ward	Newark, N. J.
Miss Anna H. Whitney . . .	Lancaster, Mass.
Miss Alice C. Chandler . . .	" "
Miss S. E. Homans . . .	Boston, Mass.
Mrs. J. R. Shippen	Jamaica Plains, Boston, Mass.
M. O. Hayes	Newark, N. J.
Miss M. Louise McLaughlin . .	Cincinnati, Ohio.
Mrs. Harrison	" "
Mrs. H. D. Leonard . . .	" "
Harriette E. Ashburner . . .	Philadelphia, Pa.
Anna B. Leggett	New York, N. Y.
Miss S. H. Foster	Portsmouth, N. H.
Mrs. W. A. Russell . . .	New York, N. Y.
Ladies' Art Association . . .	" "
Miss E. W. Perkins . . .	Boston, Mass.
Miss Helen S. Mack . . .	Lowell, Mass.
Miss J. B. Whitaker . . .	" "
Mrs. S. G. Rodes	" "
Miss Helen A. Whittier . . .	" "

Miss Clara Fisk	Lowell, Mass.
Mrs. H. C. Duganna	" "
Mrs. E. C. Wagner	" "
Miss E. M. Schellinger	" "
Miss Nellie Brown	" "
Miss W. M. Foster	" "
Miss Bella Coburn	" "
Miss Lottie E. Brown	" "
Miss N. M. Bennett	" "
Miss L. E. Hale	" "
Miss H. T. Bradt	" "
Miss L. M. Talbot	" "
Miss Lottie Keenan	Cincinnati, Ohio.
Mrs. L. P. Meredith	" "
Miss Agnes Pitman	" "
Miss Rauchfuss	" "
Mrs. A. B. Merriman	" "
Miss Eaton	" "
Miss Louise C. Bacon	Boston, Mass.
Miss S. M. L. Wales	" "
Miss A. S. Fisher	" "
Mrs. O. H. Whitmore	" "

ANCIENT AMERICAN POTTERY.

Very remarkable and interesting collections of ancient pottery are shown by the National Museum of the United States, obtained from grave-mounds of the early inhabitants of Ohio, Tennessee, Georgia, Alabama, etc. These are of archæological importance, and of value to the student of the antiquities, not only of the potter's art of this country but also for comparison with objects ot early date found in Europe and elsewhere. The objects shown—chiefly vessels of various simple forms and also some of grotesque and quaint character—are formed of clay, not wrought on the wheel, but built up and shaped by hand, and fired at no considerable temperature. Many of them are wonderfully even in line and symmetrical in form, showing considerable dexterity in the potters; they are frequently ornamented with incised devices in simple patterns such as are the common resource of uncivilized people; a few have more elaborate spiral lines, like tattooing, traced rather boldly into their surfaces. No glaze seems to have been known to these makers, but many are colored black by artificial means, perhaps in some cases merely by

the rude process of firing with grass and brush-wood, as is the pottery of some African tribes at the present day; others are painted with a red or a white pigment.

Other interesting collections are also shown of pottery of various dates, from Colorado, Utah, Arizona, etc.; as also from New Mexico. From this last locality is a vase of very striking appearance as an effective piece of ornament; a grayish ground, with designs in black skillfully adapted to the form of the object. The collection of cups, bowls, ladles, a canteen, or "pilgrim's bottle," and various ornamental vessels, the works of native potters of the Moqui Indians, is very curious and interesting.

GLASS-WARES.

COHANSEY GLASS COMPANY, *Philadelphia, Pa.*

Jars, bottles, demijohns, shades, window-glass, etc. The forms are suitable to purposes, and the glass is of good quality. Preserving-jars of two patented kinds, the "Cohansey" and the "Protector," are shown, which seem well adapted to the keeping of fruits, etc. A large and important manufacture.

J. B. DOBLEMAN, *Green Point Flint-Glass-Works, Brooklyn, N. Y.*

An important collection of "flint" glass table-wares, bottles, druggists' vases, etc. The "metal" is of good quality; cutting rich and tasteful; engraving in many cases very good, although in some instances rather too much elaborated.

J. H. HOBBS, BROCKUNIER, & CO., *Wheeling, W. Va.*

Lime-glass table-wares, lamps, etc., pressed and cut, of very good quality; also some bone-glass-ware. Forms rather heavy, cutting moderately good. Prices low.

LA BELLE GLASS COMPANY, *Bridgeport, Ohio.*

Cut, pressed, plain, and engraved table-wares. Quality of glass ordinary; forms rather heavy. The pressed wares are of good patterns, and very sharply moulded.

BOSTON AND SANDWICH GLASS COMPANY, *Boston, Mass.*

A very important collection of "flint" glass table-wares, dessert-pieces, flower-stands, toilet-bottles, etc. Quality of "metal" very good; cutting rich and brilliant, in some cases perhaps overdone; forms good; engraving neat and judiciously applied, and some of the

engraved designs are commendable. Some large bowls and stands are well made and elaborately decorated. Many of the etched patterns on table-wares are very good in design and execution.

DORFLINGER GLASS COMPANY, *White Mills, Wayne County, Pa.*

Glass table-wares, druggists' show-bottles, etc. The "metal" brilliant; forms suitable; cutting regular but often heavy; engraving of good quality and design.

H. C. FOX & SONS, *Philadelphia, Pa.*

Druggists' and perfumers' glass-wares and bottles of various kinds and forms, of very considerable variety and utility, at low prices.

SMITH BROS., *New Bedford, Mass.*

Bone- or opal glass lamp-shades, vases, globes, etc., decorated in many patterns. The colors are sometimes heavy; the designs fairly good. A large vase, about 38 inches high, is elaborately painted with fruits, etc.

THE MERIDEN SILVER-PLATE COMPANY, *Meriden, Conn.*

This company exhibit in connection with their plated wares a number of cut-glass dessert-pieces, caster-bottles, flower-holders, etc. The cutting is done by this company, and is fairly good, sharp, and effective.

MOUNT WASHINGTON GLASS-WORKS, *New Bedford, Mass.*

A large collection of glass table-wares, dessert-pieces, chandeliers, etc. Quality of "metal" good; forms and cutting fair; engraving rich and well executed. A large display of lustre chandeliers of good forms. Bone-glass globes for lamps of excellent quality. A silvered glass table, with mirror framed in lustres, is shown. Chandeliers are made to order of any color to match the furniture of rooms. A very large fountain in cut lustres, about 15 feet high, with a diameter of 16 feet, is displayed not altogether successfully.

NEW ENGLAND GLASS COMPANY, *East Cambridge, Mass.*

A large and important collecton of "flint" glass table-wares, large bowls, dessert-pieces, tiles, decorative pieces, etc. Quality of "metal" very good. Forms generally commendable; cutting tasteful and judicious; engraving and etching are in good taste and often artistic. Fine, thin tumblers, wine-glasses, etc., are admirably made. Tiles for mural decorations are in fair taste. Lamp-shades and plaques are painted elaborately.

EXCELSIOR FLINT-GLASS COMPANY, *Pittsburgh, Pa.*

Lamp-chimneys and reflectors. Of lamp-shades, a variety of forms, of ordinary patterns; some coarsely engraved. Many sizes of silvered lamp-reflectors of good quality, and at low prices.

KEYSTONE FLINT-GLASS COMPANY, *Pittsburgh, Pa.*

Lamp-glasses of plain, new, and graceful forms.

ADAMS & CO., *Pittsburgh, Pa.*

Lamp-shades of clear and bone-glass, and table-wares, of common or fair character.

CRYSTAL GLASS COMPANY, *Pittsburgh, Pa.*

Lime-glass table-wares, moulded, of fair ordinary character of "metal" and forms.

RICHARDS, HARTLEY, & CO., *Pittsburgh, Pa.*

Lime-glass table-wares, moulded, of moderate quality of "metal" and forms.

BAKEWELL, PEARS, & CO., *Pittsburgh, Pa.*

Moulded table-wares, druggists' bottles, perfumers' wares, etc., of ordinary qualities of forms and "metal." Druggists' jars with photographs. Some pieces of thin, light table-wares are well made.

O'HARA GLASS COMPANY, *Pittsburgh, Pa.*

Lime-glass table-wares. "Metal" good; forms light and graceful.

RIPLEY & CO., *Pittsburgh, Pa.*

Lime-glass table-wares, of ordinary character of "metal" and form.

ATTERBURY & CO., *Pittsburgh, Pa.*

Lime-glass lamp-chimneys and globes of clear and opal or bone-glass, of many forms, but ordinary in character.

GEORGE DUNCAN & SONS, *Pittsburgh, Pa.*

Lime-glass table-wares, of clear "metal" and good forms; some engraved coarsely but with considerable judgment.

ROCHESTER TUMBLER COMPANY, *Pittsburgh, Pa.*

A large collection of tumblers of various patterns. The "metal" is brilliant and good, and the forms simple and suitable.

The eleven foregoing manufacturers, all of the city of Pittsburgh, are among the largest houses of that place. They employ in the aggregate about 6000 persons; the amount of their productions is very large and increasing. The prices are exceedingly low.

J. M. ALBERTSON & SONS, *Norristown, Pa.*

Glass shades of various forms and sizes. The "metal" clear but rather greenish; polish of surface good; forms straight and well made. Also some large window-glass of various colors, with corrugated surface. Prices low.

CENTRAL GLASS COMPANY, *Wheeling, W. Va.*

A very good collection of pressed table-wares of lime-glass. The "metal" very brilliant and clear; the forms and patterns good; the pressing or moulding excellently clean and sharp. A praiseworthy exhibit.

WHITALL, TATUM, & Co., *Philadelphia, Pa.*

A large collection of druggists', perfumers', and chemists' wares of lime-glass. The "metal" of good quality; forms useful and various. Also green-glass jars, bottles, etc., are well made. Some lime-glass of fine blue color, in various shapes of bottles, jars, etc., is shown,—one of these samples is made in the form of a skull for holding poisons. A very large and important house.

THOMAS JONES, *New York, N. Y.*

"Patent silver glass" for insertion in furniture. A number of plates of different forms are shown. These are engraved, polished, and silvered with a brilliant effect.

WHITNEY BROTHERS, *Glassboro', N. J.*

Green-glass and other colored bottles, jars, demijohns, etc., of good ordinary character.

HARTELL & LETCHWORTH, *Philadelphia, Pa.*

Glass decorators, colored and crystal-glass globes for lamps, signs, paper-weights, etc. Cut patterns and others etched by acid and by sand-blast are good.

C. & J. SIGLER, *Paterson, N. J.*

Glass signs and letters, painted and gilt but not burned. Some of the pieces etched and gilt, and others with an application of mother-of-pearl and various colored metal foils, giving showy effects.

KLAUTSCHECK, THOMAS, & STEWART, *Philadelphia, Pa.*

Blown white window-glass and shades. An exhibit made in a pavilion adjacent to the Judges' Hall. As this is not a manufacturing house, the goods are not for competition. The glass is manufactured by E. R. Wood & Co., of Millville and Malaga, New Jersey, and is of fair quality.

WALKER MANUFACTURING CO., *New York, N. Y.*

Silvered and cut glass (for insertion in furniture), mirrors, photograph-frames, ornaments, etc. These are cut into various forms and silvered by the exhibitor.

D. DURAND, *New York, N. Y.*

A large mirror, well cut and ornamented on the borders in the Venetian manner. Also a large concave mirror.

S. P. SALLANDROUZE, *Cincinnati, Ohio.*

A large plate-glass, 18 by 8 feet, silvered by him; also a small mirror, with cut borders, in the Venetian manner. The silvering is regular, and of good quality.

LOUISVILLE PLATE-GLASS COMPANY, *Louisville, Ky.*

Manufacturers of the large glass plate exhibited by S. P. Sallandrouze, of Cincinnati, Ohio, 18 by 8 feet. It is the only large American plate exhibited. The color is rather greenish, but it shows an advance in the manufactures of this country.

C. NEWMAN & CO., *San Francisco, Cal.*

(In Agricultural Hall.)

Demijohns, of good quality, covered with willow wicker, as usual, over the glass, but also over an inside covering placed upon the glass, of *tule*, a coarse elastic kind of rush (*Scirpus valadis**) found abundantly in California. With this double covering the demijohns will bear very rough usage, falling from a height of several feet without breaking.

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* *Scirpus lacustris* of Linnæus.

MRS. ELLA HALLER, *New York, N. Y.*

(In Agricultural Hall.)

Large glass fruit-jars, with screw tops. They appear to be useful; but as the glass was made in Pittsburgh, in Baltimore, and in Philadelphia, and not shown as a manufacture, this exhibit is not for competition in this group.

GILLENDER & SONS, *Philadelphia, Pa.*

This firm has on the grounds of the Exhibition well-arranged glass-works in full operation and open to the public. A furnace of eleven pots and one annealing-oven, or "leer," producing "flint" and lime-glass. All the processes of making and decorating are shown, as the melting, blowing, forming, pressing, annealing, cutting, engraving, bending under blow-pipes, etc., and the whole work is exceedingly interesting and instructive.

The wares shown are of "flint" glass blown plain, cut, and engraved, and lime-glass, moulded or pressed, in table and other pieces. The "flint" cut-glass is of fair, moderate character; some of the thin-blown forms are good; the engraving rich and well executed, but, in some instances, rather overdone. The pressed lime-glass is fairly good, and of various patterns, at cheap rates. Specimens of ruby-coated glass are good in color.

In these works is an exhibition of fancy spun-glass, and of glass-work bent and formed with blow-pipes. Among these is a small working model of a steam-engine, which, in motion, is instructive as to the operation of all its parts, and as to the action of the steam in generation, expansion, and condensation.

HOMER BROOKE, *New York, N. Y.*

(In Machinery Hall.)

A number of various iron moulds, for pressing glass into forms, with samples of fruit-jars, bottles, etc., made in them. These last are somewhat rude in character, and not at all sharp in moulding. Also three glass-pressing machines, simple in construction, of practical design, easy in management, and adapted to purpose.

JOHN BIRD, *Philadelphia, Pa.*

(In Annex No. 3 to Machinery Hall.)

Part of a machine for pressing glass-ware. As it is incomplete and

unarranged, it is impossible to judge of its merits at this date (August 1, 1876).

DIAMOND GLASS COMPANY, *Ravenna, Ohio.*

An exhibit of window-glass employed in the Ohio State Building, of good, ordinary character.

GEORGE WM. GORDON, *Boston, Mass.*

(In the Government Building.)

Exhibits of sandstone (from Cheshire, Berkshire, Mass.) of great purity and whiteness, with samples of different-sized grains of the crushed stone as used by glass-makers. Also some specimens of glass "metal" made from this sand in glass-works of Massachusetts and New York. This metal ("flint" glass) is of good quality, dense, clear, and free from impurities. Some specimens of the same "metal" with ordinary colors are shown.*

CRYSTAL CITY GLASS-WORKS, *Jefferson County, Mo.*

A few small specimens of thick plate- green glass of fair quality. Some samples of opal- (arsenic) glass and of clear lime-glass of ordinary qualities. A specimen of the sandstone employed in this manufacture is shown, and seems fair and clean.

JOSEPH WHARTON, *Camden, N. J.*

Specimens of glass, and an earthenware saucer, to show the quality of oxide of cobalt, produced by him, for coloring pottery and glass. These specimens are of good color.

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* Professor W. P. Blake has kindly furnished the results of three analyses of specimens of this stone, as follows, viz.:

No. 18, Silica	99.061 per cent.
No. 24, Silica	99.232 " "
No. 30, Silica	99.411 " "

or less than one per cent. of impurity, chiefly alumina, and of no consequence in an industrial or manufacturing point of view.

THE CHEMISTRY AND COMPOSITION OF THE PORCELAINS AND PORCELAIN-ROCKS OF JAPAN.

BY PROFESSOR HENRY WURTZ.

The samples of porcelain-minerals and porcelains, from Japan, referred to me for chemical examination,—samples which I was permitted personally to select from the collections on exhibition, through the distinguished courtesy of the Imperial Japanese Commissioners,—have occupied a large share of my time during the last six months, in my private analytical laboratory in Hoboken; the whole investigation, in every detail, having been my own personal work, with the exception of some interesting and valuable microscopic observations, made at my request by Dr. Alexis A. Julien, of the Columbia College School of Mines, in New York.

I have spent, in addition, a considerable time in an examination of the literature of porcelain, to collect such few data as are already on record tending to throw light upon the special subject of ceramics in Japan. In this also I owe some aid to Dr. Julien.

I beg leave now to report as follows:

1. INTRODUCTORY REMARKS.

It was a subject of considerable surprise and pleasure to all, that in connection with the magnificent display of Japanese ceramic fabrics, which has become a matter of world-wide renown, there was sent also an extensive suite of the crude native minerals from which these unapproachable wares are produced by this skillful people.

It appears, from the Japanese Sectional Catalogue, that this was a Government exhibit, by the Kuwangiyo-Riyo (*Imperial Board of Agriculture, Industry, and Commerce*), Tokio, of clay, china-stone, kaolin, silex, and other minerals used in the manufacture of the pottery and porcelain of Hizen, Owari, and Ise.

This supplementary display naturally excited in all appreciative minds an extreme degree of interest, by reason of the new opportunity offered—the best by far in the history of ceramics—to the nations of the West to learn with some degree of scientific precision the

nature of the materials and methods employed in the highest developments of this art in the far Orient, so near where the art itself was born. The undersigned at once suggested to his colleagues of Group II. that this occasion should not be lost,—a suggestion which was taken up with unanimity, its originator being promptly authorized and requested to occupy his time, and to use his best efforts, in obtaining the proper samples, with all possible information regarding them, and to proceed diligently to the necessary laboratory examinations and analyses. A like interest arose in the minds of several of the distinguished gentlemen of Group I., to which latter group, indeed, these minerals, as such, were directly pertinent. A subsequent supplementary appointment of the undersigned, at the request of Group I., as an attaché to the latter, for the examination of clays and allied minerals, renders appropriate this special report by him, as addressed to both groups jointly.

It will be readily comprehended that the procural of minute information regarding these minerals, and the mode of their preparation and employment, was not unaccompanied with difficulties. These arose chiefly from the circumstance that such Japanese gentlemen of the Commission as spoke other languages than their own were unfamiliar both with ceramic technology and with mineralogy. Indeed, through an unlucky misunderstanding, it was not until after the writer had spent considerable time (partially lost) in analyzing some samples, selected without sufficiently clear information regarding their mode of employment, that he became aware of one member of the Japanese Commission who was fully and peculiarly competent to render the most efficient aid. This was Dr. G. Wagener, a gentleman of scientific training, whose function is that of Foreign Adviser to the Board of Agriculture, Industry, and Commerce. It happened, however, that the difficulties referred to came to the attention of Dr. Wagener only a few days previous to his sudden official recall to Japan, so that his time for collecting and conveying the information desired was somewhat too limited; nevertheless, communications of essential importance, both oral and written, were received from this gentleman, the substance of which will be found below.

2. THE MINERALS AND THEIR MODE OF OCCURRENCE.

These minerals are referred to as follows in the Catalogue of the Japanese Section: "Minerals used for pottery of all kinds are very abundant in Japan. This is the case to a most remarkable degree in the neighborhood of the small town of Arita, province of Hizen, the centre of the porcelain manufacture in Japan. Within a very limited

circuit, not half a mile in diameter, there are found imbedded in the rock at different places all the materials necessary for the biscuit, for the coating of the ware before glazing, for the glaze, for the 'craquelé,' etc., the best being of such good quality that, after being powdered and decanted, it is used without any further mixture for the finest ware, the so-called egg-shell porcelain. In the central part of Nippon, where granite is the principal constituent of the mountains, in the provinces of Owari, Yamashiro, and the island of Awajishima, opposite Hiogo, beds of petuntse, very much like the Bohemian material, are to be found. When used for porcelain, this material is mixed with siliceous and feldspathic minerals from other places. A thorough mineralogical and chemical examination of these minerals has not yet been made, but would, no doubt, prove to be of great interest."

It was understood that the especial object of this exhibit was to embody a complete and connected suite or assortment of the porcelain-minerals found in the region first referred to above, a range of hills in the province of Hizen, which belongs to what is now called Nagasaki-Ken, and which appears, by a map of Japan, to lie near the southeastern extremity of the empire, separated from the Corean peninsula only by the Straits of Corea, and constituting the most westerly portion of the large island of Kiusiu.* The examination could not include all the minerals exhibited, and it was thought best, therefore, to pass by the isolated samples from other localities, less generally employed. Dr. Wagener, who designated to me the special minerals of which I took samples, took also the trouble to write to me several letters, for the sake of conveying in more precise form the information arising out of his own knowledge, and gathered by him among the manufacturers present as exhibitors. The following passages are selected from these letters of Dr. Wagener:

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* Since the above was written, a map has been received, through the kindness of Prof. H. S. Munroe, of the Imperial University of Tokio, Japan, which gives some idea of the geology of this region. This gentleman has been traveling in the United States, and, as he has visited the locality of these minerals, several efforts, frustrated by as many accidents, have been made to meet him. Without a personal interview with Prof. Munroe, it is thought best not to set down here any conclusions drawn exclusively from his map. This gentleman has given recently to the public, through the columns of the *Engineering and Mining Journal*, an extended and highly valuable account of the mineral formations and resources of the Japanese Empire. In his concluding summary, Prof. Munroe introduced the following remarks, of interest to our present subject: "The universal wealth of Japan, therefore, lies not, as was formerly supposed, in inexhaustible deposits of the precious metals, but chiefly in its abundant stores of coal and iron. Next in importance, perhaps, to coal and iron, are the porcelain clays, which form the basis of a very considerable industry."

"In the neighborhood of the town of Arita, the locality called Idzumi-yama yields the following materials:

"1. Shira-, or Shiro-chuchi.*

"2. Tsuji-chuchi.

"3. Sakaime-chuchi.

"4. Uwa-kuszuri-chuchi.

"5. Indo-chuchi.

"6. Kudaru-yama-chuchi.

"Nos. 1 to 4, inclusive, are found within a very limited circuit, not in strata, but imbedded here and there in and overlaid by a non-decomposed feldspathic rock, of which, unfortunately, no reliable sample has been exhibited; but the Indo-chuchi is the one which comes nearest to it, being only partly decomposed, and containing still a considerable proportion of hard, unaltered mineral.

"The Kudaru-yama-chuchi is found between layers of the hard rock, at different places, including Idzumi-yama; but the sample you have is not from this place. Apparently, the hard portion of the Indo-chuchi would represent the undecomposed rock, and the Kudaru-yama-chuchi the result of *complete decomposition;* and perhaps you might obtain a similar product simply by washing the Indo-chuchi under a spray of water. The first four minerals seem to be intermediate products of decomposition; but it could not be asserted that the agents of decomposition have been the same as in the case of the Kudaru-yama-chuchi. If this were the case, the latter, with one or the other of the four other minerals, would generally be found in propinquity (unless the Kudaru-yama-chuchi could be deemed a transported deposit, which it does not seem to be). Besides, the Tsuji-chuchi and the others are found at greater depths than the Kudaru-yama-chuchi, and surrounded and overlaid by such thicknesses of undecomposed rock, that the decomposition can scarcely be ascribed to mere atmospheric agencies. As I told you, the immediate neighborhood of Idzumi-yama presents ample evidences of volcanic action; thus, whole rocks of volcanic glass (obsidian) have broken through the formation. In any case, the first four minerals must be treated as one group, being most likely produced by decomposition of the same rock, represented in all probability by the undecomposed portions of the Indo-chuchi.

"The Shira-kawa-chuchi and the Sei-ji-chuchi have no connection with the other groups of minerals, coming from different mountains

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* It is to be understood that *chuchi* is a generic term, equivalent to our "clay." It will be seen, however, that most of these minerals are very remote from clays, only one of them approaching, and that only in appearance, to kaolin.

in the neighborhood of Arita. They are each to be considered separately."

3. THE IDZUMI-YAMA QUARRIES.

In conversation—through an interpreter—with Mr. Kaijiro Notomi, the Japanese Judge in Group II., he made hastily, with pen and ink, the following rude sectional sketch of one of the diggings, which illustrates some points so well, that it has been thought useful to introduce it here.

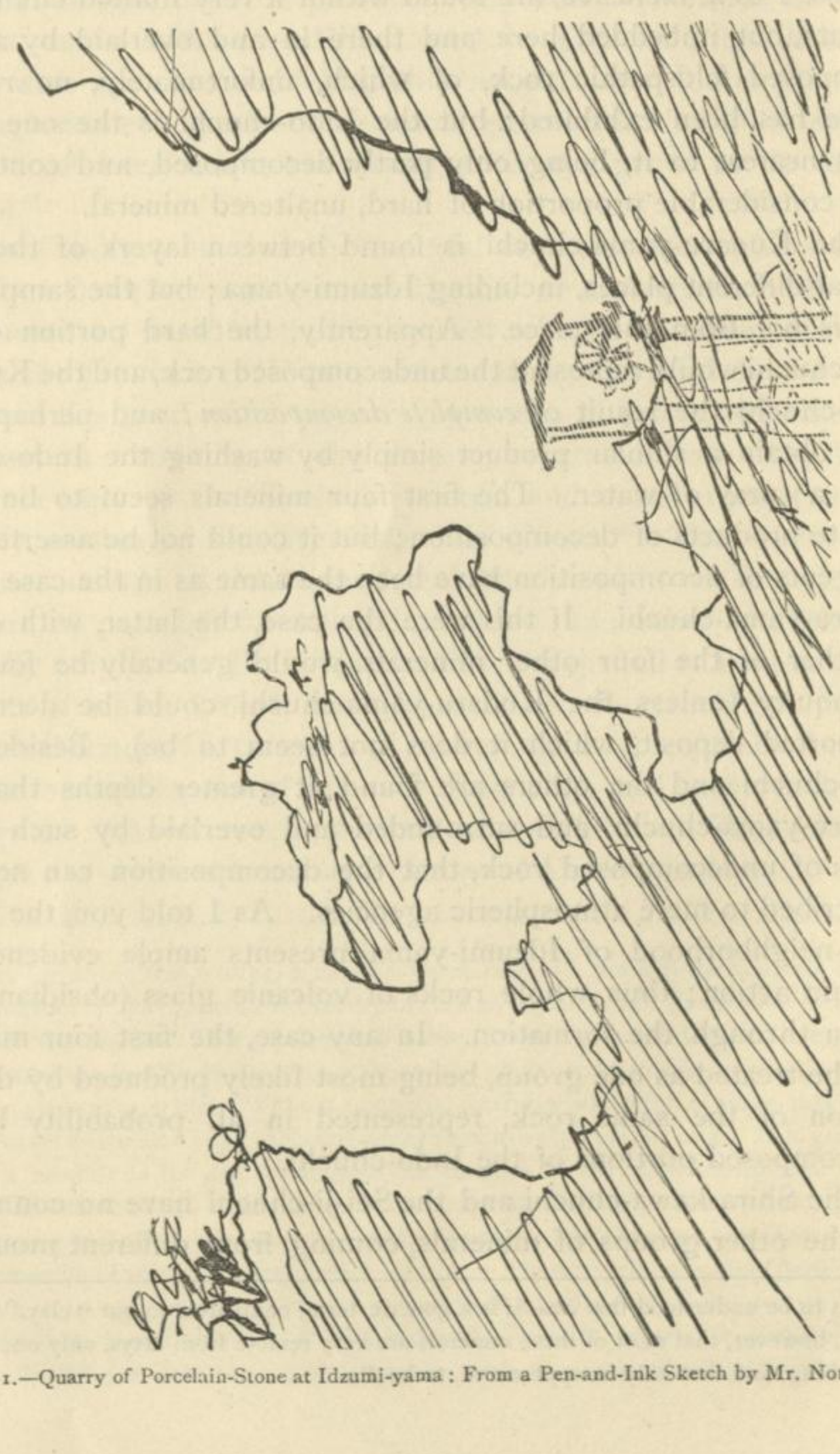

FIG. 1.—Quarry of Porcelain-Stone at Idzumi-yama: From a Pen-and-Ink Sketch by Mr. Notomi.

Mr. Notomi stated that the deepest part of the quarry here depicted was but thirty feet below the surface, but that water had come in and stopped work, although the quality of the porcelain-rock was improving. The pump-house and shaft, as he was understood, are suppositious, for the purpose of dealing with this water in future. Dr. Wagener makes the following statements on this head:

"Notomi's sketches represent the Idzumi-yama rather roughly. They are sufficient to show you that the locality is rather a complicated one. The place may be described as an irregular circular area, almost entirely inclosed by three steep hills, with three narrow ravines between them, which descend to some larger valleys. But the bottom of this kind of mountain-kettle is very irregular, presenting deep depressions and irregular elevations, one of which divides it into halves. Here and there enormous rocks lie around, as if detached and tumbled down from the sides of the hills." Dr. Wagener adds that he writes from memory, after an interval of seven years since his visit, at which time he failed to take notes of important details, from an expectation of returning again with more leisure, in which he has been disappointed.

In my searches through our yet meagre literature of Oriental ceramics, I have encountered what has been doubtless the sole source of information heretofore available regarding these porcelain-rocks of Hizen. In the great work of the famous French Orientalist, Stanislaus Julien, entitled *Histoire et Fabrication de la Porcelaine Chinoise*,* there is given as an appendix a short *Mémoire sur la Porcelaine du Japon*, by M. le Docteur J. Hoffmann, Professor at Leyden, *Interprète du Gouvernement des Indes Nêerlandaises pour la Langue Japonaise.* Hoffmann's only passage bearing on our immediate subject coincides essentially, so far as it goes, with the statements of Dr. Wagener. He says, "The *terre blanche* which is used for the fabrication of the porcelain comes from the mountain Idzoumi-yama, and forms the principal article of commerce of the province of Fizen (doubtless a misprint for Hizen). No mountain in the whole empire is comparable in this respect to this one. This material is white, but as hard as rock, and has to be broken with hammers and pulverized in mills." It does not appear—that is, it is not stated—that Hoffmann had visited the localities of the quarries.

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* This work is largely annotated by Salvétat and other eminent scientists. It is to be found in the Astor Library, and in that of the U. S. Patent Office, at Washington.

4. ORIGIN OF THE HIGHER CERAMICS IN JAPAN.

From some historical passages in the Japanese Sectional Catalogue, it would seem that the higher developments of the ceramic art in Japan were not altogether indigenous, but received important aid from the earlier experience of Chinese and Corean artisans, and that the first impulse was given about three hundred years since. We may infer that the peculiar porcelain-stones we have in hand have been quarried for nearly three centuries, and largely transported throughout Japan, while samples may have for the first time reached the nations of the West through our Philadelphia Exhibition. One passage it will be well to quote:

"The making of real porcelain in Japan began under the direction of Gorodayu Shonsui, a native of Ise, who went to China for the purpose of studying this art. After his return, between 1580 and 1590 A.D., he settled in the province of Hizen, at present the most important centre of the porcelain industry. With the excellent material found in this country, he succeeded in making all the different kinds of porcelain which even to-day form the staple produce of Hizen, viz., Some-tsuki, or blue ware painted with cobalt oxide under the glaze; the Kanyu or Hibiki, *i.e.*, the 'craquelé;' the Seidji, or celadon ware; the Akai, or the red ware; and the 'Gosai,' which name means, in reality, the 'five colors,' and was used for the porcelain painted with vitrifiable colors upon the glaze; this ware is now called 'Nishikide.' The old Hizen, or, as it is sometimes called, the Imari porcelain, chiefly manufactured in Arita, is decorated with a very limited number of colors,—blue under the glaze, black for the outlines of the ornamentation, then red, green, and gold. For a short time after the introduction of this new industry, the articles were generally marked with the name of the above-mentioned Shonsui, indicating that it was ware made in accordance with the style taught by him. About this same time, after the Corean war (1592), several Corean porcelain-makers were brought over to Hizen by the Prince Nabeshima Naoshige, and contributed greatly to the development of the new industry. There are yet many descendants of these Coreans living in Arita, but they have entirely amalgamated themselves with the Japanese."

Another passage recounts the bringing of other Corean captives about the same time to Kagoshima, a point somewhat farther south than Arita, in the province of Satsuma, who originated the "Satsuma ware." Other historical matters, though of interest, would not be in place here.

5. PREPARATION AND MANIPULATION OF THESE MINERALS.

The importance of this part of our inquiry is such that no apology need be made for the presentation minutely of every detail that has been gathered. It will have been seen that Dr. Hoffmann describes these as stony minerals, requiring machinery for their pulverization. The Japanese Catalogue states as follows:

"Whatever may be the nature of the raw material, be it quartz, felsite, kaolin, feldspar, or the peculiar porcelain-stone of Arita, it is always powdered by means of balancing pounders of a peculiar construction. These are composed of long horizontal beams, with a perpendicular cross-piece at one end, giving the whole the shape of a hammer, and with a water-trough at the other end. This instrument is put up wherever a small stream of water can be utilized; the water running into the trough raises the pounder by over-weight, and running out at the end in consequence of the incline, allows it to fall down again, with the iron-shod cross-piece dropping into a stone mortar, in which the materials are thus reduced to powder; the latter is then sifted, mixed with water, and decanted.

"No other machinery, such as the quartz- or glaze-mills of foreign porcelain manufactories, is used, and the consequence is that all the material which cannot be sufficiently powdered by the above-described pounders (amounting often from 40 to 50 per cent.) is thrown away as waste. The fine powders produced by decanting are carefully mixed, and removed into flat boxes, where the water is partly drained off through a sand bedding, covered with matting, and partly tapped off from above the deposited clay; the latter is finally brought to more consistency by placing it on the warm furnaces. Long experience, combined with the good quality of the raw material, enables the manufacturers to prepare a clay fit even for the production of very large pieces, such as vases from 6 to 7 feet in height. These are chiefly manufactured in Arita, whereas porcelain tables, painted slabs, fire-places, and similar articles are mostly made in Owari. The throwing and shaping of the clay is done upon the common potter's wheel, which, in the town of Arita (Hizen), consists of a flying wheel and a working disk, twelve or fifteen inches one above the other. These are united by a sort of a hollow wooden prism, so as to form one system of wheels, which is placed over a vertical round piece of wood, fastened in the ground. To avoid friction as much as possible, this system of wheels is resting upon the pointed stick by means of a hollow piece of porcelain, set underneath into the working disk. By means of this lathe the workmen in Arita turn out large dishes of three feet in

diameter, as well as the so-called egg-shell porcelain, not thicker than paper. For very heavy and large pieces, the lathe is turned by means of a driving-cord.

"In all other provinces but Hizen, the lathe is of a more simple and imperfect construction, the flying wheel being at the same time the working disk.

"Moulds are also used, and made of ordinary clay. Since the Vienna Exhibition the use of gypsum for moulding is taught to the porcelain manufacturers of different places, and will most likely effect an important progress. Some of the pieces exhibited at Philadelphia have been made by the new process.

"When the pieces have been sufficiently dried in the open air, they are shaped with sharp iron tools on the same lathe on which the first throwing has been done, and are then coated with a very pure white clay,* so as to give the finished ware a better appearance, and to bring out with more intensity the fine blue color of the cobalt painting. After this coating, the ware receives the preliminary baking in small kilns built in the open yards of the manufacturing localities. The pieces are then painted with the oxide of cobalt, and afterwards glazed in the same way as in Europe. The glaze is always composed of a feldspathic material, either natural or produced by the mixture of different minerals, to which is added a certain quantity of wood-ashes freed from the alkali by careful lixiviation. The proportion of ashes depends on the place which the pieces have to occupy in the kiln, the heat of which is not quite uniform."

The following extracts from the letters of Dr. Wagener convey other most important information, supplementary to the above:

"The Tsuji-chuchi, the Shiro-chuchi, and the Sakaime-chuchi are the principal materials for the body of the wares. The Tsuji-chuchi is the purest and whitest, but a little hard in the fire, so that it is generally mixed with Shiro-chuchi (seven parts to three). It is more expensive, and hence used only for the best thin-body (egg-shell) ware. Shiro-chuchi and Sakaime-chuchi are considered as equally good, and are mixed in arbitrary proportions for the larger ware. This means simply that they vitrify at the same temperature, and are both sufficiently white. By floating and decanting, however, they can separate materials of various degrees of fineness: for very large pieces the coarser materials are used.

"The Tsuji-chuchi is the best and whitest, the most expensive, and at the same time the most refractory; not vitrifying so easily, and

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* The Kudaru-yama-chuchi, so called by Dr. Wagener. See above, and below also.

for this reason it is not used alone, but is mixed with a certain proportion of less refractory Shiro- or Sakaime-chuchi, even when compounding the body of the thin egg-shell ware; so that the mass may vitrify in the same fire as the larger and thicker pieces, made of the two latter minerals alone.

"There is still another most important point to be noted. These materials are powdered by very rude machinery, and it happens that, after sifting and floating, 40 per cent. or more of the original mass is thrown away as waste, in the shape of a very coarse powder which has settled upon the bottoms of the floating tubs. Now, although so great a loss arises largely from imperfection of machinery, yet it may also be that the minerals themselves do not possess entire homogeneity of texture, but contain harder and softer parts, of which the former would be less perfectly crushed. Hence, it would result that neither the waste, nor the fine decanted product, would have the same composition as the raw mineral; most likely in one of them the proportion of silica having been increased, and in the other the proportion of alumina. Thus your analyses might present discrepancies which would be inexplicable without taking these facts into consideration.

"When the body of the ware is finished, and before baking, it is coated with the Kudaru-yama-chuchi, also called Kesso-chuchi (which means 'whitening clay'). The object of this coating is to make the ware appear whiter, but also, and chiefly, to produce a finer cobalt-blue. After the first baking, the painting with oxide of cobalt is done upon the ground of Kesso-chuchi; then the ware is glazed and baked in the finishing-kiln. The glaze is composed of the Uwa-kuszuri-chuchi and lixiviated wood-ashes, mixed in various proportions, according to the place which the ware will occupy in the kiln, in which the heat is not uniform.

"The Shira-kawa-chuchi, mixed with Shiro- or Sakaime-chuchi, is used for the 'craquelé.' The Sei-ji-chuchi is used for the greenish glaze, called 'celadon,' in the same way as the Uwa-kuszuri-chuchi."

It may be well to mention in this place that the mineralogical characters of these several minerals will be described below, each under its own head; and the next point in order to be considered is

6. PREPARATION OF THE SAMPLES FOR ANALYSIS.

A. The Minerals.—It follows, as a matter of course, as suggested by Dr. Wagener above, from the circumstance of the preparation of the minerals for use by processes of elutriation or flotation, that no results at all reliable or useful, in the way of comparison with the

wares themselves, could be expected from mere analysis of the minerals in their crude state. The Japanese methods of preparation must needs be imitated, as nearly as practicable, in the laboratory. Each sample was therefore, after weighing, carefully and patiently pulverized by simple taps of a pestle, avoiding all trituration, until it all passed through fine bolting-cloth; the finer parts were then separated by suspension in water, from 25 to 45 per cent. of the mass being thus decanted, allowed to settle, then dried, first in air, then over oil of vitriol, and reserved for analysis. The tedium of this part of the work, partly on account of a notable toughness and infrangibility of the small particles of these minerals, was great and unusual, but unavoidable.

B. The Porcelains.—The samples of wares selected for analysis by Dr. Wagener were flat, to facilitate the grinding off of the glaze. They were of two kinds, one representing the finer "egg-shell," and the other the heavier common ware. The formulæ, indicating the washed minerals and proportions thereof, used in compounding the mass—as obtained by Dr. Wagener from the manufacturers present—accompanied each, and are stated below. The removal of the glaze, which was not without its difficulties, especially in the case of the thinner ware, was satisfactorily accomplished through the kindness of Mr. James Gillender, of Philadelphia, at his large glass-works in the Exhibition grounds, this gentleman placing his machinery and a skilled operative freely at the disposal of the writer. Thanks are due to him for this aid.

The next step was the crushing of these samples for the analyses, which again was not altogether a simple matter. Their hardness forbade the ordinary use of steel, porcelain, or even agate mortars. A plan was therefore used which was devised by the writer for cases of this kind, and communicated eighteen years since to the American Association.* This consists simply in pulverizing in a hard iron mortar, elutriating with alcohol (not water) when extreme fineness is required, and removing the abraded iron from the powder subsequently, by means of a solution of iodine.

7. METHODS OF ANALYSIS.

A. General.—The need of an accuracy as nearly absolute as possible in this series of analyses, led to the adoption for most of them of a system which consists in making a set of analyses all simultaneously and parallel, all conditions being as uniform as possible

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* *American Journal of Science* [2] xxvi., 191, Sept. 1858.

throughout. Thus, for example, equal weighed or measured quantities of all reagents are used. But the essential device, to which this is subordinate, is to conduct a parallel blank analysis, in which no material is taken. The figures from the latter serve to correct absolutely the actual analyses, eliminating all errors from impurities of reagents, material (if any) dissolved from, and left adherent to, beakers and dishes, ashes of filters, etc. The analyses made with these special precautions will, for distinction, be designated below as Absolute Analyses. The minerals and porcelains were all fluxed for the general analysis, with ten parts of mixed flux (equivalent mixture of sodium and potassium carbonates).

B. The Alkali-Determinations.—Some special remarks should be added on this head. The method of Dr. Lawrence Smith* is usually employed in this class of analyses, consisting in conversion of the alkali into soluble chloride by fusion with a mixture of sal-ammoniac and lime-carbonate. The preference of the writer, however, is for his own earlier method of simple fusion with chloride of calcium to accomplish the same transformation,—a method whose publication antedates the above by nearly three years.† The chloride of calcium (free from magnesium) is most conveniently employed in the form of saturated alcoholic syrup (which contains half a gramme of $CaCl_2$ in each cubic centimetre), measured out from a burette into the platinum crucible containing the assay, and mixed with the latter by stirring with a platinum wire. The crucible is then covered, heated till the alcohol begins to boil, and its vapor is kindled. In a few minutes the alcohol burns away and the mixture is ready for application of a higher heat. Copious fumes of hydrochloric acid are now evolved, and after two or three minutes the heat is raised to bright redness, fusing the mixture, for ten or fifteen minutes. After cooling, cold water dissolves out all the alkali. To the liquid, without filtration, ammonia (to prevent effervescence) and powdered carbonate of ammonia are added in excess, heat applied till the lime-carbonate (at first bulky and gelatinous) condenses into a heavy granular precipitate, the last traces of lime thrown down by a little oxalate of ammonia, the filtrate evaporated in platinum, ignited, redissolved in water,

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* *American Journal of Science*, July, 1853, pp. 6 and 7.

† *American Journal of Science*, November, 1850, p. 329, also 323. In his recently published volume of collected *Scientific Researches*, Dr. Smith expresses his opinion (p. 220) that "$CaCl_2$ has but little decomposing effect on silicates, its action (in his own mode of application) being simply that of a menstruum in which the lime can act conveniently on the mineral." Multitudes of experiments of the writer have given uniform results at variance with this view; but these questions must be discussed on some other occasion.

filtered, evaporated again, and the pure chlorides of the alkali-metals weighed, and separated as usual. It is desirable to employ in all cases the same device above brought forward, of a parallel blank analysis, especially as calcium-compounds can scarce be obtained free from quite appreciable contamination with sodium. To this latter remark even the purest artificial precipitated carbonate of lime is equally liable, more so than some native calcites.

8. DETAILS OF THE ANALYSES.

The minerals selected and submitted to analysis were eight in number, making, together with the two porcelains analyzed, ten materials in all, which will be designated by letters of the alphabet:

A. The Tsuji-chuchi.
B. " Shiro-chuchi.
C. " Sakaime-chuchi.
D. " Uwa-kuszuri-chuchi.
E. " Indo-chuchi.
F. " Kudaru-yama-chuchi.
G. " Sei-ji-chuchi.
H. " Shira-kawa-chuchi.
J. " Egg-shell Porcelain.
K. " Thick-body Porcelain.

A. The Tsuji-chuchi.—This is the most valuable and costly variety of the porcelain-stone found at Idzumi-yama, and forms 70 per cent. of the body of the finer egg-shell porcelain. It is a dull-white, porous, granular, coherent mass, not very unlike coarse chalk in appearance, but somewhat harder and very much tougher; breaks with difficulty; is rough to the touch, smearing the fingers, though not readily; fracture granular, conchoidal, dull; mass obscurely laminated (?). It adheres to the tongue, with a chalky taste, and has a distinct odor, much more of a chalky than a clayey character. It crushes grittily between the teeth, not at all with a sandy or quartzose grit, but about like calcite. In the mass, under a low magnifying power, it has almost a saccharoid appearance, composed apparently of small granules, which have a distinct though dull lustre. The aspect suggests homogeneity, which is disproved, however, by the results of the washing and analyses. Splinters are scarcely affected before the blowpipe; but in powder, both the raw and washed mineral are easily fritted fast to a platinum wire in an intense blowpipe jet, becoming translucent. It contains no trace of carbonic dioxide. In boiling water the mass evolves air appreciably. After powdering and igniting it has a pinkish tinge. The proportion of fine powder remaining sus-

pended in water, after pounding and sifting as above specified, was 45 per cent. of the whole mass.

The results of absolute analysis of the washed Tsuji-chuchi (45 per cent.), after drying over oil of vitriol, were as follows:

		Computed to 100 parts, without the water.
Combined water	2.518	.....
Silica	78.181	80.672
Alumina	15.699	16.174
Ferrous oxide	.663	.684
Lime	none	none
Magnesia	.099	.102
Soda	1.744	1.799
Potash	.551	.569
Manganese	trace	trace
	99.430	100.000

Density of the powder analyzed, taken with exceeding care and accuracy, at 0° C. = 2.6962. It may in this place be added that two similarly-exact determinations upon two samples of the whole mass of the Tsuji-chuchi, gave 2.6845 and 2.6855.

It yielded to 20 per cent. potash-lye, on three minutes' boiling, but 0.444 per cent. of silica, with 0.333 per cent. of alumina, containing therefore but little amorphous uncombined silica or opal.

The entire absence of lime from the Tsuji-chuchi is not only in itself remarkable, but bears on the analysis of the egg-shell porcelain below. The fact was settled to be such, by repeated and rigid tests. No doubt can remain that this variety—or at least the sample of it exhibited—was exceptionally devoid of lime, having probably been deprived thereof by some natural solvent; and the superior refractory character attributed to this variety might reasonably seem connected with this freedom from lime.

B. The Shiro-chuchi.—This variety is also used in the egg-shell ware, to the extent of 30 per cent. of the washed mineral. In the mass it is finer-grained, harder, tougher, and more compact than A, but otherwise quite similar; having an equally white color and a like chalky taste and odor, adhering to the tongue, and smearing the fingers slightly (when hard rubbed), though without the slightest smooth or unctuous feel. Diffused throughout it are some small, dark-colored specks not present in A. These, under the magnifier, are seen to contain slight nuclear remains of small crystals of iron pyrites. On blowpipe test these specks gave an iron reaction, but no permanent color was imparted to a phosphorus-salt bead in either the oxidizing or reducing flames. The proportion of finer material

obtained by the same process of crushing and elutriation was much smaller than in the case of the Tsuji-chuchi, being but 25 per cent.; but, except in the presence of a little lime and a little more iron, the composition of this washed portion does not greatly differ from that of A.

The Shiro- (like the Tsuji-chuchi), though dull to the eye, shows under the magnifier, on the part of the granules which make up the mass, a distinct degree of lustre, scarcely less than that of a fracture of the porcelain itself. The magnified aspect, under low power, is that of some compact feldspathic or felsitic psammites, though porosity is of course proved by the adhesion to the tongue. Thin splinters appeared to yield slightly before the blowpipe at their thinnest edges, and the powder, on the extremity of a fine platinum wire held axially in the most intense mouth-blowpipe heat (from a stearic-acid candle of the best quality) about equal to the point of fusion of platinum, passed into unmistakable transparent blebby fusion, a thing which could not be accomplished in the case of the Tsuji-chuchi. This is entirely in accordance with the statements of the manufacturers, given by Dr. Wagener. That the presence of so small an amount of lime, with the trifling additional percentages of iron and alkali, should produce so perceptible a difference in fusibility is remarkable, but may not surprise some chemists of special experience. It illustrates well the almost inutility of any but the most refined and absolutely exact analyses of materials employed in such arts as the ceramic.

The absolute analysis of the washed Shiro-chuchi (softest 25 per cent. of the whole), dried over oil of vitriol, yielded:

		Computed to 100 parts, without the water.
Combined water	3.330	.....
Silica	77.685	80.920
Alumina	15.189	15.822
Ferrous oxide	.895	.932
Lime	.146	.152
Magnesia	.096	.100
Soda	1.469	1.530
Potash	.508	.530
Manganous oxide	.013	.014
Sulphur	trace	trace
	99.331	100.000

Boiling 20 per cent. potash-lye dissolved out 2.769 per cent. silica and 1.352 per cent. of alumina.

C. The Sakaime-chuchi.—This variety is used, with the Shiro-chuchi, in compounding the body of the thicker and commoner porcelains. There is little in its appearance to distinguish it, either by the

eye or the magnifier, from the Shiro-chuchi, except possibly less hardness and a little coarser grain. Except that no specks of pyrites were discovered in it, the description of its characters, and behavior before the blowpipe, would be substantially similar to that given above of the Shiro-chuchi. It evolves, when boiled in water, a little air, and with hot nitric acid minute traces of carbonic dioxide. The amount of the softer portion obtained by elutriation was 30 per cent. After ignition and grinding, the powder had a feeble pinkish tinge. Absolute analysis of the finer 30 per cent., dried over oil of vitriol, gave:

		Computed to 100 parts, without the water.
Combined water	3.320	.....
Silica	78.073	81.141
Alumina	13.993	14.542
Ferrous oxide	1.020	1.060
Lime	.186	.196
Magnesia	.229	.242
Soda	1.722	1.789
Potash	.961	.999
Manganous oxide	.031	.031
	99.545	100.000

Density, taken at 0° C., with great care, was found to be 2.6041,—lower, to a remarkable degree, than that of the washed Tsuji-chuchi. The difference is too large to be attributable to the small additional amount of water, and must be due also to essential molecular variation.

Boiling 20 per cent. potash-lye dissolved, of silica, 2.887 per cent.; of alumina, 1.428 per cent.

An isolated analysis of the whole mass gave:

		Without water.
Combined water	2.610	.....
Silica	78.922	81.314
Alumina	14.373	14.809
Ferrous oxide	.868	.894
Lime	.162	.167
Magnesia	.224	.232
Soda Potash	2.463	2.539
Manganous oxide	.044	.045
Carbonic dioxide	trace	trace
Sulphur	trace	trace
	99.666	100.000

From these analyses it would seem that the washed product differs very little from the whole mass, a fact which was found to hold with others of these minerals.

D. The Uwa-kuszuri-chuchi.—This variety is used in compounding

glazes, in admixture with lixiviated wood-ashes. It differs from the preceding varieties in being softer, smearing the fingers readily (without any clay-like smoothness, however), and it has throughout a good many dark specks, accompanied by points of iron pyrites visible under the lens. In other respects its general description resembles the preceding companion-minerals. After ignition and grinding, the powder was pale pinkish. Elutriation yielded 35 per cent. of the mass. The absolute analysis of this, dried over oil of vitriol, gave:

		Computed to 100 parts, without the water.
Combined water	3.715	.....
Silica	78.210	81.772
Alumina	14.407	15.059
Ferrous oxide	1.408	1.471
Lime	.097	.102
Magnesia	none	none
Soda	1.385	1.447
Potash	.142	.149
Sulphur	trace	trace
	99.464	100.000

Boiling potash-lye, 20 per cent., dissolved from the washed mineral 1.969 per cent. of silica and 1.709 per cent. of alumina.

Of the whole mass of this variety, but a partial analysis was completed, which gave:

Combined water	2.91
Silica	81.33
Alumina	13.01

E. The Indo-chuchi.—A great interest attaches to this variety, from the fact, as stated by Dr. Wagener in his letters, that it still retains, in admixture, some of the unaltered mineral, from which he conceives all the four preceding kinds, together with the one which comes next (F), to have been derived by unknown processes of alteration. It presents a coarse-grained mass, rather irregular in texture, color, fracture, and degree of porosity. In some places it is quite white, in others much stained with limonite. Scraping with a knife at once distinguishes some harder parts, or flakes, dispersed irregularly throughout the mass. With great labor a considerable quantity of this harder material was dissected out, and crushed to coarse powder, in order to remove the remainder of the soft portions adherent, which was accomplished by grinding in a mortar with water, with a light pressure, so long as the water became at all milky. A coarse sand-like material was thus obtained having fully the hardness of unaltered feldspar. Under the magnifier this presented the appearance of an-

gular, opaque, milk-white fragments, conchoidal, and dull. No traces of feldspathic cleavages. Some grains showed what appeared like encrusted, or possibly corroded surfaces, a little honey-combed and lustrous, which may indicate alteration. On ignition of these grains, they first blacken somewhat, apparently from presence of organic matter, but quickly burn white again. This behavior is very curious, differing from that of any of the associated minerals. No very marked odor accompanies this blackening, but the water given off has a distinct acid reaction, due very likely to sulphurous acid; so that the blackening may be due to the coexistence of a trace of sulphuric acid, or an acid sulphate with organic matter. Another curious fact about this Indo-chuchi was the development of a distinct musk-like odor from it when warm. After ignition most of the grains had assumed a reddish ferruginous tinge, some few, however, remaining white. The total iron in the mass, nevertheless, as shown by the analysis, is surprisingly small, being evidently also in ferrous form. The absolute analysis of these hard grains, dried at 100° C. for many hours, gave:

		Computed to 100 parts, without the water.
Combined water	1.155	.....
Silica	82.292	83.698
Alumina	11.981	12.186
Ferrous oxide	.139	.141
Lime	.287	.291
Magnesia	.064	.064
Soda	2.981	3.032
Potash	.506	.515
Manganous oxide	.072	.073
	99.477	100.000

Density, taken with great care, upon the sand-like mass, at 0° C. = 2.489. Two sediments, obtained successively (as below) from the liquid poured off from this, yielded the densities 2.6032 and 2.5769, the more altered portions of the rock being therefore very much denser. The fact that the second sediment was lighter than the first, is attributable, in part, at least, to a higher degree of hydration.

By boiling 20 per cent. potash-lye, there was dissolved from this mineral,—of silica, 6.587 per cent., present doubtless in opaline form; of alumina, not a trace.

The above analysis (after deducting the opal present) may be well represented by the following empirical formula:

$O_{51}.Si_{22}Al_4Na_2.H_2O$. Density (computed at 0° C) = 2.533.

In washing out the above hard—supposed unaltered—Indo-chuchi,

the milky water, after separation of all the coarser heavy sediment, was saved, and allowed to stand for one hour, when a fine sandy sediment had separated from it. It is thought that an examination of this will be of much interest, to compare with the harder (or at least tougher) portion of the mass whose composition is above given. Up to the time of closing this report, however, only its density can be given, which was found to be, at 0° C., 2.6032,—considerably higher, therefore, than that of the coarser portion. Further, on standing for six days, the milky liquid poured off from the last had again deposited quite a large quantity of fine mud; and, finally, the same liquid, again, on adding—to coagulate the suspended matter—$\frac{1}{400}$ of its weight of chloride of calcium, became entirely clear in a few hours, with separation of a small white precipitate.* All these products are in process of examination, and the results will be highly interesting; but some months must elapse before these results can be fully elaborated for publication, together with similar investigations in progress upon some of the other minerals of the group.

F. The Kudaru-yama-chuchi.—This is the variety also called Kesso-chuchi. It is, like the last, of especial interest, for several reasons, one of which is that this is the only variety presenting any approach, even in aspect, to a clay. Other reasons will appear in discussing the porcelain analyses.

It is a pure white, soft, chalk-like substance, easily rubbed up between the fingers, with a slightly unctuous feel, but quite inferior in this latter respect to a true clay. Under the magnifier it appears to be made up of very small, amorphous, transparent grains, irregular in size. In water it immediately falls to powder with effervescence (from escape of air), but the paste formed has very little of the plasticity of that formed by true clays. It is chalk-like in odor, like the other minerals of the group, and shows no grittiness between the teeth. Even after ignition, and notwithstanding its very appreciable proportion of iron, its color remains pure white. Like all the other related minerals, it may, when in powder, be fritted fast to a fine platinum wire by the intensest heat of the mouth-blowpipe, though

* It may be of interest here to note the curious fact, encountered in reading the memoir of Ebelmen and Salvétat (referred to in a subsequent paragraph), that the Chinese porcelain-makers have long been acquainted, practically, with the circumstance here made use of, the power of soluble salts (particularly those of lime) to coagulate and precipitate suspended slimy mineral matters from water, which has been supposed by some to be a quite recent discovery, claimed by several chemists. Ebelmen and Salvétat received, with their other minerals from King-te-tching, one called "Chy-kao," stated to have this precipitating power. Their analysis showed this mineral to be simply a fibrous variety of gypsum or lime-sulphate.

possibly with more difficulty than the others. Two analyses were made, one an isolated analysis of the whole mass, the other an absolute analysis of a portion obtained by washing over in suspension in water and drying over oil of vitriol, which portion amounted to 44.8 per cent. of the mass.

Absolute analysis of the latter yielded:

		Computed to 100 parts, without the water.
Combined water	7.607	.....
Silica	49.931	54.072
Alumina	38.738	41.951
Ferrous oxide	1.582	1.713
Lime	none	none
Magnesia	.206	.223
Soda	1.445	1.565
Potash	.440	.476
	99.949	100.000

Density carefully determined at the temperature of melting ice, or 0° C. = 2.627.

By boiling 20 per cent. potash-lye, there was dissolved from this 4.205 per cent. of silica, with but a trace of alumina, from which must be inferred the presence of a corresponding amount of soluble or opaline silica. Assuming the composition of the latter to be 95. silica, and 5. water, and its density at 0° C. to be 2.09, the composition of pure kudaruyamite,* deducting the opal, becomes essentially:

		or
Combined water	7·39	7·79
Silica	45·51	47·95
Alumina	38.74	40.82
Ferrous oxide	1.58	1.67
Soda	1.68	1.77
	94.90	100.00

Density of the pure kudaruyamite, as computed at 0° C. = 2.653.

This is the composition of a pinite, by the nomenclature of Dana; and kudaruyamite is therefore to be regarded as a variety of the pinites, looked on by Genth as amorphous damourites. The main peculiarity of kudaruyamite is, that whereas the pinites and damourites are invariably potash-minerals, this variety contains soda instead; and the alkali is, moreover, in much less proportion than in other pinites. Genth, however, regards the paragonite-schists (which are

* It is merely provisionally and for convenience that I coin this and other like names by adding to the Japanese words for these minerals the usual mineralogical termination *ite*, instead of *chuchi*, which latter is harder to write and to pronounce.

matrices of corundum) of St. Gothard, Pregatten in Tyrol, and Ochsenkopf in Saxony, as sodium-damourite; but, although pure kudaruyamite has nearly the composition of the micaceous paragonite, by some of the analyses of the latter (containing, however, more water and much less soda), it could not be regarded as paragonite, from its lack of many of the necessary characters. Paragonite-densities range as high as 2.895 (Œllacher), a variation from kudaruyamite sufficient in amount to indicate a variation in volumic type, such as cannot here, however, be fully explained. Margarodite is another variety, also micaceous, to which kudaruyamite approaches closely in percentage composition. We must be satisfied, for the present, with having accomplished the highly important point of identification of kudaruyamite as a member of Dana's pinite group of products of alteration. Further light may come when a complete study—now in progress—shall have been made of the molecular volumic relations of this and the other minerals of the locality.

The other (isolated) analysis made of the whole mass of the kudaruyamite was as follows:

		Computed to 100 parts, without the water.
Combined water	7.57	.....
Silica	48.65	53.24
Alumina	38.05	41.64
Ferrous oxide	2.37	2.59
Lime	none	.....
Magnesia	.43	.47
Soda, Potash	1.88	2.06
	98.95	100.00

The coarser portion of the kudaruyamite, 55.2 per cent. of the whole mass, gave at 0° C. the density 2.6209, slightly less than the washed portion.

G. The Sei-ji-chuchi.—This one, as stated by Dr. Wagener, is not a companion-mineral of the preceding six, not coming from the Idzumiyama quarries, but from some other place in the neighboring country. The analysis was not therefore made by the absolute method. Like D, it is used as a glaze-constituent, for a peculiar green glaze. Its grain is much coarser and rougher than that of the preceding minerals, and it is very distinctly laminated in structure. It has, in fact, the aspect of a somewhat altered feldspathic psammite, being in all except color not unlike some of the finer-grained varieties of our Triassic (?) albitic psammites of the Palisade Range* (so called brown, or red sand-

* This comparison may require some explanation, even to some readers not unfamiliar with lithology. In a communication made by the writer, early in 1871, to the Lyceum of

stones, used for building purposes). Though generally white, it is considerably stained by limonite in many places. It adheres to the tongue, though not so much as the Idzumi-yama minerals, and has the same peculiar chalky odor. The analysis gave:

		Computed to 100 parts, without the water.
Combined water	1.297	.....
Silica	77.844	80.101
Alumina	13.510	13.901
Ferrous oxide	1.530	1.574
Lime	none	none
Magnesia	.307	.316
Soda } Potash }	3.993	4.108
	98.481	100.000

It is evidently related in composition to the Idzumi-yama group of minerals.

H. The Shira-kawa-chuchi.—This mineral—also, like the last, not from Idzumi-yama—is used in admixture with B and C in making the peculiar glaze for the "crackle" ware. It is white, with brownish

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Natural History of New York City, it was shown that the great mass of detrital conglomerates that extends from Haverstraw, on the Hudson, in New York, down through New Jersey and Pennsylvania, containing conformable beds of so-called trap (of which the Hudson River Palisades is one), called by Dana the Palisade Range, and deemed by him probably the American equivalent of the New Red Sandstone of England (possibly also partly of the Jurassic)—that this formation is composed, as to its sandy beds, chiefly of angular grains of an altered albitic mineral, and as to its finer shaly beds of disintegrated mica. Active, and even energetic incredulity being expressed, among geologists and mineralogists, Dr. Paul Schweitzer (then of the School of Mines, now of the Missouri State University) was led to make some analyses (which will be found in the *American Chemist* for July, 1871, p. 23). These confirmed in every respect the lithological determinations of the writer, as above stated. Though the bearing of these facts upon the matter in hand will not fully appear until the geological relations of these Japanese minerals shall come to be fully understood, it is thought that one of Dr. Schweitzer's many careful and valuable analyses will repay quotation, for the sake of comparison with that of the Sei-ji-chuchi above.

Combined water	0.82
Silica	77.70
Alumina	11.81
Ferric oxide	1.89
Lime	.55
Magnesia	.43
Soda	6.89
	100.09

Density, as determined by the writer at the time for Dr. Schweitzer, at a normal temperature, was 2.608: equivalent probably to about 2.62 at 0° C. This sample was one taken by the writer from quarries in the sandstone, under the Palisades, on the river-brink near Haverstraw.

bands and stains, finer-grained than G, but coarser than the Idzumi-yama group, porous, rough to the touch, but smearing slightly, adhering to the tongue, with the chalky odor and taste, and had a feeble flesh-color in powder after ignition. Isolated analysis of whole mass:

Combined water	.91
Silica	79.13
Alumina	16.44
Ferrous oxide	1.28
Lime	none
Magnesia	.24
Soda, Potash	1.49
Manganous oxide	.15
	99.64

J and K. The two Porcelain-bodies.—The mode of preparation of these for analysis has been before explained. The following table gives the figures obtained by absolute analysis, with the specifications of component parts as imparted to Dr. Wagener by the manufacturers:

	Egg-shell ware, containing: washed Tsuji-chuchi, 70 p. c.; washed Shiro-chuchi, 30 p. c.	Thick-body porcelain, containing: washed Shiro-chuchi, 50 p. c.; washed Sakaime-chuchi, 50 p. c.
Silica	78.763	74.545
Alumina	17.847	19.315
Ferrous oxide	.638	1.916
Lime	.213	.106
Magnesia	.029	.176
Soda	1.975	2.832
Potash	.203	.566
	99.668	99.456
Densities, at 0° C.	2.3367	2.3079

Examination of these figures, and comparison of them with the analyses of the washed minerals, shows that while the correspondence in the case of the egg-shell body is quite close enough to verify the formula given by the makers, in the case of the common porcelain there is quite a marked and decided departure from the composition that should follow from the specified mixture of components. Whether this discrepancy is due to variations in the composition of the Shiro- and Sakaime-chuchi (variations by no means improbable*), or to some other cause, it seems almost useless, under existing circumstances, to conjecture. The deficiency of silica and excess of

* Thus, the sample of egg-shell ware analyzed contains a quite appreciable amount of lime, more than found in the Shiro-chuchi, while in its other component mineral, the Tsuji-chuchi, no lime at all was found.

alumina, in the thick-body ware, over the minerals stated to enter into it, appears too large to be accounted for by the mere coating of Kudaruyama-chuchi, which is given before glazing; but this may nevertheless have had some influence. We must rest satisfied with the important verification presented by the analysis of the finer egg-shell ware, of the surprising fact that Japan porcelain, excelling all others, in important characteristics regarded as normal for porcelain *par excellence*, is made without the use of kaolin at all, or of any equivalent therefor; being compounded, as to its body, solely of petuntse-like or petrosilicious minerals. Indeed, the traditional principle,—so often repeated in the literature of the art, as a proverb of the Chinese,—that while "the petuntse constitutes the flesh of porcelain, kaolin must form its bones," is proved here to be altogether inapplicable. It may also be submitted that a common popular belief regarding Oriental porcelain in general,—which appears to have been altogether accepted since the celebrated memoir of Ebelmen and Salvétat was published, about 1850,*—that no essential technological differences exist between European and Oriental porcelain fabrication, should no longer be so implicitly accepted. As an example, Liebig and Kopp's *Jahresbericht der Chemie, etc.*, of 1850 (p. 643), says that "Salvétat and Ebelmen's results furnish the conclusion—in the highest degree interesting to civilization—that the Chinese porcelain industry, as regards the raw materials, the preparation of the mass, and the glazing of the wares, wholly corresponds with that of Europe." This interpretation of Ebelmen and Salvétat's results—which has been generally extended, in popular belief, to all Oriental porcelain—is really not fairly justifiable, in the opinion of the writer, by an examination of the original memoir of Ebelmen and Salvétat; even with reference to the Chinese porcelain of King-te-tching (which, with a large assortment of the raw materials used in that huge assemblage of porcelain-works, constituted the subjects of their research). These chemists, among other minerals, give analyses of a large number of petrosilicious minerals from King-te-tching, approximating to each other closely in composition, the average of which may be stated as follows:

		In 100, without water.
Combined water	3.	.....
Silica	75.	78.13
Alumina	14.	14.58
Soda	4.	4.17
Potash	3.	3.12
	99.	100.00

* *Annales de Chimie et de Physique* (3), xxxi., 257, and xxxv., 312.

with small amounts of iron, lime, magnesia, and sometimes manganese. The close resemblance to the Idzumi-yama minerals, except in the larger proportion of alkalies, is evident. In Ebelmen and Salvétat's memoir there appears no evidence that Chinese porcelain-bodies may not sometimes be made up of the above-mentioned petrosilicious minerals, with little or no admixture; while among the actual analyses of Chinese porcelain-bodies on record, several may be cited that approximate well to these minerals in composition.* Thus, Salvétat himself, in his *Leçons de Céramique*, vol. ii. p. 374, cites one such

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* Since this report has been put in type, I have been so fortunate as to encounter—in the course of renewed searches for facts bearing upon Oriental ceramics—a most important document, that had previously escaped me. In the *American Journal of Science* for March, 1871, p. 179, there is printed a letter from the distinguished geologist Baron von Richtofen, addressed to our American geologist, J. D. Whitney, under date of Shanghai, Nov. 17, 1869.

This letter absolutely confirms the deduction, drawn from chemical facts, in the above Report, that Chinese porcelains have also usually a strictly petrosilicious basis, as proved above for those of Japan. The inference would appear plain, from Richtofen's statements, that even the word kaolin is applied by the Chinese to an elutriated petrosilex.

Baron von Richtofen recounts a journey up the valley of the great Yang-tse River, in which he visited King-te-ching, and crossed a formation of "clayslates, with sandstones occasionally imbedded," which he describes as more than stupendous in magnitude and thickness; whose strata stand on edge with an E.N.E. strike, and with dips of 70° or 80°. He says,—

"I have to record the unexpected fact, that the material from which the porcelain of King-te-ching is made is taken from certain strata intercalated between these slates, and occurring at several places, separated from each other laterally, that is, at angles with the strike of the rocks. It is a rock of the hardness of feldspar (inferior kinds are not so hard), and of a green color, which gives it in some measure the appearance of jade, to which the Chinese, too, compare it. This rock is reduced, by stamping, to a white powder of which the finest portion is ingeniously and repeatedly separated. This is then moulded into small bricks. The Chinese distinguish chiefly two kinds of this material, both sold in King-te-ching in the form of bricks, and as either is a white earth, they offer no visible differences. They are made at different places, in the manner described, by pounding hard rock, but the aspect of the rock is nearly alike in both cases. For one of these two kinds of material, the place Kao-ling ('high ridge') was, in ancient times, in high repute; and, though it has lost its prestige since centuries, the Chinese still designate by the name Kao-ling the kind of earth which was formerly derived from there, but is now prepared in other places. The application of the name, by Berzelius, to porcelain earth, was made upon the erroneous supposition that the white earth which he received from a member of one of the embassies (I think, Lord Amherst) occurred naturally in this state. The second kind of material bears the name Pe-tun-tse ('white clay')."

Baron von Richtofen remarks furthermore that he purposed having laboratory examinations made; but if these have been made, I have not encountered the results.

Reference to a map of Asia shows that Arita, in Japan, is something over 800 miles almost E.N.E. from King-te-ching, and, therefore, on the prolongation of the strike of this Yang-tse Group of Richtofen; but whether this has any significance is at present, of course, but speculation.

of a Chinese porcelain (see No. 13 of the table below); and Laurent and Malaguti obtained, from the body of a white Chinese porcelain vase, figures not very wide of a felsite or petrosilex (see No. 14 of the table). Also some among the European porcelains have somewhat like compositions, as Nos. 8, 10, and 11 of the table. European porcelains, however, as well as some of the Oriental, differ from the Japan wares in being much more aluminous from the use of kaolin as a constituent, being hence also more refractory than the Chinese, as was remarked by Ebelmen and Salvétat.

The writer believes that he is at least justified in urging that the generally accepted belief regarding the modes of compounding the Chinese wares should be suspended until it can be reconsidered in the light of further information and chemical examination—when opportunity may occur—of proper samples.

In this connection it will be interesting to quote also (from Stanislaus Julien's work, in a note by Salvétat) an analysis of a sample of "*terre à porcelaine du Japon*," by Malaguti, as follows:

Silica	75.9
Alumina	20.0
Lime	.6
Potash	3.5
	100.0

Salvétat remarks upon this that it "is a petrosilex," and further that "it probably represents only *la composition de l'élément fusible*," a conjecture which readers of this present report may probably not accept readily. This might also have been one of the Idzumi-yama minerals, though the presence of potash instead of soda throws much doubt upon this supposition.

It is well known, from statements and from copies of native Chinese pictures given in Stanislaus Julien's work, that the Chinese petuntse, or petrosilex, is not used in the raw state, but goes through operations of pounding and flotation precisely similar to those applied to the Idzumi-yama minerals of Japan. The products thus obtained pass into Chinese commerce as concreted again into the form of bricks. Ebelmen and Salvétat give, in their memoir before referred to, analyses of one of these materials, called Yeou-ko, stated to be used at King-te-tching as an ingredient of glazes, in admixture with lime and ashes,—which will be quoted, not only because they analyzed both the raw and the washed mineral, but because they determined the density of the former also. They describe the raw Yeou-ko as a slightly greenish rock, scaly in

fracture, and containing minute pyritous cubes disseminated. It fused before the blowpipe to a white enamel. The analyses gave:

	Raw Mineral.	Washed Mineral.
Combined water	2.7	2.3
Silica	75.9	75.9
Alumina	13.9	14.2
Iron oxide	.7	.8
Lime	.4	.5
Magnesia	traces	traces
Soda	3.8	3.5
Potash	2.9	2.8
Manganous oxide	traces	0.3
	100.3	100.3

Density, 2.62.

The washed Yeou-ko, which is evidently substantially identical, excluding some small impurities, with the raw mineral, may be closely expressed by the following empirical formula:

$$O_{147}Si_{60}Al_{14}FeNa_8K_2.6H_2O.$$

This is given for comparison with an empirical formula similarly deduced from the washed portions of the Shiro- and Sakaime-chuchi above, the soluble silica in the latter having been computed out and eliminated, as *opal*. Provisionally, we may call this variety *shirolite*.

$$O_{146}Si_{61}Al_{14}FeNa_4.8H_2O.$$

The egg-shell body may be approximated to a like empirical constitutional type, thus:

$$O_{146}Si_{60}Al_{16}Na_4;$$

and the thick body, also, as

$$O_{150}Si_{60}Al_{18}Na_6.$$

As one more example, the purified, washed Tsuji-chuchi, which forms 70 per cent. of the egg-shell body, may be brought to a like relation, differing from shirolite by $2(SiO_2H_2O)$; thus:

$$O_{142}Si_{59}Al_{14}FeNa_4.6H_2O.$$

No intrinsic importance is attached to these empirical formulations, *per se*. They are merely interesting and convenient, as representing equivalent relations. With regard, however, to certain studies of the molecular volumes of these minerals, in connection with those of the porcelains, these formulæ have an essential importance. To forward such studies, with which the writer is greatly occupied, much care has been given to density-determinations of all these substances. But this branch of the subject is far from ripe for presentation in this report.

9. ANALYSES OF CHINESE AND EUROPEAN PORCELAINS.

[NOTE.—No pretense of completeness can be made for the following table; but some of the figures have been brought together here for the first time; and it is probably sufficient for purposes of comparison with the Japan wares.]

NUMBERS.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
ANALYSTS.	Laurent.	Laurent.	Laurent.	Laurent.	Laurent.	Müller of Prague.	Cowper.	Müller of Prague.	Müller of Prague.	Müller of Prague.	Vielguth.	Salvétat.	Salvétat.	Laurent and Malaguti.	Anonymous.	Cowper.	Cowper.
KIND OF WARE.	Sèvres, from 1770 to 1836.	Sèvres of 1843.	Vienna of 1806.	Berlin of 1808.	Meissen and Dresden, of 1825.	Berlin.	Berlin.	Bohemian.	Meissner.	Elgersburger.	Nymphenburger.	Chinese. First Quality.	Chinese. Third Quality.	White Chinese Vase.	Chinese Dish.	Chinese. First Quality.	Chinese. Inferior Quality.
Silica	58.0	58.03	61.5	66.6	57.7	71.34	72.96	74.80	60.03	72.77	72.80	69.00	73.3	70.50	73.50	71.04	68.96
Alumina	34.5	33.94	31.6	28.	36.0	23.76	24.78	21.09	34.53	24.53	18.40	23.60	19.3	20.70	28.50	22.46	29.24
Oxide of iron	.....	.....	.8	.7	.8	1.74		.....	trace.	trace.	2.50	1.20	2.0	.08	.08		
Lime	4.5	4.58	1.8	.3	.3	.57	1.04	.64	.....	.....	3.30	.30	.6	.05	.06	1.04	1.60
Magnesia	.....	.....	1.4	.....	.....	.19	trace	trace	trace	trace	.30	.02	trace	.01	trace	.....	.....
Soda	.....	.....	.....	.....	.....	.58	1.22	.58	1.35	1.61	1.84	2.90	2.9	.....	.....	1.22	.....
Potash	3.0	2.97	2.2	3.4	5.2	2.00		2.48	2.26	.94	.65	3.30	2.5	6.00	5.00		
Manganous oxide	.....	trace.	.....	.6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Totals	100.0	99.52	99.3	99.6	100.0	100.18	100.00	99.59	99.27	99.85	99.79	100.32	100.6	97.34	97.14	100.00	99.80
Densities	.....	.....	.....	.....	.....	.....	2.419	.....	.....	.....	.....	.....	.....	.....	.....	2.314	2.314

10. MICROSCOPIC STRUCTURE OF THE JAPAN PORCELAIN.

Ceramic microscopy bids fair to be a most important adjunct to ceramic chemistry, and no opportunity should be lost of attaining facts in this branch. Learning that Dr. Alexis A. Julien, of the School of Mines of Columbia College, possessed the facilities for this kind of work, I requested him to make a section of the egg-shell porcelain, and contribute to this report a note upon its structure. He has kindly done so, as below, and has, furthermore, given me some notes, which I shall cite, from a memoir of Behrens, in *Poggendorff's Annalen*, recounting microscopic examinations of some Berlin porcelains (the cuts of which I have also had copied), and referring also to sections of what purported to be Japanese porcelain.

Ehrenberg long since observed that some porcelains examined by him consisted of a transparent vitreous mass, throughout which were diffused a greater or less proportion of small, opaque, rod-like bodies. These characteristic bodies are called belonites. Dr. Julien's notes from Behrens, with the cuts of the latter, will explain the character of these very satisfactorily. The cuts will be given first.

FIG. 2.—Part of a thin section of the bottom of a crucible of Berlin porcelain. x 1500.

Exhibits the rounded fragments of quartz and others still more rounded and inclosing glass cavities, surrounded by belonites.

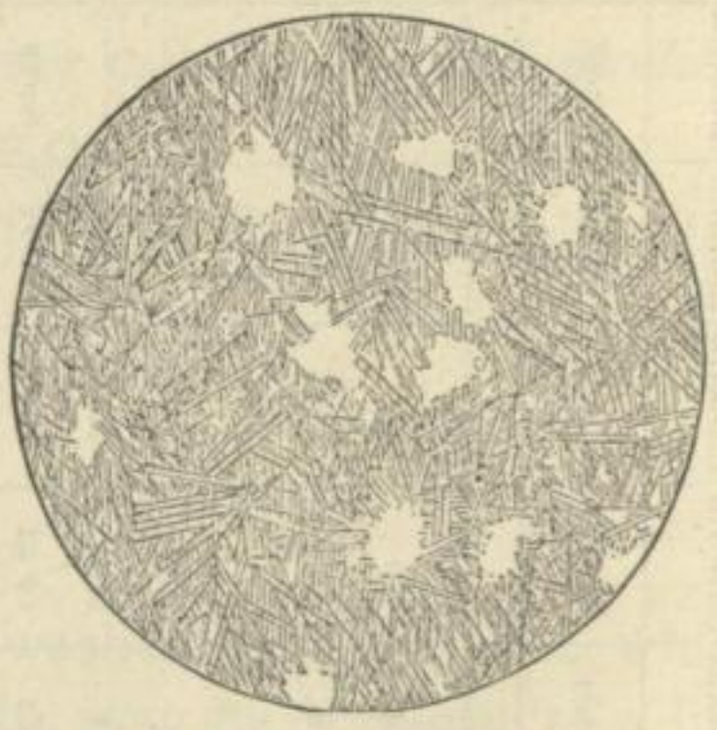

FIG. 3.—Part of a thin section of the cover of a crucible of Berlin porcelain. x 2000.

Minute granules scattered through the network of belonites.

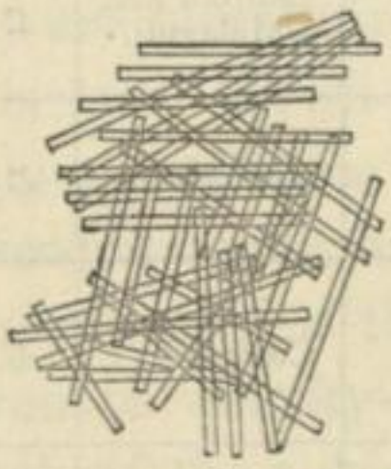

FIG. 4.—Same porcelain as Fig. 3, with a differently prepared section.

Exhibits belonites more highly magnified.

FIG. 5.—Same porcelain as Fig. 3.
Granules isolated and in groups.

ABSTRACT OF A SUPPLEMENT TO A PAPER OF H. BEHRENS, ON MICROSCOPIC STRUCTURE OF JAPANESE PORCELAIN. (*Poggendorff's Annalen der Physik und Chemie*, vol. cl. p. 397, 1873.)

Japanese porcelain is made up of the same constituent substances as European porcelains, but in relatively different proportions. The latter consist of the products of devitrification, termed belonites and granules, distributed in an irregular network, along with partially rounded fragments of quartz, through a colorless, limpid glass, the products of devitrification predominating in quantity over the quartz, and generally over the glass. In Japanese porcelain, however, it is doubtful whether the quantity of the quartz or that of the belonites is the larger, while the quantity of the glass is decidedly greater than that of the belonites. The belonites are exceedingly minute, rod-like little crystals, and in this porcelain are well formed, gathered in little bunches and radiating groups, and mingled with little, rounded granules, apparently of the same material. Quartz is present in abundance in little splinters, whose edges are somewhat rounded, and air-bubbles are distributed through the ware, especially in the thick layer of glaze, and are unusually large and generally of a circular outline in the sections. Both the chemical and microscopical examinations denote a content of silica only a little greater than that of European porcelain. In the manufacture of the body of this ware a large quantity of quartz has been employed, and a considerable proportion of kaolin has been added by means of the flux (feldspar), as shown by the beautiful development of the devitrification products. The rounding of the fragments of quartz, the large size and spherical shape of the air-bubbles, and their accumulation in the glaze, signify that the ware has been exposed for a short time to an intense heat, and that the glaze material is little more fusible than that of the body. A confirmation of this is found in the thistle-head bunches of belonites distributed through the thick layer of glaze, with similar bunches throughout the body,—an occurrence which is wholly wanting in European porcelain. Their position in the glaze is such as to suggest their origin in the body, out of which they appear ready to rise, as well as the quartz splinters, which also often occur in the glaze. Indeed, it is known that the Chinese heat their porcelain in little ovens, with quick fires.* The thickness of the glaze is partly due to exudation of the glass on the upper surface of the ware. The highly

* On the contrary, the Japanese use kilns of immense size. (See the *Japanese Sectional Catalogue of the International Exhibition of 1876.*)

esteemed translucency of Asiatic porcelain may be attributed to the smaller number of belonites and air-bubbles, not to greater care in manufacture than that bestowed on European porcelain.

It is plain that, if the samples of Behrens were really Japanese in origin, they were not of the species of porcelains selected for my analyses by Dr. Wagener, at Philadelphia. The presence of quartz in Behrens' ware is sufficient to prove this. Behrens' description and his comments are, therefore, of no direct value to us, and have no direct bearing on our special subject of investigation; and, indeed, seem more curious than useful.

It is otherwise, of course, with the figure and note we have next to present of Dr. Julien.

FIG. 6.

Explanatory Note by Dr. Julien.—Cross-section of surface of Japanese egg-shell porcelain at an indentation, with thicker glaze, near the bottom of the cup. At the left is the glaze, occupied by bubbles and cloudy bunches of belonites. The bubbles are circular, vary greatly in size, and on the surfaces of the section are partly filled with impurities due to the sawing and grinding of the section. On the right is a portion of the body, mottled by the more thickly-grouped bunches of belonites distributed through a glassy base, and containing many bubbles. Between the two, at *a*, is a cloudy and very thin belonite layer separated from the main body, on the one side, by a thin film of glass, containing few belonites, and having the larger bubbles of the glaze mostly attached to its outer side.

[*Additional Note by Author.*—On seeing the proof of the above Fig. 6, Dr. Julien indicated one important omission on the part of the engraver. The intermediate layer *a*, between the body and the glaze, being largely composed of minute belonites, should have been delicately shaded instead of being left blank.]

Dr. Julien's thin layer of belonites, *a*, between the main body and the glaze, doubtless indicates the preparatory coating of Kudaru-yama-chuchi or Kesso-chuchi, which is applied before baking, as a ground for the glaze and for the colors.

11. DENSITIES AND MOLECULAR VOLUMES.

As has been before remarked, this branch of the subject is not yet in a stage for complete discussion, and only some general preliminary remarks can be presented.

Two striking points are elicited very distinctly by the exceptionally exact density-determinations that have been made, of the porcelains and of the different preparations from the Idzumi-yama minerals; only a portion of which determinations have, however, been brought forward in this report. One of these points is doubtless new, and the other old. The latter relates to the changes of density or volume which occur during the baking of porcelain. Gustav Rose and Malaguti found that, notwithstanding the well-known contraction of mere bulk, which porous porcelain-biscuit undergoes in the kiln; with reference to actual solid or homogeneous volume, the operation of baking is accompanied by expansion. G. Rose found that the density of one porcelain (the pores being eliminated) was, before baking, 2.613, after baking, 2.452, a molecular expansion of 6.16 per cent.; while Malaguti found 2.619 before, and 2.242 after; a molecular expansion of no less than 14.4 per cent.

In the case of the Japan egg-shell porcelain, the 70 per cent. of Tsuji-chuchi, with density 2.6962, and the 30 per cent. of Shiro-chuchi, with density 2.6041, must make a raw mass of density 2.6686, while the burnt porcelain has 2.3367, an expansion of 12.44 per cent.; not much below that found by Malaguti. The material for the thick-body ware is, before and after baking respectively, 2.6041 and 2.3079, an expansion of 11.38 per cent. Thus we have here valuable and striking confirmations of this previously known but highly significant principle.

The other point relates to the natural molecular changes undergone by the Idzumi-yama minerals. The general tendency of the investigation has been to the probable conclusion that the alterations which have given rise to several of the different materials discussed above, have been rather changes of molecular constitution than of chemical composition; and, moreover, surprising to say (this being the novel fact alluded to), that these changes have been accompanied by remarkable condensations, or augmentations of density. The process of disintegration has been accompanied by a contraction of the molecules of the mass, explaining the porosity that occasions adhesion to the tongue. Thus, the whole mass of the Tsuji-chuchi has the density 2.685, while the more disintegrated portion—45 per cent. —from which the porcelain is made, has the higher density 2.6962.

Therefore the harder and less disintegrated portion (55 per cent.) must have the lower density 2.6758; a molecular condensation, on the part of a portion of the mass, of nearly 1 per cent. In this case the change has been small, but in other cases it has been larger. Thus the harder portion of the Indo-chuchi showed a density of 2.489, and the medium portion, not including the finest, as high as 2.6032, a condensation of 4.4 per cent. of volume. Several other similar facts were made out; and the writer has been led to ask the question, whether changes merely of condition of molecular aggregation may not be commoner, and more influential in shaping and conditioning the external surface of the earth, than has been supposed. A little consideration shows that in metamorphic and volcanic rocks, the extant constitutional equilibria of crystallized minerals having been established at temperatures and conditions of expansion greater than are normal at the surface, such equilibria are very likely to be unstable at the surface and at lower temperatures; and, in readjustment, the new equilibria assumed should be those of more condensed molecules. Contraction and porosity must result, admitting water and oxygen, and other modifying and disintegrating subaërial agencies, into the interior parts of great masses of rocks previously compact and impermeable. Hence hydratation, oxidation, kaolinization, some kinds of amorphism of rocks, and even some important large geological transformations, are more readily explicable than has been possible on previous hypotheses.

The writer finds himself readily able, on looking attentively into the phenomena, to bring the formation of ordinary kaolin and the like minerals, under this new generalization. Thus the ordinary density of normal kaolinite $Al_2O_3.2SiO_2.2H_2O$ is 2.6 or higher, notwithstanding the 14 per cent. of water it contains. There is every reason to believe that this water is present as ordinary water of crystallization, the density of which has been proved by our American chemist, F. W. Clarke, of Cincinnati, to be 1.3081.* It is easy thus to prove, therefore, that the density of normal kaolin, without its water, is at least 2.81, while the highest determinations of all that have been made, for all the feldspars, are as follows:

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* *American Journal of Science*, [3] vol. viii. p. 428. Professor Clarke showed that the molecular volume of the water of crystallization in thirty-one hydrated salts was nearly the same, the average being 13.76. Dividing 18, the equivalent of water, by this, gives us 1.3081, the density of water of crystallization, by this determination.

Orthoclase (Breithaupt's *loxoclase*)	2.62
Albite (Rammelsberg's *hyposclerite*)	2.63
Oligoclase (v. Rath, from Albula)	2.72
Andesite (Delesse, from Chagey)	2.736
Labradorite (Sterry Hunt, Montarville)	2.74
Anorthite (Streng, Hyffhauser Mts)	2.77

Only two or three cases are known of feldspars of greater densities than these (some rare varieties, classed as labradorites), which, as exceptional cases, have no bearing on our argument. We thus arrive at the novel and surprising fact that in ordinary kaolinization of feldspathic rocks there is a great molecular condensation of matter.

Some space has been expended upon this subject, to furnish an instance of the high interest and importance (destined to be a governing importance in the future) that attaches to this study of molecular condensations and expansions, as yet almost untouched by chemists. To follow the subject further would not be pertinent to this report. Together with many other questions that have been raised by this investigation, and many further interesting facts developed therein, it must be reserved for further communications, that it is hoped may hereafter be made to the scientific world, as sequences of this present report.

PORTLAND, ROMAN, AND OTHER CEMENTS AND ARTIFICIAL STONE.

BY GEN. Q. A. GILLMORE, U.S.A.

In the masonry construction of the ancients bitumen was largely employed for cementing together the bricks and stones and filling the interstices between them, and "slime for mortar" (bitumen) was used in building the Tower of Babel. According to Herodotus, the walls of Babylon were composed of bricks united together with hot asphaltum. An analysis of some mortar taken from the pyramid of Cheops shows that the Egyptians used a mixture of lime and sand, proportioned about like the common lime-mortar of the present day, and the writer has seen mortar of a similar character taken from the aqueducts of ancient Rome.

Both Pliny and Vitruvius speak of the admirable properties of the natural Italian pozzuolanas as exhibited in the marine constructions of the Romans extant in their day, and in using this material there is perhaps no better formula than that recommended by Vitruvius

himself, which has been very generally followed down to the present century throughout Italy, and at Toulon and other ancient ports on the French coast. It consisted, when required for mortar, in mixing together and tempering with water 12 parts of pulverized pozzuolana, 6 parts of clean silicious sand, and 9 parts of recently slaked lime. To this was added 6 parts of broken stone fragments, when it was intended to be used for a *pisé*, or a filling, as concrete or béton is used in the open air at the present time. Such a combination, with thorough manipulation and proper treatment, should give good results, comparing favorably with those now obtained with feebly hydraulic lime and sand.

What is known as Dutch trass closely resembles the Italian pozzuolana in its composition, and is used in the same manner, its principal ingredients being silica and alumina, with a large preponderance of the former. It has long held an important place among the building materials of the Netherlands.

This class of materials, comprising, besides those already named, the arènes, some of the ochreous earths, and the sands of certain grauwackes, granites, schists, and basalts, and sometimes furnace-slags and burnt clay, were largely depended upon, throughout the civilized world, where hydraulic lime could not be procured or had not been discovered, for conferring in a feeble degree the hydraulic property upon mortars, until about the beginning of the present century. It is one of the popular errors of the day to suppose that the mortars used by the builders of former centuries were more enduring than those of the present age. Such is not the case, and no proof of it is furnished by any existing or historical evidence respecting their character, restricted as such evidence mainly is to aqueducts, sewers, and other subterranean works that have not been exposed to the disintegrating action of the elements. On the contrary, they have been found almost invariably accompanied by conditions extremely favorable to their indefinite preservation. By the use of hydraulic cement we are able to produce a mortar of greater strength and hardness, and possessing when only a few months old more of the acknowledged characteristics of durability, than any that the researches of antiquarians have ever brought to light.

The discovery of the natural cements about the beginning of the present century was a great step in advance, but even that event appears to have been erroneously regarded at the time as simply the rediscovery of a lost art, and the article first produced was called Roman cement, a name now generally applied to all natural quick-setting cements.

It was first made in England, by Parker, by breaking up and burning, and then grinding, the argillo-calcareous, kidney-shaped stones called septaria, found in the Kimmeridge and London clay, gathered upon the sea-shore after storms, or obtained by digging. They vary considerably in their composition, generally containing not far from 70 per cent. of carbonate of lime, 18 to 25 per cent. of clay in which the silica predominates, less than 3 per cent. of carbonate of magnesia, and some oxide of iron. Stones of similar character were found and used for the same purpose in France and Russia.

The Roman cements gave such satisfaction that attempts to manufacture them by burning an artificial mixture of chalk and clay soon followed, at first with varying success, but finally culminating in the discovery of the superior results obtained by burning a mixture of definite proportions at a high heat, and the consequent production of Portland cement from clay and chalk, and Vicat's cement from clay and lime. The former was called Portland cement from its resemblance in color to the English Portland stone. The latter took the name of its discoverer. It was also ascertained that besides the nodules of septaria there were numerous and extensive beds of argillaceous and argillo-magnesian limestones which, by burning and grinding, would yield a good natural quick-setting cement.

A new and important industry at once sprung into existence. For some years after the method of making Roman cement was discovered, the chemists failed to detect the elementary source of the hydraulic property, Guyton de Morveau believing it to be oxide of manganese, while Mr. Vitalis, of Rouen, in 1807, declared the presence of that mineral to be unnecessary. This was proved, indeed, by the fact that it was not invariably present in the Roman cements made from the septaria. In 1813, Descotels, engineer of mines, attributed this property to silex, which was of course true with respect to certain silicious limestones like that of Teil. The combinations due to alumina in connection with silica were detected about the same time, and when Vicat, a French engineer of roads and bridges, published his memoir on the subject in 1818, the accepted theory was that the hydraulic energy was conferred by a certain proportion of clay in the limestone, and Vicat was the first to prove by experiment that an artificial mixture of carbonate of lime and clay, when suitably burnt, would yield a hydraulic cement as good as that derived from the natural stone. He established an artificial-cement manufactory not far from Paris, which since his death has been conducted by his heirs. It produces the celebrated Vicat cement, to which reference will hereafter be made.

In England this new and attractive industry, and the existence of inexhaustible supplies of the materials requisite for its remunerative development, quickly enlisted the attention of capitalists, and the shores of the Medway and the Thames soon became the seats of numerous and extensive manufactories of the best quality of Portland cement, which not only found ready markets both at home and abroad, but for some time practically monopolized the trade in the article and controlled its price. In 1856 competing works were started in France, at Boulogne-sur-Mer, and subsequently at other places on the continent of Europe.

The United States, being plentifully supplied with the argillo-magnesian and to some extent with the argillaceous limestones suitable for making Roman cement of good quality, and having had, since 1830, a considerable amount of capital invested in its manufacture in the Atlantic States, the valley of the Ohio, and elsewhere, with an increasing demand for the product at remunerative prices, were slow to adopt the use of the more costly though superior article, and it was not until after the close of the civil war that the importation of Portland cement received any encouragement. It was first used here upon government works, and subsequently in the manufacture of artificial stone by the Coignet process. Within the last two or three years the importations have amounted to about 20,000 tons (100,000 barrels of 400 pounds) per year. Within the same period, however, two Portland-cement works of moderate capacity have been started in Pennsylvania, and a third—organized on a liberal basis, in the expectation of a large demand—expects to begin manufacturing in the State of New York in a few months. It is probable, therefore, that after the close of the coming winter very little if any foreign Portland cement will find a market in the United States, except in the Pacific States, where it will be procured by direct importation.

CALCAREOUS CEMENTS.

This term, in its most comprehensive sense, embraces all the articles commonly employed as the cementing material or matrix in the mason's art, and therefore includes common lime, hydraulic lime, and hydraulic cement.

COMMON LIME.

No descriptive definition of common line is deemed necessary here, and there is nothing connected with the contributions of this material by exhibitors calling for special mention as evidence of progress in its manufacture, except what may more properly be referred to when

describing the recent improvements in kilns used for burning lime, cements, and the products of the ceramic art.

HYDRAULIC LIME.

Hydraulic lime is obtained by burning and slaking an impure limestone containing 12 to 20 per cent. of silica, or clay in which silica predominates. If silica only, or a clay containing very little alumina, be present, the product is called silicious hydraulic lime, and when otherwise, argillaceous hydraulic lime. The slaking is usually done by the sprinkling process. A species of hydraulic lime is also produced by burning and slaking some of the varieties of argillo-magnesian limestones. They are less valuable than those derived from the silicious and argillaceous limestones.

PAVIN DE LAFARGE, *Teil, France.*
SOULLIER & BRUNOT, *Teil, France.*

The hydraulic lime of Teil, on exhibition, is manufactured from the quarries of silicious limestone at Teil, canton of Viviers, department of Ardèche, France. These quarries have been worked for several centuries. They belong to the lower Neocomian marls of the cretaceous formation. The stone contains from 80 to 81 per cent. of carbonate of lime, about 13 per cent. of silica, and a little less than 2 per cent. of alumina, the other ingredients being less than 2 per cent. each of the carbonates of magnesia and iron, and a little sand. The stone is burnt with coal in continuous or perpetual kilns, at a heat just sufficient to expel the carbonic acid without vitrifying any part of the stone, and when drawn is spread out in thin layers and sprinkled with water from a hose. The sprinkled lime falls into powder, and is then shoveled into heaps, and the slaking is completed by the aid of the steam evolved. It remains in these heaps for about ten days, and is then passed through a screen made with No. 40 brass wire, 50 to the lineal inch each way. The product thus obtained is the hydraulic lime of Teil. The residue which does not pass through the screen, consisting of particles of various sizes, from that of a small pea and under, is made up of free lime and the compounds of silica, alumina, and lime, but they do not contain sufficient free lime to cause slaking in the presence of water. This residue, when reduced to powder by grinding, constitutes the natural Portland cement exhibited by Messrs. Pavin de Lafarge and Messrs. Soullier & Brunot. Both of these establishments also exhibit the Teil hydraulic lime.

The current prices, delivered at Marseilles, are for the lime 32 francs, and for the Portland cement 50 francs, per ton of 2204 pounds,

in sacks, the sacks to be returned to the manufacturer. If packed in barrels, the lime is 48 francs per ton, and the cement 65 francs, gross weight, the barrels becoming the property of the purchaser.

The works of Messrs. Pavin de Lafarge are located on the bank of the river Rhone, at the base of the opened quarries. They contain 34 continuous lime-kilns, each having a daily capacity of 130 cubic yards of lime. The aggregate daily consumption of coal is 100 tons. The establishment also contains 30 screens, 31 pairs of millstones, 5 steam-engines, 1 water-wheel, and is well supplied with all other appliances, such as trucks, cranes, weighing-scales, etc., for handling the lime. It gives employment to 600 men, and manufactures its own fire-brick, about 2000 tons annually, for lining the kilns.

The average annual production of the works is 100,000 tons (2204 pounds) of the screened lime and 10,000 tons of Portland cement.

In the organization and management of the business, ample provision seems to have been made for promoting the health and comfort of the workmen, and for encouraging habits of industry and thrift.

For the men without families quarters are provided where meals are served, *à la carte*, on checks or counters supplied by the overseer on account of each man's monthly pay, and the scale of prices is such that a prudent man can live at a cost of 25 to 30 cents per day, including a moderate allowance of common wine. This allows for 3 meals per day. The men are lodged and provided with beds for about 1 cent each per day. Of the 600 workmen 250 are unmarried, and are provided for in this manner. The men with families are quartered near by in a village belonging to the company, in which there is a grocery, a bakery, and a clothing-store, where all the workmen are allowed to supply themselves. Provisions are advanced on credit without charging the consumer with interest.

A savings bank is provided in which the workmen may deposit their money, in any sum from 1 franc to 1500 francs, upon which 4½ per cent. interest per annum is allowed. In March, 1876, the bank contained 60,000 francs belonging to the employés.

A sick fund presided over by the heads of the firm, aided by a committee of management composed of clerks and workmen, is maintained by retaining 1½ per cent. of the earned wages, to which the establishment itself contributes a sum equal to one-fifth of the amount stopped from the men. From this fund pensions are paid to the aged workmen and to the widows of workmen, and assistance is given to the sick during their absence from the works. A hospital is provided for men without families when sick. A school-house for the children, and a church and minister, are also provided.

HYDRAULIC CEMENTS.

The hydraulic cements, after burning, do not, like the limes, slake in the presence of water, and have therefore to be reduced to powder by grinding. They may all be arranged in two comprehensive classes, viz.:

1st. The heavy, slow-setting cements, both natural and artificial, produced at a high heat. This class embraces the Portland and the Vicat cements; but as the difference between the two rests more upon a single, although distinctive, variation in the process of manufacture than upon the character of the cement produced, it is deemed proper for the purposes of this brief description to include both under the general designation of Portland cement.

2d. The light, quick-setting natural cements, such as the Grenoble, the Rosendale, the Louisville, and other Roman cements.

PORTLAND CEMENT.

Portland cement is produced by burning, with a heat of sufficient intensity and duration to induce incipient vitrification, certain argillaceous limestones, or calcareous clays, or an artificial mixture of carbonate of lime and clay, or of lime and clay, and then reducing the burnt material to powder by grinding.

There were four methods of making this cement represented in the Exhibition. They will each be briefly described, although some of the manufacturers expressly declined to furnish the information asked for concerning the details of their process, while others have not responded to the inquiries addressed to them on the subject. Enough is known, however, with respect to the materials employed and the details of the treatment to which they are subjected, in the several modes of manufacture, to enable those who have given the subject any intelligent attention to understand their essential and distinctive features. It is not practicable for manufacturers to derive any advantage from withholding information on this subject.

1st Method. By this method the cement is produced by burning at a high heat an argillaceous limestone containing from 77 to 80 per cent. of carbonate of lime and 20 to 23 per cent. of clay, and then grinding the burnt material to a fine powder between millstones.

The stone should be a homogeneous and intimate mixture of its constituent ingredients, and the clay in it should contain at least 1½ to 2 parts of silica to 1 of alumina. There are generally present, also, carbonate of magnesia and oxide of iron in small quantities, and sometimes a small percentage of the alkaline compounds, but the

stone should contain not less than 94 per cent. of the essential ingredients—the carbonate of lime and clay—in order to yield a Portland cement of first quality. The presence of carbonate of magnesia becomes seriously objectionable when the amount exceeds 2½ to 3 per cent.

Only two localities were represented by this method of manufacturing Portland cement, viz., Teil, in France, and Coplay, in the United States, near Allentown, Pennsylvania. The Teil cement is produced in the process of making the hydraulic lime of that locality, as already described.

The Coplay Cement Company, *Allentown, Pa.*

The Coplay Cement Company exhibited three brands of cement, viz., Saylor's Portland cement, Coplay hydraulic cement, and Anchor hydraulic cement, all made from an argillaceous limestone quarried at Coplay, about six miles from Allentown. The two last named are light, quick-setting cements. For several years the Coplay hydraulic cement, which is quick-setting and good of its class, has been made from this stone by burning it in perpetual kilns, at a lower heat than that necessary to produce good Portland cement. In making the Anchor cement, a certain small proportion of the raw stone is ground up with the burnt cement to give it a darker color. It also renders it more easily worked by the masons, and does not impair its strength. The stone is not a homogeneous mixture of the constituent ingredients, and when burnt at the high and long-continued heat which Portland cement requires, it yields a heterogeneous mixture, containing Portland cement, common quick-setting cement, and common and hydraulic lime. In the process followed in making Saylor's Portland cement, the raw stone is first finely ground between millstones, in order to obtain a homogeneous mixture of the ingredients. It is then tempered stiffly with water, and formed into lumps or balls of irregular shape of from 3 to 5 pounds weight, which after partial drying are burnt at a high heat in upright intermittent kilns, in layers alternating with layers of anthracite coal; about sixteen days being consumed in charging, burning, cooling, and drawing the kiln.

The establishment contains 3 kilns for burning the Portland cement, and 4 for the light cements, with ample grinding-power driven by steam. The largest production in any one year has been 52,000 barrels (of 300 pounds) of the light cements. The present yearly capacity is 70,000 barrels of the light cements, and 12,000 barrels (of 400 pounds net) of Portland cement. When running full, employment is given to 50 men and boys.

At Seilley, France, Portland cement is made by a mode similar to that pursued at Teil, but none of it was on exhibition, and no further reference to it will be made.

2d Method. Argillaceous chalk of the same composition as the natural stone above mentioned is used for making cement by the second method, and either the "wet process" or the "dry process" may be followed.

By the wet process the argillaceous chalk is mixed up with a large quantity of water in a circular wash-mill, provided with heavy iron harrows, attached to the horizontal arms of a vertical revolving shaft, to secure a thorough reduction of the more solid particles to an impalpable paste. When a thorough and intimate mixture is thus effected, the semi-liquid mass is conducted away to large, open reservoirs, where it is left to settle. The clear water as it rises to the surface, or as the heavier materials subside, is drained off, and the raw cement, which remains, is allowed to become partially dry and hard by the evaporation produced by exposure to the atmosphere.

While the mixture is in the reservoirs samples of it are taken from time to time and made into cement in sample-kilns, to verify the correctness of the proportions of carbonate of lime and clay. If any error in this particular is discovered it is corrected by washing in new material containing an excess of the deficient ingredient, or sometimes by mixing together the contents of two or more reservoirs.

When the raw cement has attained, by drying, the consistency of very stiff clay, it is turned up to the air by shovelfuls, and, after further drying to about the condition of bricks when ready for the kiln, it is burnt. Large ovens are generally used for drying the mixture in extensive works.

By the dry process the calcareous clay is ground up in a circular mill, under edge-runners, with just sufficient water to render it somewhat softer than mason's mortar, and is then partially dried by natural or artificial means,—preferably in large, shallow pans, or upon a drying-floor underlaid with steam or hot-air flues.

When it has become sufficiently stiff, it is moulded into irregular-shaped balls by hand or passed through a brick-making machine, and is then further dried to the condition suitable for burning.

In burning, the material requires to be subjected, for several hours, to a heat sufficient to produce incipient vitrification, in either perpetual or intermittent kilns. Throughout Europe the prevailing custom is to burn with gas-coke or anthracite coal in upright, bell-shaped intermittent kilns, the raw cement and the fuel being placed in the kiln in

alternate layers and fired from below. The kiln is charged through side doors, which are kept tightly closed during the process of burning. The burnt cement, called "clinker," is of a dark-greenish color, and the pieces are much contorted and shrunken from the effects of the heat.

LONQUÈTY & Co., *Boulogne, France.*

The only locality known by the writer to furnish the material for making Portland cement by the second method is near Boulogne-sur-Mer, France, where the extensive establishment of Messrs. Lonquèty & Co. is engaged in this important and growing industry. The raw material employed is found in the Inferior Cretaceous formation, and consists of an argillaceous chalk, containing from 76 to 82 per cent. of carbonate of lime and 18 to 24 per cent. of clay. The deposit is sufficiently soft to be excavated with a pick and shovel.

The chalk is first reduced to a very liquid paste by the wet process. It is then carried to the mixing apparatus, where a small percentage of certain other ingredients, of which the exact character and amount are not known to the public, is incorporated with it. The paste is then conveyed to large reservoirs, where a partial drying ensues, which is subsequently finished in drying-kilns. It is then burnt in intermittent upright kilns with anthracite coal or coke, and at once ground and packed in barrels for the market.

The company began manufacturing in 1856, and the amount of capital now invested in the business exceeds half a million of dollars. The principal works are at Marais, in Boulogne, which contain 30 kilns for burning the cement, 84 drying-ovens, and 24 sets of millstones, and, when running to their full capacity, produce 70,000 tons (of 2204 pounds) of Portland cement annually, and give employment to 637 workmen. The company carry on less extensive works at Chatillons, in Boulogne, and also at Nesles, near the city, where the quarries which supply the argillaceous chalk are located. At these two works 14 cement-kilns and 8 drying-ovens are operated, and 184 men employed.

The aggregate yearly capacity of the three works is 100,000 tons of cement.

3d Method. This yields an artificial Portland cement by mixing together the carbonate of lime and clay. It is especially adapted to localities where chalk or soft marl abounds, although it is also applicable where the compact limestones have to be employed. Any pure, or nearly pure, limestone will answer, although it is well to remember that the large consumption of power involved in the reduc-

tion of the hard carbonates to powder places them under a disadvantage which practically excludes their use in regions which supply chalk or tender marl. Suitable clay is of much more rare occurrence than suitable limestone, for the reason that it must contain the silica and alumina in a certain condition of comminution and in certain proportions; otherwise it will not produce good Portland cement.

When the calcareous ingredient is chalk, the wet process, already described, is usually followed, but the chalk, especially if it contains flint, should not be allowed to mingle with the clay until it has passed a fine wire sieve.

All the English Portland cements are made by the wet process, with a mixture of either the white or the gray chalk, and clay procured from the shores or dredged from the bottom of the Medway or Thames. These are pulverized and mixed together in a circular wash-mill, and subsequently treated in the manner already described for the second method.

One manufactory is located at Birkenhead, and there are several on the Thames, in the neighborhood of London. Those represented in the Exhibition were Francis & Co., Hollick & Co., A. H. Lavers, the Wouldham Cement Company, and Eastwood & Co., all of London.

EASTWOOD & CO., *London, England.*

Eastwood & Co. exhibited specimens of cement formed into shape for testing, but no cement-powder, and as the age and history of the moulded specimens are not given, it has been impossible to ascertain their strength and hardness at any given age, or to fix, with any certainty, their comparative value. The specimen briquettes are dense and hard, and it may, perhaps, be assumed that the cement of which they are made is of good standard quality.

FRANCIS & CO., *London, England.*

Francis & Co. employ 200 men, and their works have a yearly productive capacity of 20,000 to 30,000 gross tons. It is expected that the capacity will be more than doubled during the present year by additional works, of which the company is about to take possession. The Parian cements manufactured and exhibited by Francis & Co. are of two grades,—the superfine quality and the second quality. They are both of superior excellence and strength. The base of all Parian cements is calcined gypsum. They are suitable for interior use only, and are not hydraulic.

Wouldham Cement Company, *London, England.*

The Wouldham Cement Company operate 16 kilns and 6 sets of millstones, producing about 18,000 tons of Portland cement annually, and giving employment to about 250 workmen. The specimen exhibited stands high on the list for crushing strength.

A well-known manufacturer of Portland and Parian cements, in London, in reply to inquiries addressed to him on the subject, estimates that there are from 30 to 40 cement manufacturers in Great Britain, that the capital employed in the business cannot be far short of £1,500,000 sterling, and the total annual production 650,000 to 700,000 tons, giving employment to about 5000 men. This includes all descriptions of cement,—the Portland, Roman, Parian, and Keene. The total quantity produced other than Portland is comparatively small.

Scanian Cement Company (limited), *Lomma, Sweden.*

Sweden was represented by an artificial Portland cement, manufactured after this method, by the Scanian Cement Company (limited), from cretageneous chalk and clay, at Lómma, near Malmö. It is made by the wet process, and burnt with coke made on the spot from English coal. The German upright kilns are used, and they are fired intermittently. Brick-making and the quarrying of limestone for export are carried on by the same company. All the work of the establishment is done by the job or piece, and gives employment to from 300 to 400 men. No women are employed. The production of 1874 was valued at $138,900 gold, and comprised 16,000 barrels of Portland cement, 5,000,000 pieces of bricks, roofing, and drain-tiles, and 610,000 cubic feet of quarried limestone. In 1875 38,000 barrels of Portland cement were produced. A sick fund and a library have been established for the benefit of the workmen.

With hard limestone the dry process is usually adopted, the raw materials—the stone and the clay—being first kiln-dried at 212 degrees Fahrenheit, or above, in order to expel moisture and prevent caking in the mill, and otherwise facilitate grinding and sifting. After being dried the two are mixed together in suitable proportions, already indicated, and reduced to fine powder. One kind of machine will not suffice for grinding the raw materials economically. In some of the German manufactories three are used, viz.: (1) a stone-crushing machine, which delivers the materials in pieces not larger than a walnut; (2) a further reduction is secured by a vertical mill or edge-

runner; and (3) it is then ground between horizontal millstones to a powder, of which 90 per cent. should pass a wire screen of 80 fine wires to the lineal inch.

The mixed and powdered materials are then tempered to a stiff paste in a brick-machine, and formed into bricks of suitable size for burning, the mixture being kept warm with coils of steam-pipes during this process. In some cases the liquid used for tempering is not pure water, but a mixture formed by adding to 100 parts of water from 3 to 6 parts of calcined soda, and 5 to 6 parts of newly-burned slaked chalk or lime, which is kept hot by coils of steam-pipes. The burning takes place at a high heat, as prescribed for the natural Portland cement.

THE WAMPUM CEMENT AND LIME COMPANY (limited), *New Castle, Pa.*

This company exhibited a Portland cement manufactured by the dry process, from an artificial mixture of fossil limestone and clay. Both are ground to powder and mixed in the proper proportions with water, formed into bricks, dried in ovens, and then burnt with coke at a high heat in intermittent kilns. The works have been started within the past year, and contain at present but one kiln and one run of stone. They have been planned for a capacity of 30,000 barrels per year, but cannot produce more than 10,000 barrels with existing appliances.

WILLIAM MCKAY, *Ottawa, Canada.*

Mr. McKay exhibited a cement made in a sample-kiln, with a mixture of shell-marl, clay, and carbonate of soda. The marl and clay are first dried, and finely pulverized separately. Fifty (50) parts of the clay are then mixed with 57 parts of a hot solution formed by boiling together 100 parts of lime-water, 3 parts of the carbonate of soda, and 1 part of extract of wood-ashes. With this clay-mixture, while hot, 120 parts of the pulverized marl are thoroughly incorporated. This is then properly dried, and burned in any suitable kiln. The cement has, as yet, been manufactured only experimentally. The essential ingredients—the marl and clay—are said to exist in abundance near Kingston, Canada. In tensile and compressive strength this cement compares favorably with the Portland cement of medium quality.

4th Method. In this the carbonate of lime is burned and slaked before the clay is added, and the proportions are correspondingly varied by making the proper allowance for the loss of weight at this first burning. In the incorporation of the ingredients and the prepa-

ration of the mixture for the kiln, either the dry or the wet process may be followed. In the final burning, however, the heat need not be continued so long as has been found necessary in the first, second, and third methods, inasmuch as the carbonate of lime has previously been reduced to quicklime at the first burning.

The celebrated Vicat cement, exhibited by an importer, and, therefore, not deemed entitled to an award, is produced by this method in France. The Vicat cement is usually superior in quality to the average Portland cements manufactured from carbonate of lime and clay (although the sample on exhibition did not attain to that standard), and commands a correspondingly higher price in all markets where it is known.

TOEPFFER, GRAWITZ, & Co., *Stettin, Germany.*

The Portland cement exhibited by this firm is also made from an artificial mixture of lime and clay, and justifies by its excellence the opinion heretofore expressed, that this method of obtaining cement, if properly followed, will generally produce an article superior to that made with carbonate of lime and clay. The Stettin cement is burnt in large, periodical, upright kilns, with coal or coke. The establishment operates 14 of these kilns, employs 600 men, and annually produces from 130,000 to 200,000 barrels of cement, of 440 pounds, gross weight.

BORST & ROGGENKAMP, *Delfzijl, Netherlands.*

This firm exhibited a Portland cement of good medium quality, but no particulars with regard to the materials and process employed in its manufacture were supplied. The works were started in 1870, employ 15 workmen, grind with a 20 horse-power engine, and produce about 5000 gross tons annually. One-fifth of the entire production is exported.

C. SCHMIDT, *Riga, Russia.*

Russia was represented by the Portland and Roman cement of Mr. C. Schmidt. Both articles were creditable to the manufacturer. No detailed information concerning the process of manufacture could be procured. The yearly production of both kinds amounts to 60,000 barrels, for which about $300,000 is realized in the market.

BRUNO HOFMARK, *Port-Kund, Russia.*

Some Portland cement labeled *Bruno Hofmark, Port-Kund, Estland, Russia*, was also received and tested, and some cement tiles, similarly marked, were found to be very hard, strong, and well moulded. No

information with respect to the magnitude of the works, or the raw materials used, or the process followed in the manufacture, could be procured.

SOCIETÀ ANONIMA PER LA FABBRICAZZIONE DEL CEMENTO, *Reggio-Emilia.*

From Italy two hydraulic cements and some cement tiles were exhibited by the *Società anonima per la fabbricazzione del cemento*, etc., Provincia di Reggio-Emilia. Both articles possess merit, and are creditable to the manufacturer. The cements rank as light cements, of fair quality.

SOCIÉTÉ ANONYME DES CHAUX EMINEMMENT HYDRAULIQUES, *near Montélimar.*

From France some cement tiles, and a cement catalogued as Portland cement, were exhibited by the *Société anonyme des chaux éminemment hydrauliques de L'Homme d'Armes*, près Montélimar, but no information in detail concerning the process of manufacture could be obtained. The tiles are very hard, indicating excellence in the cementing material of which they are composed.

THE LIGHT, QUICK-SETTING NATURAL CEMENTS.

In the foregoing description some of the natural, quick-setting cements, known as Roman cements, have been mentioned, because it was deemed best not to separate them from the Portland cement catalogued under the same number and exhibitor.

The natural cements usually take the name of the place of manufacture. They are produced by burning at a heat just sufficient in intensity and duration to expel the carbonic acid certain argillaceous or silicious limestones, containing less than 77 per cent. of carbonate of lime, or argillo-magnesian limestone containing less than 77 per cent. of both carbonates, and then grinding the product to a fine powder between millstones. They can be and in France and England formerly were produced artificially by burning a mixture of lime or carbonate of lime and clay, prior to the discovery of the process of making Portland cement by slightly varying the proportions of the ingredients and burning the mixture at a high heat. The superior qualities of the latter, producing, as it does, a mortar possessing about four times the strength, at much less than twice the cost of the light, quick-setting artificial cements, gradually drove them from the market, and their manufacture soon ceased, and has never been resumed.

It is not expected, however, that the use of these natural cements will be superseded by that of the Portland. For certain purposes they are as necessary, not to say indispensable, at the present day, as they were when their introduction revolutionized the former methods of executing submarine constructions in masonry, by taking the place of the feebly hydraulic mixtures made from hydraulic lime, trass, or natural or artificial pozzuolana. They possess sufficient strength for the purposes to which they are usually applied, viz.: for massive concrete foundations, for the concrete hearting and backing of thick walls faced with brick or ashlar, and as the means of conferring the hydraulic energy upon mortar for ordinary stone and brick masonry. At the same time it must be admitted that for similar purposes good Portland cement, suitably diluted with common lime in order to reduce it to the strength of the quick-setting natural cements, is, in most localities, the least costly of the two.

For concrete foundations laid green in water, these quick cements are almost invariably to be preferred in the hands of ordinary workmen to those which set more slowly, for the obvious reason that most of them not only hold the sand by their unctuous and adhesive properties more tenaciously than the Portland cement, but their prompt induration arrests the washing effects of the water, and prevents the progressive separation of the sand and cement before it has had time to proceed far enough to produce serious injury to the concrete.

Most of these cements can be suitably burned in any kiln and by any method that will answer for common lime, although some of them require a higher degree and a longer application of heat than will usually suffice for the pure, or nearly pure, carbonates.

This type of hydraulic cement made a meagre display at the Exhibition, and some of the best known and most valuable brands—foreign and domestic—were not represented at all. It is somewhat remarkable also that, with one or two exceptions, no statistical information was submitted, so that this report has to be prepared in great measure from data previously in the possession of the writer.

The Cumberland Hydraulic Cement and Manufacturing Co., *Cumberland, Md.*

This company exhibited, by their agent, Mr. S. M. Hamilton, of Baltimore, Md., a barrel of their cement made from an argillo-magnesian limestone, quarried near Cumberland City, on Will's Creek, not far from its confluence with the Potomac River. The stone is burnt in upright continuous kilns, in layers alternating with layers of coal. It is an excellent natural cement of the light, active type, and

may be made either quick- or slow-setting at pleasure, by mixing together in suitable proportions the products of the different strata of the quarry.

The establishment contains 6 upright continuous kilns, and the fuel used for burning is the semi-bituminous coal of Alleghany County, Maryland. Four pairs of French burr-stones do the grinding. Provision is made for 2 additional pairs. A steam-engine furnishes ample power for the 6 sets of stones. A yearly producing capacity of 400,000 barrels of 300 pounds each is claimed for the works. The greatest production in any one year was 150,000 barrels. The works give employment to from 25 to 30 men.

CHARLES TREMAIN, *Manlius, Onondaga Co., N. Y.*

A light, quick-setting cement, possessing great merit, manufactured in the township of Manlius, from the tentaculate or water limestone which overlies the Onondaga salt group, also some articles moulded from a mixture of cement and sand, consisting of blocks of artificial stone, pieces of flagging, and ornamented architectural building-blocks in different colors, with leaves, fruit, and flowers in alto-relievo. The articles are well moulded, hard, and tough, giving evidence of the good quality of the cementing ingredient employed.

Some calcined gypsum for fertilizing purposes was exhibited by Mr. Tremain. This belongs to another group of exhibits, and is mentioned here simply because the two industries are carried on in one establishment and under one organization. It contains 13 kilns and 4 sets of 4½ feet millstones. The cement-works produced in 1874 50,000 barrels, and in 1875 48,000 barrels. They give employment, when running full, to 70 men, while the plaster-works require from 20 to 50 men, according to the demand and production. The plaster interest of this establishment is one of the largest in the United States.

THE ALLEN CEMENT CO., *Siegfried's Bridge, Pa.*

A light, quick-setting cement made from the argillo-magnesian limestone of that neighborhood. The cement is of good quality, and is an excellent representative of its type. It gave good results when tested, and from the testimony of those who have used it in important constructions, no doubt can be entertained of its practical value. The works contain 2 kilns and 2 sets of millstones, and have a productive capacity of 24,000 barrels. Their average yearly production since they were started in January, 1872, has been between 15,000 and 16,000 barrels. From 16 to 18 men are employed constantly. The mill is arranged for 2 additional sets of stones.

THE HOWE'S CAVE ASSOCIATION, *Howe's Cave, N. Y.*

Three brands of natural quick-setting cement, made from different strata of a ledge of argillo-magnesian limestone existing in that locality. The cement taken from one of the barrels is of good standard quality as a natural cement; that from the others of fair medium quality, well suited for ordinary building purposes requiring the use of hydraulic cement, but unable to stand so large a dose of sand as the one first named. A stratum of stone, contiguous to those which furnish the cement, yields a hydraulic lime, said to answer very well for making Scott's Selenitic mortar. It is not equal, however, for this purpose to the Burham, the Blue Lias, and the Barrow limes of Great Britain.

The works contain 4 cement-kilns and 1 of McCulloch's patent lime-kilns, and 2 run of stone. Their yearly productive capacity is 100,000 barrels. The largest annual production has been 35,000 barrels. The business was started in 1870, and gives employment to 22 men.

P. GAUVREAU, *Quebec, Canada.*

A natural quick cement, which is excellent of its kind. Of this cement Sir William Logan, in his geological report, says, "The stone contains a large proportion of clay. A specimen of the calcined and ground stone prepared for use by Mr. Gauvreau, of Quebec, gave 11.60 of water and carbonic acid, and the residue consisted of lime, 52.49; magnesia, traces; silica, 27.40; alumina and oxide of iron, 12.16; sulphate of lime, 7.95=100. The proportion of sulphate of lime is remarkable. It became in less than twenty-five minutes solid, after mixing with water."

A more detailed analysis by F. Able, chemist of the English War Department, gave results not differing materially from the foregoing. The analyses would seem to indicate that the cement would be improved in quality by burning it at a high heat, provided the stone is a homogeneous and intimate mixture of the ingredients.

The works contain 2 upright kilns, elliptical in horizontal section, burnt intermittently with wood fuel, and 2 sets of Excelsior millstones, each capable of grinding 75 to 80 barrels of cement in 10 hours. They are driven by steam-power. The largest yearly production has been 9000 barrels, and the average reaches 7000 barrels. The works employ from 15 to 18 workmen.

THOMAS GOWDY, *Limehouse, Ontario, Canada.*

A natural cement, suitable for the purposes to which quick-setting

cements are commonly applied, but requiring to be used with a somewhat smaller proportion of sand than some others in order to produce a mortar of superior quality.

The works contain 7 kilns, using pine-wood for burning, and one set of millstones, capable of grinding 65 barrels per day. The establishment produces yearly 5000 to 6000 barrels of cement, 150,000 bushels of common lime, and 1,000,000 feet of lumber, besides a quantity of lath and shingles.

Before awards were recommended for any of the hydraulic cements on competitive exhibition, samples were taken and carefully tested, under the direction of the writer, by Mr. James Cocroft, principal overseer of the fortifications on Staten Island, New York. Before testing, the samples were entered in a book with the names of the exhibitors, and also with numbers, and the numbers only were furnished to Mr. Cocroft with the specimens to be tried. He, therefore, had no knowledge of the locality or the establishment from which any particular cement was derived.

The directions were to mix the dry cement with an equal measure of clean sand, temper the mixture with water to the consistency of stiff mason's-mortar, and mould it into briquettes of suitable form for giving the tensile strength on a sectional area of 1½ inches by 1½ inches, equal to 2¼ square inches. These briquettes were left in the open air one day, then immersed in water for six days, and tested when seven days old. After obtaining the tensile strength in each case, the ends of the broken specimens were ground down to one-and-a-half-inch cubes, which were used the same day for obtaining the compressive strength by crushing. The results obtained by crushing, being regarded as the truest indications of relative value, were relied upon in recommending awards. Both the tensile and crushing strength per sq. in. are given in the following table, obtained respectively by dividing the tensile strength of the briquettes and the crushing strength of the cubes by 2¼.

The table also includes some English Parian cements tested in the same manner and with the same proportions of sand as the hydraulic cements, with the exception that the specimens were not immersed in water, but were kept seven days in the open air and then tested.

The manner of producing the Selenitic mortar introduced into the table is given elsewhere.

In further explanation of the table it may be well to state that although it shows, beyond question, under the conditions named, the absolute crushing and tensile strength of the several mortars at the

age of seven days, and hence with a close approximation to accuracy the relative values for building purposes of all the specimens of cement exhibited, it may not correctly indicate the relative merits of the customary productions of the manufactories represented. Some of them may have used especial care in preparing the articles exhibited, while others may have sent average samples from the stock on hand.

The quality of the well-known English Portland cement is fairly represented in the table, while that of Lonquèty & Co., of Boulogne, is not; for they have on more than one occasion sent to the American market by the cargo a better article than the sample exhibited.

The Scanian cement, from Sweden, was exposed to the air three months in a loose pile on the floor before it was tested, and it may have been injured thereby. The results obtained with it were considerably lower than those previously reported by a Swedish engineer.

The deductions to be drawn from the table may be objected to on the ground that a sufficient time for the several cements to arrange themselves in their order of merit was not allowed between the time of mixing and the time of testing the mortars. There is some force in such a criticism, although very little, and not enough to impair the general accuracy of the table, or to justify any doubts of the correctness of the recommendations for awards. The experience of the writer has convinced him that all possible mixtures of Portland or of natural quick-setting cements, with or without sand, with much or little water, if arranged in the order of their crushing strength at any time after they are six to seven days old, will, as a rule, remain in that order throughout all subsequent induration. The exceptions would apply only to cements differing very little from each other in strength when about a week old.

TENSILE AND CRUSHING STRENGTH OF PORTLAND, ROMAN, AND OTHER CEMENTS.

The tensile strength was obtained on a sectional area of 2¼ square inches (1½ in. by 1½ in.), and the crushing strength with 1½ inch cubes. The materials were moulded in the plastic state like stiff mortar, and tested when seven days old. The hydraulic cement specimens were kept in water the last six days. The Parian and Selenitic cements were not put into water.

No.	KIND OF CEMENTS.	Proportions of Dry Ingredients.	Tensile Strength per Square Inch. Average of Several Trials.	Crushing Strength per Square Inch. Average of Several Trials.
	PORTLAND CEMENTS.			
1	Toepffer, Grawitz, & Co., Stettin, Germany.....	Cement, 1 Sand, 1	216 lbs. 3 trials.	1439 lbs. 12 trials.
2	Hollick & Co., London, England.....	Cement, 1 Sand, 1	216 " 3 "	1330 " 10 "
3	Wouldham Cement Co., London, England.....	Cement, 1 Sand, 1	199 " 3 "	1140 " 12 "
4	Saylor's Portland Cement, by Coplay Cement Co., Coplay, near Allentown, Pa., United States.....	Cement, 1 Sand, 1	184 " 2 "	1078 " 8 "
5	Wampum Cement & Lime Co., New Castle, Lawrence Co., Pa., United States.....	Cement, 1 Sand, 1	168 " 3 "	968 " 12 "
6	Pavin de Lafarge, Teil, canton of Viviers, department of Ardèche, France.....	Cement, 1 Sand, 1	158 " 3 "	931 " 12 "
7	A. H. Lavers, London, England.....	Cement, 1 Sand, 1	192 " 2 "	926 " 6 "
8	Francis & Co., London, England.....	Cement, 1 Sand, 1	163 " 3 "	907 " 14 "
9	Wm. McKay, Ottawa, Canada.....	Cement, 1 Sand, 1	141 " 3 "	882 " 10 "
10	Borst & Roggenkamp, Delfzijl, Netherlands.....	Cement, 1 Sand, 1	132 " 3 "	826 " 12 "
11	Lonquèty & Co., Boulogne-sur-Mer, France.....	Cement, 1 Sand, 1	108 " 3 "	764 " 12 "
12	Riga Cement Co. (by C. Schmidt, Riga), Russia.....	Cement, 1 Sand, 1	134 " 2 "	693 " 5 "
13	Scanian Cement Co., Lomma, near Malmö, Sweden.....	Cement, 1 Sand, 1	112 " 3 "	606 " 14 "
14	Bruno Hofmark, Port-Kund, Esthland, Russia..	Cement, 1 Sand, 1	154 " 2 "	580 " 6 "
	ROMAN AND OTHER CEMENTS.			
15	Coplay Hydraulic Cement, by Coplay Cement Co., Coplay, near Allentown, Pa., United States.....	Cement, 1 Sand, 1	38 " 2 "	292 " 8 "
16	Charles Tremain, Manlius, New York, United States.....	Cement, 1 Sand, 1	48 " 3 "	276 " 12 "
17	Allen Cement Co., Siegfried's Bridge, Pa., United States.....	Cement, 1 Sand, 1	43 " 3 "	276 " 12 "
18	P. Gauvreau, Quebec, Canada.....	Cement, 1 Sand, 1	47 " 2 "	234 " 8 "
19	Riga Cement Co. (by C. Schmidt, Riga), Russia.....	Cement, 1 Sand, 1	44 " 2 "	230 " 6 "
20	Anchor Cement, by Coplay Cement Co., Coplay, near Allentown, Pa., United States.....	Cement, 1 Sand, 1	41 " 3 "	208 " 12 "
21	Cumberland Hydraulic Cement Co., Cumberland, Md., United States.....	Cement, 1 Sand, 1	41 " 3 "	196 " 12 "
22	Société anonyme des chaux eminemment hydrauliques de L'Homme d'Armes, prés Montélimar, France.....	Cement, 1 Sand, 1	29 " 2 "	184 " 7 "
23	Howe's Cave Association, Howe's Cave, New York, United States, No. 1.....	Cement, 1 Sand, 1	28 " 2 "	183 " 6 "
24	Howe's Cave Association, Howe's Cave, New York, United States, No. 2.....	Cement, 1 Sand, 1	44 " 2 "	170 " 10 "
25	Howe's Cave Association, Howe's Cave, New York, United States, No. 3.....	Cement, 1 Sand, 1	31 " 2 "	170 " 8 "
26	Società anonima per la fabbricazzione del cemento, provincia di Reggio-Emilia, Italy, No. 1.....	Cement, 1 Sand, 1	27 " 3 "	181 " 12 "
27	Società anonima per la fabbricazzione del cemento, provincia di Reggio-Emilia, Italy, No. 2.....	Cement, 1 Sand, 1	22 " 3 "	154 " 12 "
28	Thomas Gowdy, Limehouse, Ontario, Canada...	Cement, 1 Sand, 1	24 " 2 "	126 " 8 "
29	A. H. Lavers, London, England.....	Cement, 1 Sand, 1	24 " 2 "	122 " 6 "

No.	KIND OF CEMENTS.	Proportions of Dry Ingredients.	Tensile Strength per Square Inch, Average of Several Trials.	Crushing Strength per Square Inch, Average of Several Trials.
	PARIAN CEMENTS.			
30	Francis & Co., London, England, No. 1.....	Cement, 1 Sand, 1	181 lbs. 3 trials.	1175 lbs. 8 trials.
31	Francis & Co., London, England, No. 2.....	Cement, 1 Sand, 1	169 " 3 "	696 " 12 "
32	A. H. Lavers, London, England.....	Cement, 1 Sand, 1	51 " 2 "	205 " 6 "
	SCOTT'S SELENITIC CEMENT.			
33	Patent Selenitic Cement Co., London, England..... [The cement was composed of 20 parts of Howe's Cave hydraulic lime and 1 part of calcined gypsum.]	Cement, 1 Sand, 1	52 " 5 "	297 " 20 "

THE INDURATION OF HYDRAULIC MORTARS.

When certain argillaceous limestones of homogeneous texture and composition, containing from 12 to 20 per cent. of clay, are burned with an intensity and duration of heat a little greater than that necessary to expel the carbonic acid, all the silica and alumina of the clay enter into combination with a portion of the lime (CaO), forming both the silicate of lime ($SiO_3.3CaO$) and the aluminate of lime ($Al_2O_3.3CaO$). There remains in the burnt product an excess of the caustic or quicklime, which slakes in the presence of water, reducing the whole mass to a powder. In slaking, the quicklime is converted into hydrate of lime (CaO.HO).

When this variety of hydraulic lime is mixed into a paste with water, the anhydrous silicate and aluminate of lime form respectively hydro-silicates and hydro-aluminates of lime, by combining with a certain number of equivalents of water, and they subsequently undergo a species of crystallization technically termed *setting*, which constitutes the hydraulic property, and which will go on in damp places or under water.

When alumina is present in but small quantities, as in the case of the hydraulic lime of Teil, the hydraulic property is due mainly to the crystallizing energy of the anhydrous silicate of lime.

When certain argillaceous limestones, containing from 20 to 23 per cent. of clay in which the silica suitably predominates, are burned at a high, long-continued heat, they may be expected to yield Portland

cement. All, or nearly all, the silica and alumina and lime enter into combination with one another, producing the silicate of lime as before, and also the double silicate of alumina and lime ($SiO_3(Al_2O_3.CaO)_3$), leaving not enough caustic or free lime in the product to produce slaking to powder in the presence of water, and leaving also very little if any inert silica and alumina to adulterate the cement and impair its hydraulic energy. The superior quality of Portland cement appears to be due in part to this equilibrium existing between the constituent ingredients of the raw material, and in part to the presence of the double silicate of alumina and lime, which is produced only at a high heat, and which requires a less number of equivalents of water for its hydration than the compounds formed at a low heat.

When the stone contains more than 23 per cent. of clay it cannot usually be burned at the high heat required to produce Portland cement without greatly impairing the hydraulic energy of the product, as portions of it become converted into inert slag. Even if it could withstand the requisite degree of heat, the cement would be weakened by the presence of uncombined clay, inasmuch as that constituent is supposed to be present in excess of the required amount of 20 to 23 per cent. necessary for the conversion of all the lime into the elements of hydraulic energy. Argillaceous limestones of this character do not, therefore, yield Portland cement. When burnt at a low heat they produce what are known as Roman cements, which are generally light in weight, quick-setting, and possess only from one-fourth to one-fifth the strength of the genuine Portland cements.

In burning argillo-magnesian limestones like those from which most of the natural American cements are made, both silicate and aluminate of magnesia ($SiO_3.3MgO$ and $Al_2O_3.MgO$) are formed, as well as the silicate and aluminate of lime. These magnesian compounds become hydrated in the presence of water, and are pronounced by both Vicat and Chatoney to furnish gangs which resist the dissolving action of sea-water better than the silicate and aluminate of lime. They are mostly light in weight, and quick-setting cements, and are not improved by burning at a high heat. The magnesian limestones, therefore, are not capable of yielding Portland cement.

All the several types of hydraulic cement above mentioned, including hydraulic lime, which ordinarily stands lowest in energy, can of course be made by burning an artificial mixture of the requisite ingredients; but the argillaceous or argillo-magnesian deposits are so numerous, and so generally distributed over the face of the earth, that the artificial process for commercial purposes is rarely resorted to except for the production of Portland cement.

Several specimens of Selenitic mortar, plastering, and concrete were exhibited by the Patent Selenitic Cement Company (limited), of London, England. They were hard, dense, and strong, but their exact composition and age were not given.

The merits of the Selenitic process consist in the use of unslaked lime (which should be one of the hydraulic varieties) in such a manner, in combination with calcined gypsum, that the slaking of the lime is prevented. With suitable limes, like the Burham and the Blue Lias and the Barrow Lias limes of Great Britain, the addition of 5 to 7 per cent. of the gypsum will suffice.

The prepared Selenitic lime sold in the English markets in bags is simply lime of a suitable kind, to which about 4 per cent. of calcined gypsum has been added, both having been intimately mixed and ground together, and then sifted through a sieve of 30 fine wires to the inch both ways. At the time of using it an additional pint of the plaster to a bushel of the prepared lime is mixed in the water, making in all a little over 5 per cent. of the plaster. One bushel of prepared Selenitic lime requires about 6 gallons of water.

The mortar may be made after the following formulæ, from prepared Selenitic lime containing 4 per cent. of plaster:

1.—In a mortar-mill with a five-feet pan. Throw into the pan of the edge-runner about 6 gallons of water, with the first gallon of which 1 pint of finely-ground plaster of Paris has been well mixed, and gradually introduce a bushel of the prepared Selenitic lime, keeping up the grinding until the whole is reduced to a creamy paste. The sand is then to be added, and the whole to be ground together for ten minutes more.

2.—In a plasterer's tub. When a mortar-mill cannot be had, an ordinary plasterer's tub or trough, with an outlet or sluice, may be substituted. Into this tub pour a gallon of water, to which a pint of the plaster has been added, then pour the rest of the water into the tub, and mix well; next gradually introduce a bushel of the prepared Selenitic lime, which must be thoroughly mixed with the water in the tub. The mixture is then taken from the tub, or run out by means of the sluice, and mixed with sand in the following proportions:

For brick-work and first coat of plaster,—

(No hair required.)

2 pails (6 gallons) of water;
1 pint measure of plaster;
1 bushel of prepared Selenitic lime;
6 bushels of clean sharp sand.

For outside plastering use 4 bushels of sand instead of 6, and for finishing rough stucco-face use 2 or 3 bushels of fine washed sand instead of 6. For first coat for lath-work use only 3 bushels of clean sharp sand instead of 6, and add 1 hod of well-haired lime putty.

For concrete use 1 bushel of sharp sand to the bushel of Selenitic lime instead of 6, and 6 to 8 bushels of the ballast. The addition of one-sixth bushel of best Portland cement is also recommended to improve the setting.

The prepared Selenitic lime must be kept perfectly dry until made into mortar for use.

It is of the utmost importance that the mode here indicated of preparing the mortar, concrete, etc., should be observed, viz., by first well stirring the plaster in the water, and then the lime into the well-mixed milk of plaster and water; otherwise the cement will slake and spoil.

Selenitic lime or mortar should not be used in conjunction with gauged stuff for cornices, screeds, etc.

The sand, ballast, or other ingredients, should always be clean and free from loam. When the sand is very dry, more water than the quantity above specified will be required.

No more mortar should be gauged than can be used in the same day.

If it should ever happen that the mortar gets heated and sets very rapidly, add a small quantity of plaster—not exceeding half a pint of plaster to a bushel of lime—in gauging, or make up in smaller quantity at a time.

Finely-ground burnt clay (ballast), or cinders, or stone chippings, as a substitute for sand, in whole or in part, can be used with great advantage in every description of work.

When the prepared Selenitic lime contains the whole of the required amount of plaster, of course none is to be added at the time of using it. When no plaster has been previously mixed with the ground lime, the process of preparing the mortar is the same,—that is, 1 bushel of the plain lime is mixed into 6 gallons of water containing the entire dose (5 to 6 per cent.) of plaster, and the sand is then added.

The best limes for the Selenitic process are the hydraulic argillaceous limes, containing from 14 to 20 per cent. of clay in which the silica predominates. From 5 to 7 per cent. of plaster will completely arrest the slaking action of such limes.

The Selenitic mortars prepared and tested, of which a record is given in the same table with the cements, contained equal parts—by measure—of Selenitic lime and sand. They were made under the

personal directions of Mr. John H. Sturgis, of Boston, Massachusetts, the agent of the London company, with hydraulic lime manufactured specially for the purpose at Howe's Cave, New York, rendered Selenitic with 5 per cent. of plaster of Paris, introduced at the time of mixing the specimens.

In making the mortar 1 measure of plaster of Paris was intimately mixed with 2 measures of water, then 1 more measure of water was added and mixed. Into this a mixture of the dry lime and sand, containing 20 measures of the lime and 20 of sand, was thoroughly stirred and more water added to form a stiff paste. The mortar was then moulded into briquettes and tested when seven days old. They were not immersed in water at all. The crushing strength of 1½-inch cubes was 670 pounds, as an average of twenty trials, or 297 pounds per square inch. The average tensile strength from five trials was 116 pounds on a section 1½ inch by 1½ inch, or 52 pounds per square inch.

Although the process renders this lime superior in strength to the best natural quick-setting cements, the results do not compare favorably with those obtained with the best English limes, and Mr. Sturgis states, in a written communication, that he has not yet found any lime in this country that comes quite up to his idea of what is required in this process.

CEMENTS NOT EXHIBITED.

It is deemed proper as a subject of general interest to refer briefly to some cements not represented in the Exhibition.

The National Portland Cement Company, of Kingston, Ulster County, New York, has recently been organized for making Portland cement by the fourth method above described. The materials employed are fuller's-earth, kaolin, and lime. They are thoroughly ground and mixed together in suitable proportions by the wet process, although much less water is used than in the English works or in those at Boulogne. The mixture when completed is in a rather stiff semi-liquid state. In this condition it is run out upon a floor underlaid with warming-flues, where it is dried to the stiffness of tempered brick-clay. It is then passed through a brick-machine, and subsequently burnt in common continuous upright kilns with anthracite coal.

Specimens of this cement have been tested several times by the writer with excellent results. On the last occasion the method adopted with the cements in the Exhibition was strictly followed. One-and-a-half-inch cubes, seven days old, composed of equal parts

of dry cement and sand, gave a crushing strength of 3335 pounds per cube, as an average of twenty trials, being a little higher than the best Portland cement exhibited, as shown by the table.

It is to be regretted that the Exhibition did not contain a more numerous display of the natural quick-setting cements, especially such as have more than a local reputation.

The Rosendale cement—discovered in 1828–29, when constructing the Delaware and Hudson Canal—is derived from the tentactulate or water-limestone belonging to the lower Helderberg group, known as Formation VI. of Professor H. D. Rogers's classification of the rocks of Pennsylvania. The deposits are mostly found within a belt scarcely one mile wide, skirting the northern base of the Shawangunk Mountains, in the valley of Rondout Creek, Ulster County, New York.

Sixteen companies, with an aggregate cash capital exceeding one and a quarter million of dollars and a yearly productive capacity of one million five hundred thousand (1,500,000) barrels (of 300 pounds), are engaged in the manufacture of this cement. The greatest production of any one year was one million four hundred thousand (1,400,000) barrels.

At Fayetteville, New York, cement has for many years been manufactured from the same ledge of stone which furnished the Manlius cement exhibited by Mr. Tremain. The yearly capacity of the Fayetteville works is 150,000 barrels, although they have never produced over 90,000 barrels in any one year. It is also manufactured on a small scale by other parties in that neighborhood.

It is also produced at Acron, Erie County, New York.

In the Western States the most extensive works are located at and near Louisville, in both Kentucky and Indiana.

The manufacture of cement in this locality began at Louisville in the year 1830. It is now carried on upon a large scale by a corporation which unites several distinct and separate interests under the name of the Western Cement Company of Louisville, Kentucky, representing a cash capital of about $600,000. The aggregate productive capacity of all the mills during a working season of 280 days is 950,000 barrels (of 300 pounds). The largest aggregate sales of any one year (1873) amounted to 450,000 barrels, and the average of the yearly sales from 1873 to 1875 (both included) was 368,419 barrels. The number of men ordinarily employed is about 170, and when running full about 400. (Condensed from information furnished by Captain A. McKenzie, U. S. Corps of Engineers.)

At Utica, La Salle County, Illinois, natural cement is manufactured

from a ledge of stone about seven feet thick which crops out on the margin of the Illinois River. There are two establishments engaged in the business, with an aggregate productive capacity of 300,000 barrels per year. About half that quantity per year has been made and sold.

The manufacture of cement is carried on about a mile and a half north of the city of Milwaukee, Wisconsin, by a company recently organized. The works, which have been in operation but a few months, are planned for the production of 150,000 barrels in a working season of 200 days.

The James River Cement Works at Balcony Falls, Rockbridge, Virginia, can produce about 50,000 barrels per year.

On the Potomac River this same type of cement has for many years been made at Shepherdstown, West Virginia, and at Round Top, three miles from Hancock, Maryland. The Shepherdstown works can produce 125 barrels and the Round Top works nearly 350 barrels per day.

At Kingston, Bartow County, Georgia, a small manufactory, capable of producing 12,000 barrels per year, has quite recently been put into operation.

Near New Haven, Connecticut, two companies have, within the last two years, commenced making cement.

The cements above named have all been examined and tested by the writer, many of them repeatedly, and some of them have been used for years upon government works under his supervision. Their relative value for building purposes is therefore known, but as they were not represented in the Exhibition it is deemed proper to say nothing of their quality except that it varies between rather wide limits among the different brands.

No good hydraulic cement has yet been discovered in the Pacific States, or, if found, has not been manufactured for the market.

The manufacture of Portland cement has, within the last six months, been commenced at Kalamazoo, Michigan, by the Eagle Portland Cement Company, of Chicago, Illinois, from marl containing from 80 to 90 per cent. of carbonate of lime, and clay found on the banks of the Kalamazoo River. A sample has been shipped to the writer for trial, but had not arrived at the time of closing this report.

ARTIFICIAL STONE.

There were not many kinds of artificial stone exhibited, and none, it is believed, that are new with respect to the materials employed and the reactions brought into play to secure induration and strength.

Vases, urns, fountains, statuary, tiles, building-blocks, and architectural ornamentations assume a variety of forms and degrees of excellence, but they generally have a common basis,—a mixture of sand or pulverized stone and hydraulic cement,—and depend primarily on the quality of the materials employed, though largely on thoroughness of manipulation and skill in workmanship, for such merit as they may possess.

A large proportion of the artificial stone exhibited was hard and compact. Its durability, when exposed to the weather, need not be questioned, especially in cases where the density and strength are satisfactory, and are known to be due to the hydraulic energy of the cementing medium.

It is now a well-established fact that a mixture of good hydraulic cement, especially of Portland or Vicat cement and clean sand, if suitably proportioned and thoroughly mixed and compacted, will withstand, without injury, the disintegrating effects of alternations of heat and cold in the latitude of the Northern United States and Canada, if prepared during the spring, summer, or early autumn, so as to afford not less than six weeks or two months for the unchecked operation of "setting" before the intervention of heavy frosts. Prolonged practice also proves that a small proportion of common lime and a large proportion of good hydraulic lime, of either the silicious or argillaceous type, may be added to the cement without impairing in any serious or even sensible degree the durability of the stone or its ability to resist frost, although its strength and hardness will be diminished by such admixture. The hydraulic lime of Teil is highly prized for this purpose. Common lime may be added largely when the appliances for securing thorough manipulation and consolidation of the materials are entirely suitable and efficacious.

THE UNION STONE CO., *Boston, Mass.*

Artificial stone made by the process of the French chemist Sorel. The cementing substance is oxychloride of magnesium. It is produced by adding a solution of chloride of magnesium—for which bittern-water, the usual refuse of sea-side salt-works, is a suitable substitute—to the protoxide of magnesium obtained by calcining and grinding carbonate of magnesia (magnesite).

The articles exhibited were soapstone borders for furnace registers, stove-pipe insulators, etc. They are made by first grinding up natural soapstone to a powder, and then thoroughly mixing it with a suitable proportion, say 8 to 10 per cent., of the burned and ground magnesite. This mixture is then moistened with bittern-water, of a density

of 20° to 30° Baumé, thoroughly triturated in some suitable mill, and then compacted in strong moulds of the required form by tamping it in layers. Sandstone, granite, and marble can be imitated in a similar manner.

Samples of the artificial soapstone were taken and reduced to blocks measuring $1\frac{13}{16}$ inches by $1\frac{13}{16}$ inches by $2\frac{5}{8}$ inches, which gave an average crushing strength, when compressed on the side, of 10,000 pounds, or 2100 pounds per square inch. Several varieties of this artificial stone furnished by the Union Stone Company were tested by the writer in 1870 with somewhat remarkable results. A piece of whetstone, made with flour of emery as a base, gave, when two years old, a crushing strength per square inch of 19,636 pounds; and some fine marble, containing 15 per cent. by weight of the calcined magnesite, gave, when three years old, a crushing strength of 11,555 pounds per square inch. Five other specimens of different kinds varied from 7680 pounds to 4923 pounds in crushing strength per square inch.

The works of the company are largely devoted to the manufacture of emery grindstones.

Mr. Durrschmidt, *Lyons, France.*

A variety of artificial emery-wheels, small millstones, razor-hones, whetstones, etc., and some of the artificial emery in powder. It is made by burning and grinding a mineral called bauxite, found in the south of France. The unburnt mineral contains about 70 per cent. of alumina, 5 per cent. of peroxide of iron, 5 per cent. of silica, and 20 per cent. of water. The result of burning with the proper intensity and duration of heat is a very hard material, fit to replace the natural emery of Turkey and Naxos for some purposes.

The process by which the powder is agglomerated and a solid body produced was not given by the exhibitor with any degree of clearness. The binding medium, however, is not hydraulic cement nor oxychloride of magnesium, but is some material which, after being mixed with the emery, is moulded into form while hot. In making some of the smaller articles, such as razor-hones and knife-sharpeners, the mixture is applied to wood as a sort of veneer. India-rubber enters into the composition of the cement in some of the articles. The grit is of good quality and the texture firm. The information given was too meagre to justify any decided expression of opinion concerning its durability. It appears to resist abrasion and to wear very well.

THE FIRE-PROOF BUILDING CO., *New York.*

An interesting and instructive display of building materials moulded into blocks in a variety of hollow and solid forms, adapted to the construction of fire-proof partition-walls, floors, ceilings, roofs, smoke-flues, etc. They are composed of 3 volumes of calcined gypsum, 2 of Teil hydraulic lime, and 5 of coke-dust, and weigh only 60 to 61 pounds to the cubic foot. The material is a good non-conductor of heat and cold, much better than common brick indeed, resists in a high degree the action of fire or water, and, although remarkably light, possesses ample strength for the purposes to which it is ordinarily applied. For floors and partitions the blocks are made hollow, with a thickness of material around the perforation varying from one to two inches, according to the size and form of the block. For floors the blocks are moulded into hollow voussoirs, laid generally on the lower flanges of iron beams, so as to produce a horizontal surface on the top and on the bottom, flush with the upper and lower edges of the beam respectively, the hollows forming a series of tubes parallel to the beams. For roofs the blocks may be thin, like tiles or flagging, and broad enough to reach from rafter to rafter. If the latter be of flanged iron the flanges may support the flags. Slating can be applied in the ordinary way, as the material is soft enough to receive nails.

The exhibitors illustrated the method of using their material by a full-sized model of a portion of a house, showing the top floor, partition, and exterior walls, and a mansard-roof. The steep part of the roof was faced inside and out with the tiles, while the flat portion was finished with thin slabs set between iron rafters and resting on the flanges. The hollow partition-blocks were usually made about 2 feet long and 1½ feet high, and were perforated vertically. They were laid up in horizontal courses, breaking the vertical joints in such manner that the apertures extended continuously from bottom to top of the partition.

It cannot be doubted that safety from conflagrations would be greatly increased if the method of building here indicated were generally followed.

E. P. ALBERT, *New York, N. Y.*

These large sewer-pipes, sewer-culverts, and flagging-stones were made from a mixture of sand, kaolin, rosin, and lime. The articles are hard, possess a close texture and sufficient strength, and are impervious to water. The durability of the material for sewers has not

yet been demonstrated. A piece of it was exposed to the weather five years in New York without deterioration.

The sand (150 pounds) and the clay (30 pounds) are first carefully dried by artificial heat and then thoroughly mixed together in an iron kettle. The melted rosin (25 pounds) is then mixed in and the whole stirred to an adhesive paste, after which 1 pound of caustic lime is added and stirred in. The material is poured into moulds while hot and compacted by pressure. The advantage claimed for it is its relative cheapness when moulded in large sizes.

The Phœnix Stone-Manufacturing Co., *Philadelphia, Pa.*

A very creditable display of artificial building-blocks and flagging-stones, in some of which the sand was replaced by furnace-slag and in others by marble-dust. The cementing medium was a mixture of natural hydraulic cement and common lime. A circumstance deserving especial mention in connection with the productions of this company is that the materials, after being mixed together with very little water, are compacted in the moulds by the repeated blows of a steam-hammer weighing about 2500 pounds. They are so thoroughly consolidated by this method that the blocks can be handled at once and the flagging-stones ranged upon edge.

The net cost of manufacturing and placing on cars flags 15 inches square and 2¼ inches thick, composed of 1 measure of cement, 2 of slaked lime, and 5 to 6 of pulverized furnace-slag, is 5 to 6 cents per superficial foot. The use of marble-dust increases the cost of production about 2 cents per square foot.

The mould in which the stone is compacted is suspended on a car by trunnions resting in bearings, which are movable up and down. The car carrying the mould, the latter being of metal and very strong, is run under the hammer, and the trunnions lowered until the bottom of the mould rests firmly upon a cast-iron anvil. The mixed material is then filled into the mould, and the compressing-die lowered down upon it and disconnected from the hammer. The steam-hammer is then set to work delivering blows upon the die, which are repeated until the material is thoroughly compacted. The hammer is then hooked on to the die, and the latter is raised out of the mould and additional material introduced and compacted by blows as before. When the mould is full and the consolidation completed, the die is raised up out of the way, and the trunnion-bearings are also raised by the simple movement of a lever, so as to throw the weight of the filled mould upon the car. The car is then run out and placed under another similar die, by which the finished block is ejected downwards.

Fig: 3

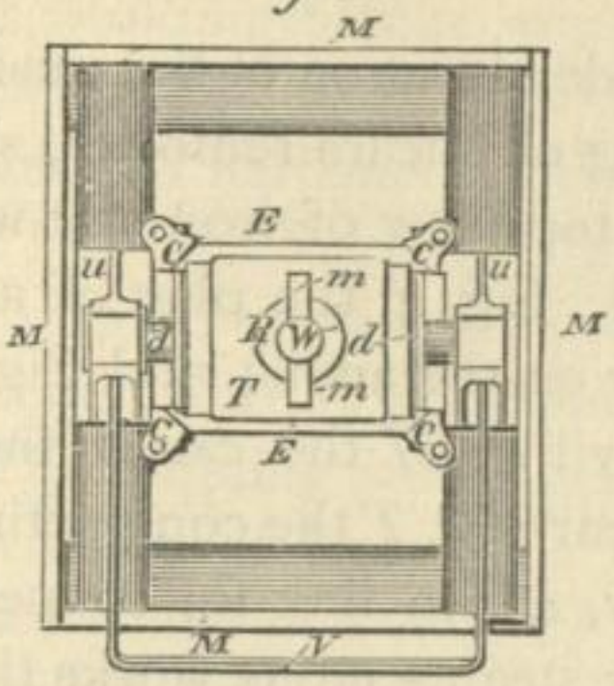


Fig: 4

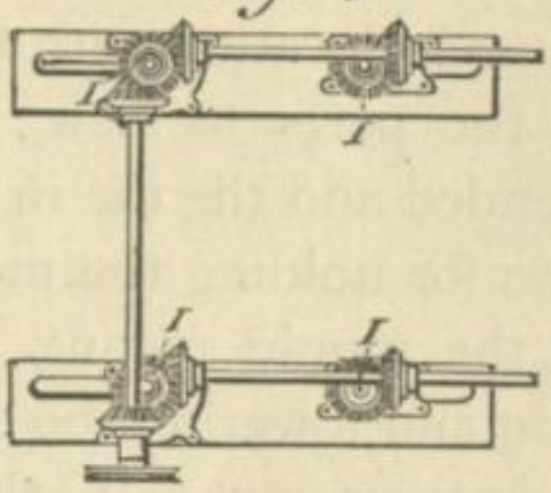


Fig: 1

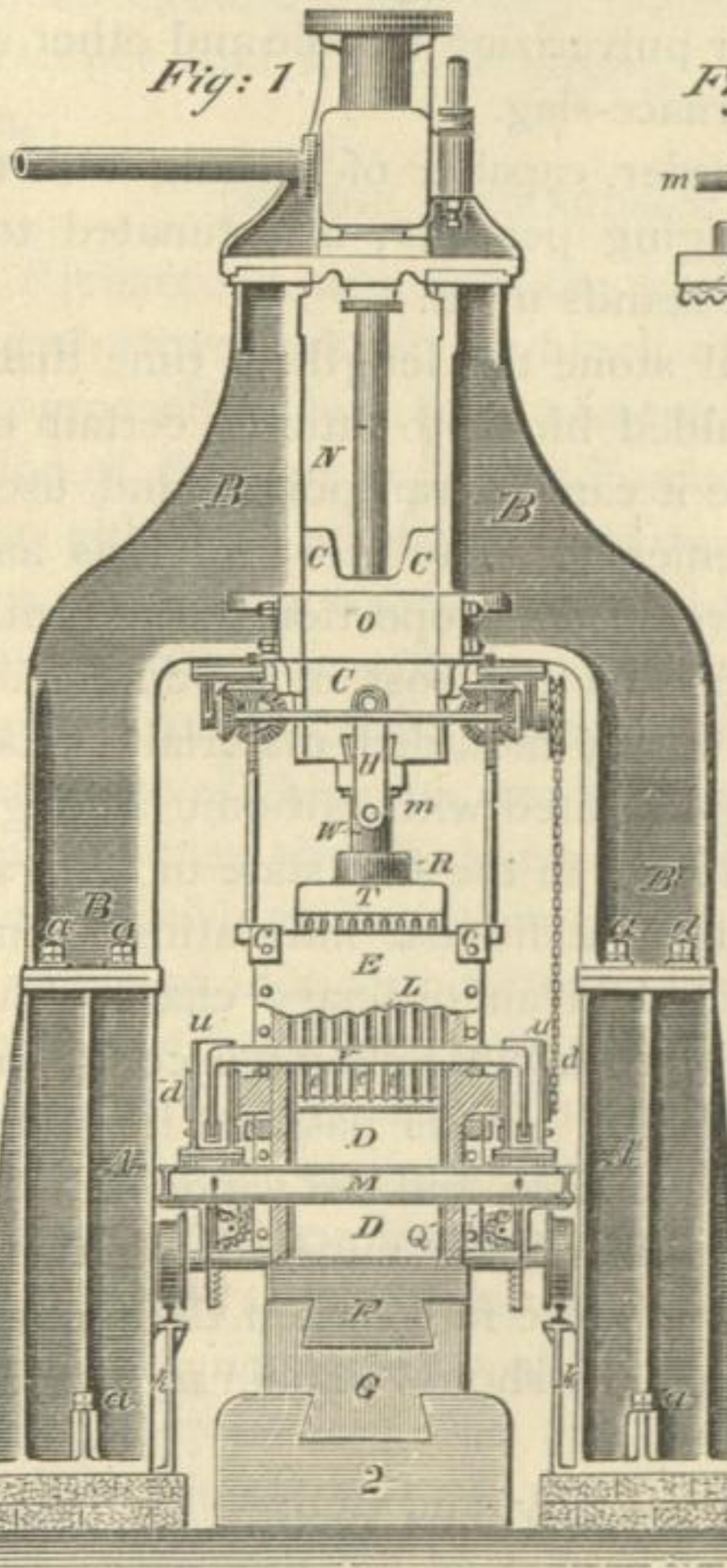


Fig: 5

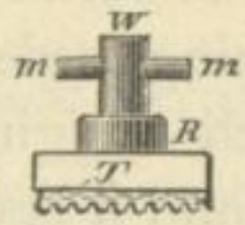
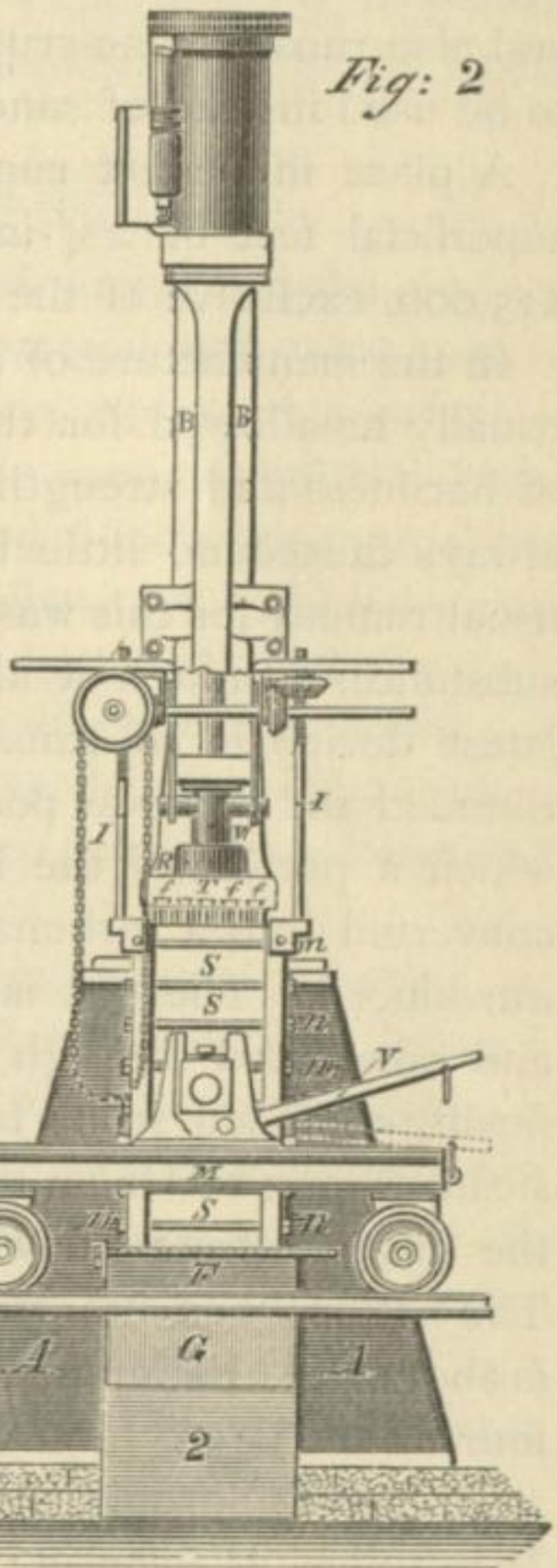


Fig: 2



MACHINE FOR MANUFACTURING THE PHŒNIX STONE.

The edges of the compressing-die, which come in contact with the interior sides of the mould, are grooved or corrugated vertically, so as to provide for the escape of the air in the passage of the die up and down.

In the drawings Fig. 1 shows a side elevation of the machine; Fig. 2, an end elevation with the near leg of shears removed, so as to expose the parts to view; Fig. 3, a top view of iron car with mould suspended and the die in the mould; Fig. 4, the plan of a system of screws for holding the mould firmly on the anvil; and Fig. 5, the die. *E* is the mould resting on the anvil *F*, *M* the car, *V* the lever for raising and lowering the trunnion-bearings, *T* the compacting-die with corrugations, *e*, *e*, *C*, *C*, the hammer, *H* the link for connecting hammer and die, etc. A 60-horse-power steam-engine works the hammer, and also runs a stone-crusher for pulverizing marble and other stones to be used instead of sand or furnace-slag.

A plant in perfect running order, capable of turning out 10,000 superficial feet of 2¼-inch flagging per day, is estimated to cost $15,000, exclusive of the land it stands upon.

In the manufacture of artificial stone the length of time that must usually be allowed for the moulded block to attain a certain degree of hardness and strength before it can be transported and used has always caused no little inconvenience. The most obvious and the usual remedy for this was to increase the proportion of the cementing substance, although it also increased the cost of production. The latest device is to cause the freshly-moulded material to be surrounded and as far as possible permeated with carbonic acid gas, by which a portion of the lime present in the free state or otherwise is converted into a carbonate, and an additional indurating agent thus introduced. The gas is generated in an ordinary charcoal-furnace and conducted through a pipe into a close chamber containing the freshly-moulded stone to be treated. In its passage it unites with steam from a boiler on top of the furnace, and the vapor of water and the gas penetrate the chamber and remain mingled together in it. The action upon the specimens is more rapid when the temperature is above 100° Fahrenheit. The articles should remain in the chamber four or five days.

Roland & Sprogle, of New York City, and George Richardson, of Milwaukee, Wisconsin, exhibited apparatus for this process. Both embody the same principle, and there is no essential difference in the two methods of applying it.

ROLAND & SPROGLE, *New York, N. Y.*

Roland & Sprogle also had on exhibition a fine collection of paving-tiles, building-blocks, miniature burial-cases, match-boxes, and other articles, made with a mixture of hydraulic cement, common lime and sand, all hardened by the carburetting process. The selling price of the 2¼-inch flagging is 25 cents per square foot, that of plain building-blocks 60 to 70 cents per cubic foot, and that of ornamental blocks 90 cents to $1.25 per cubic foot, depending on the cost of the moulds. The building stones generally contain 1 volume of Portland cement, 1 volume of Rosendale or other equivalent cement, ½ volume of slaked lime-powder, and 4 volumes of clean, fine sand. The specimens exhibited were well moulded, of uniform color, free from efflorescence, and hard and strong. The moulding is done by hand-tamping.

GEORGE RICHARDSON, *Milwaukee, Wis.*

Mr. Richardson, who calls the process *carbonizing*, and the product *carbonized* stone, exhibited a block of the material and some sewer-pipe, composed of hydraulic cement 1 volume, and sand 2 volumes, a portion of the cement being Portland. He uses no common lime. He also exhibited an iron mould for making 6-inch sewer-pipe, the sections of the pipe being connected by a collar-joint. Each section is moulded with a longitudinal rib along the bottom called the bed-piece, which has the same projection as the collar beyond the exterior circumference of the pipe, and supports the section in its place when laid, and enables the thickness of the pipe to be somewhat reduced without diminishing its transverse strength.

The value of this carburetting or carbonizing process does not appear to be restricted to simply hastening the induration, but it introduces an additional source of hardness,—the subcarbonate of lime,—which would not otherwise appear for many years, or at best but feebly, except on those surfaces exposed to direct contact with the air, and for a limited depth only. It is believed, therefore, that the ultimate strength and hardness of the stone are somewhat, though not materially, increased by this process. Whether the extra expense which this involves will prevent its general adoption, is a question yet to be demonstrated.

JAMES T. ALLEN, *Philadelphia, Pa.*

Artificial imitations of polished marbles and other stones, in columns, pedestals, pilasters, wainscoting, mantels, and slabs. The

imitations are excellent, the Egyptian green, the verd-antique, the Tennessee marble, the black marble of Lake Champlain, lapis lazuli, Lisbon, Sienna, brocatelle, Scotch-granite, bloodstone, etc., being beautifully reproduced in their polished appearance. The body of all these imitations is either calcined gypsum or Keene's cement applied to a skeleton or core of wood. The columns and pedestals are therefore hollow, the core being formed of slats with openings between them like lathing. The coloring materials are pigments of various kinds, indigo, gamboge, chrome-yellow, Indian red, etc., mixed up with the plaster and water to the condition of a stiff paste, and then applied to the plaster or the cement a day or two after the core has received its first rough coat. The Keene's cement is used for the finishing layer on flat but not on round surfaces, as it is much harder to work than the plaster composition. The columns are turned and polished in a lathe. In the Levant and verd-antique marbles, fragments of natural alabaster are imbedded in the body while soft, receiving their final polish with the rest of the surface. The polishing is done with pumice and other stones of different grades of fineness, and water.

The selling price of these articles appears to be comparatively high. Columns 9 feet high, exclusive of base and capital, and 13 inches in diameter, sell for $80 singly, and something less in sets; pedestals 1 foot in diameter and 3½ feet high, including the base, for $35; and a good pattern of wainscoting, about 4 feet high, for $6.50 per lineal foot. Plain slabs are sold for 80 cents and upwards per square foot.

P. P. QUACKENBOS, *Philadelphia, Pa.*

Four large ornamented vases of artificial stone, composed of hydraulic cement and sand, and perhaps a little common lime. The articles are well moulded, and the material is hard and strong. It is not known whether the process followed in manipulating and compacting the materials is in any respect peculiar.

WILSON MITCHELL, *Philadelphia, Pa.*

Portsilica paving-tiles, some plain gray, and others colored red, yellow, and blue, well adapted for paving foot-paths, areas, cellars, churches, etc.

MILNER & HERD, *Strathroy, Canada.*

A vase about 3 feet high, and a window-cap made with a mixture of hydraulic lime and cement.

W. W. TRIP, *Providence, R. I.*

A garden-seat, a large vase with cover, a carriage-step, and garden curb or bordering, made with cement and sand, possessing a good degree of strength and hardness.

GERONIMO BOADA, *Matero, near Barcelona, Spain.*

Balusters, slabs, and small ornamented building-blocks, composed of hydraulic cement and sand, hard, strong, and fairly moulded. A church front in Barcelona is built of the same material.

JOSÉ GABRIEL CADIZ, *Santiago, Chili.*

Marble mantels, fluted pilasters of variegated marble, and a number of tiles, all very hard, dense, and strong. The body is concrete, faced with a fine-grained composition. No information concerning the process of manufacture could be obtained, the exhibitor not being present, and the parties in charge having no knowledge thereof.

R. ESCUDERO, *Santiago, Chili.*

Artificial grindstones, balusters, and railing, composed apparently of silicious sand and hydraulic cement of good quality, well moulded and hard and strong.

Several of the parties having hydraulic cement on exhibition also made a more or less prominent, and some of them a very creditable, display of artificial stone or béton, into which their cement entered as the binding medium, in order to show its strength and general fitness for a special branch of industry. Notably among these, in addition to those named, were L. and E. Pavin de Lafarge, of Teil, France; the Coplay Cement Company, of Allentown, Pennsylvania; the Wampum Cement and Lime Company, of New Castle, Pennsylvania; and Lonquèty & Co., of Boulogne, France.

BRICK-MAKING MACHINERY, BRICK-KILNS, PERFORATED AND ENAMELED BRICKS, AND PAVEMENTS.

BY GEN. Q. A. GILLMORE, U.S.A.

Brick-machines may be classified, with respect to the humidity and condition of the clay affording the best practical results, into four classes, to wit: Dry-clay machines; Crude or moist-clay machines; Tempered-clay machines; and Slush- or mud-machines.

With the exception of the slush-machines, which operate to advantage only upon very soft and highly-tempered clay, and which were not represented at all in the Exhibition, the machines of the several classes run almost imperceptibly into one another in their respective methods of producing bricks, although there is a marked and wide difference between the extremes in the first three classes,—that is, between those which require the clay to be dry enough to receive compression into form by means of a sudden blow or impact and those which force the clay continuously through a die, in the form of a plastic bar if for bricks, and of a plastic pipe or tube if for drain-tiles, to be immediately cut up into the required lengths.

Very great improvements have been made in brick-machinery within the last ten or twelve years, all successfully tending to the substitution, in a greater or less degree, of machine- for hand-labor, and the abridgment of the time consumed from the moment the clay is dug from the bank until the finished brick is taken from the firing-kiln. These improvements, which at first were somewhat restricted in their scope, and had special reference to a more rapid and less costly production of common bricks, are now able to achieve the higher grades of workmanship. Indeed, it seems altogether probable that within a very few years the best quality of face bricks will be made by machinery, and hand-made as well as hand-pressed bricks will be driven from the market.

In the Dry-clay machines, the clay, if not in proper condition for the purpose, is first dried and then reduced to a coarse granulated form by some suitable device. This is commonly done by passing it be-

tween two cylinders, or two cone-shaped rollers, revolving towards each other on the upper surface with different velocities. They are placed nearly in contact with each other, so that the larger stones are thrown off, while the smaller ones pass through or are crushed. The granulated or disintegrated clay is filled into the brick-moulds by hand, or by some device of filler-boxes, or graduated measures, operated automatically, and is then compacted by tamping, or by one or more applications of steady pressure, according to the nature of the machine. In order to insure a close and compact brick of at least the required thickness, it is customary, and necessary in practice, to fill the moulds to excess, and as they cannot be relieved of this excess by an orifice in the top or bottom mould-plate, as in the case of a moist or plastic clay, which will flow more or less freely under heavy continued pressure, the moulded bricks are passed under a sizing-knife, which shaves them down to a uniform thickness.

With machines in which a number of moulds are grouped together, and filled simultaneously, it has been found extremely difficult to fill them all alike so as to produce bricks of uniform density. If this difficulty has been entirely surmounted, the fact is not within the knowledge of the writer.

A brick made with dry clay, whether compacted by tamping or by steady pressure, is not plastic when delivered by the machine. although it can be indented somewhat if pressed by the thumb or finger. When an attempt is made to bend it, only a very slight change of form will take place before breaking. The absence of the requisite degree of moisture causes imperfect cohesion during the process of moulding and imperfect or incomplete fusion in the kiln. It has been found that dry-clay bricks possess in an inferior degree the power to withstand the disintegrating effects of the weather, especially in high latitudes.

Crude or moist-clay machines generally work in clay in its natural condition, as taken from the bed. It is first disintegrated by some suitable apparatus, as in the dry-clay process, and then fed into the moulds and compacted by one or more applications of steady pressure. The surplus clay may be removed and the bricks brought to a uniform thickness by passing them under a sizing-knife, followed in some cases by a smoothing-plate to remove the rough surface left by the knife. The bricks are more plastic than those produced by the dry-clay machine, and can generally be hand-pressed, if desired, immediately after they are delivered from the machine. A few hours' exposure in the open air, in favorable weather, renders them dry enough for burning.

Tempered-clay machines are usually less costly, and therefore in more common use throughout the world, than those intended to work in dry or crude clay. There are exceptions to this rule, for some machines which work at their best in highly-tempered clay, and deliver a very plastic brick, consist essentially of a revolving mould-table, provided with moulds with movable bottoms, to which pressure is applied by an arrangement of parts that are sometimes not at all simple.

The usual device for tempering the clay is a pug-mill, which consists of an iron cylinder, having a revolving shaft in its axis provided with radial knives set spirally, like the arms of a steamer's propeller, so that they not only cut up and mix and temper the moistened clay so as to render it plastic, but they drive it forward towards the end of the cylinder, where it receives compression, either by being forced through a contracted opening or die issuing therefrom in the form of a continuous bar, to be at once cut up into bricks, or by being fed into brick-moulds and compacted therein by suitable appliances for giving a steady pressure. As the expressed bar has a uniform cross-section, a full set of dies of different forms will enable a single machine to produce in turn solid, perforated, or cornice bricks, floor- and drain-tiles, and other forms. Machines operated on this principle are known as expressing-machines. Their simplicity, comparatively low price, and ready adaptation to the production of a variety of forms, confer a claim for popular favor not surpassed by that of any other class of brick-machines. The pug-mill may be set in a vertical or in a horizontal position, and the end in which the die is set in expressing-machines may be tapering. Whatever may be the position of the pug-mill, the die is commonly so arranged that the bar of tempered clay issues forth horizontally.

Bricks cut from an expressed bar by wires or steel blades are apt to be rough and jagged on the edges where the cutting instrument leaves the bar, unless the clay is quite free from gravel and coarse sand; while if a small pebble obstructs the cutter, the brick on either side is liable to be greatly injured in sightliness, if not altogether destroyed. These machines, therefore, are by no means equally well adapted to all qualities of clay.

ISAAC H. GARRETSON, *Keokuk, Iowa.*

Mr. Garretson's tamping brick-machine is simple, and the one exhibited quite rude in construction. It works in dry clay only, consists essentially of an arrangement for raising and letting fall (by means of cams attached to a horizontal revolving shaft) one or more wooden iron-shod rammers or stampers. The bottom or iron-shod

part of these stampers fits somewhat accurately into the brick-moulds and drops into them at each fall. The dry clay, previously disintegrated by some suitable device or by hand-labor, is fed into the moulds by a wooden wheel revolving in a hopper above. The feeding is intermittent, being suspended while the stamper is down. After being taken from the moulds the bricks are passed under a sizing-knife to reduce them to a uniform thickness.

A machine with two stampers costs $100, and the exhibitor stated that six stampers, properly attended, will make 18,000 bricks in 10 hours, and have quite recently been working at that rate in St. Louis, Missouri. This machine requires only a small power to run it, and its low price places it within the reach of parties with limited means. The bricks made with it are very heavy and compact.

AUGUSTUS MORAND, *Germantown, Philadelphia, Pa.*

Mr. Morand exhibited an excellent brick-machine, and afforded the Judges an opportunity to see one at work in the city at Morand & Co.'s brick-yard. It consists essentially of two pug-mills,—one horizontal and the other vertical, and a horizontal revolving mould-table; in the moulds of which the bricks are formed and receive their pressure, and from which they are delivered to an off-carrying belt.

The clay and water are put into the horizontal mill, where the spirally-set knives mix and temper the material and force it towards the delivery end, where it descends into the vertical mill, also provided with helicoidal arms or knives. Under the mill, and in contact with its lower end, revolves with a uniform continuous motion the horizontal mould-table, in which there are eight moulds of the size of a brick, at equal distances from each other, near the periphery. The mixed and thoroughly tempered clay is forced downward through a slot in the bottom of this mill, thus filling the moulds in succession as they pass under the slot. Each full mould then passes under a pressure-plate, which confines the clay on top, while a movable plate which fits into and closes the mould at the bottom, on the under side of the table, is forced up by passing over a cam. This compresses the plastic brick, and ejects the air and excess of clay through a small circular aperture in the pressure-plate provided for that purpose. After passing the pressure-plate, the bricks are thrust up to the top of the mould-table by another cam, and are then pushed off automatically to an off-carrying belt set at the height of the top of the table. They are taken from this belt and sanded, hand-pressed, put on cars, and conveyed to the drying-ovens, all within the space of a few minutes after the crude clay is introduced into the first pug-mill.

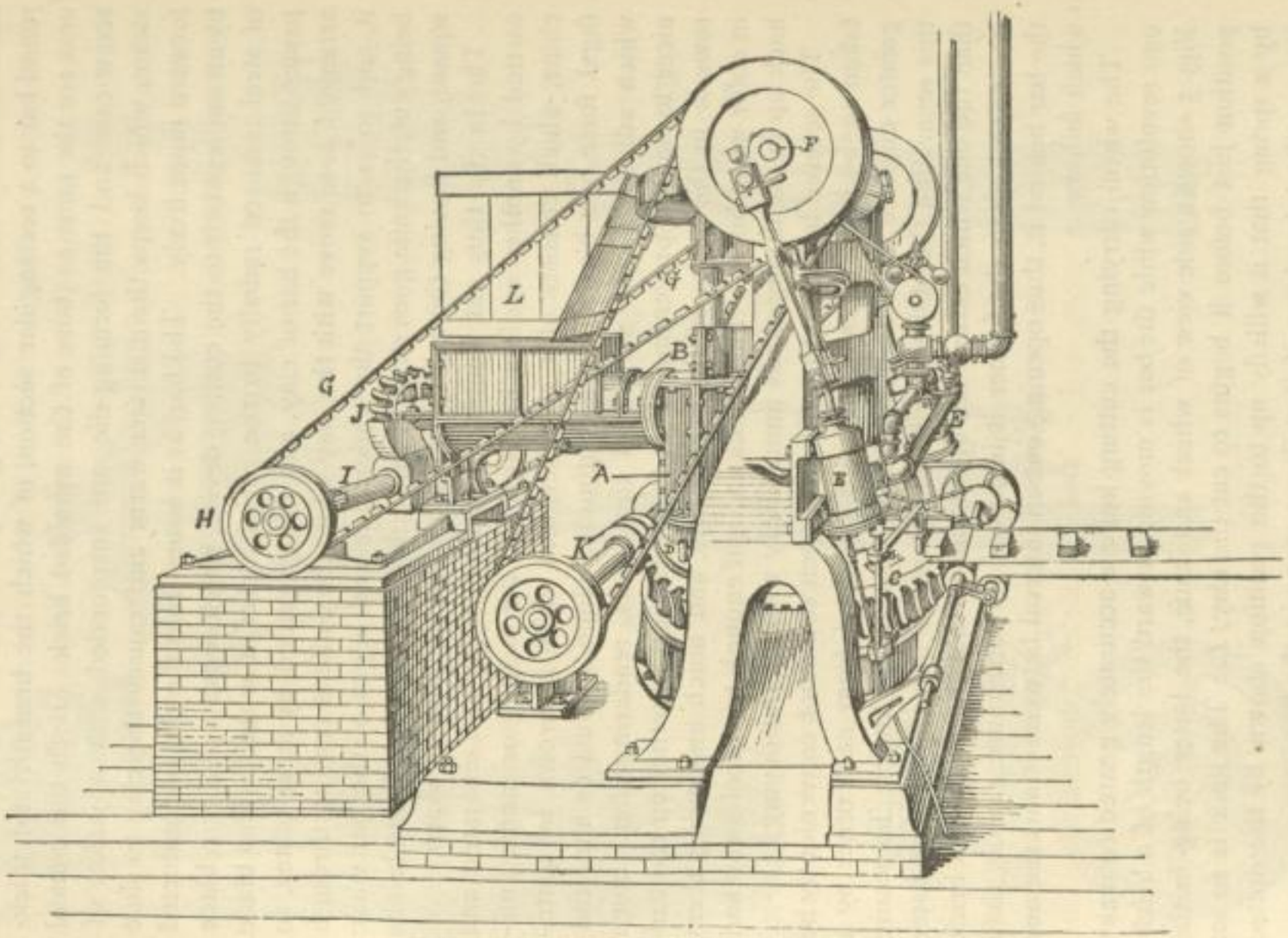
The characteristic merit of the Morand machine—due to the double pugging which the clay receives—is the high degree of homogeneity and plasticity which it confers upon the bricks. In these respects it possesses in a superior degree all the advantages of the best expressing-machines, without sacrificing the greater accuracy of form and smoothness of edges which a well-moulded brick always has over one cut from a plastic bar.

A component part of the machine exhibited is a driving-engine, consisting of two inclined cylinders, each 8½ inches in diameter and 12 inches stroke, with all the necessary connections. The cylinders seen at *E E* are connected directly with the main driving-shaft *F*, located on top of the frame, and carrying a worm and two solid V-pulleys. The worm, which is not seen in the drawing, works into a large horizontal worm-wheel fixed to the upper end of the shaft of the vertical pug-mill, *A*, in order to operate that mill. Two V-belts driven from the two V-pulleys pass over two other pulleys, one of which is seen at *H*, on the shaft *I*, carrying a worm which gears into a vertical worm-wheel, *J*, fixed to the shaft of the horizontal pug-mill *B*, and drives that mill. The mould-table *C* is revolved by the worm-shaft *K*. The moulds are made in segments, so that they can without difficulty be removed from the table when it is desired to alter the number or size of the moulds, or replace those that are worn out. A roller-mill for disintegrating the clay should be placed in the bottom of the hopper *L*, directly over the horizontal pug-mill.

The Morand machine can produce from 22,000 to 24,000 bricks in 10 hours without working to its fullest capacity. Its weight is 9 tons, and its price, with engines, $5000, or without engines, $4000.

CHAMBERS BROS' & CO., *Philadelphia, Pa.*

A working model of their "clay-tempering brick-making machine." The machine itself was seen in full operation at the company's yard. It is an expressing machine, shown in Figs. 1, 2, and 3, constructed almost wholly of iron, consisting essentially of a horizontal cylindrical pug-mill terminating in a frustum of a cone next the delivering end of the mill. The pug-mill, which includes all the cylindrical and about half the conical portion of the machine, is provided with spirally-set knives, which cut up and temper the clay, and force it forward towards the die. The smaller portion of the cone is provided with a conical screw firmly attached to the end of the pug-mill shaft. This screw receives the tempered clay as the latter is thrust forward by the pug-mill, and forces it onward through the die. In order that the clay shall not revolve with the screw, which would



THE MORAND BRICK-MACHINE.

stop its onward motion, the inner surface, the conical case, is roughened by checks, pits, or longitudinal corrugations, preferably the latter. The screw further tempers the clay, and then delivers it in a solid round column to the forming-die, which gradually reduces the round bar to a rectangular section, of which the breadth and thickness are the same as those of the moulded brick. Both the conical screw-case and the forming-die are surrounded with a jacket of steam, which keeps their surface warm and causes the clay to slide forward more freely. The bar, as it issues from the die, is conducted by an endless belt to the cutting device, which consists of a thin blade of steel, secured radially to the periphery of a wheel. The blade passes through the bar of clay, and being guided by steel plates, so arranged as to move with the clay while the knife is passing through it, and so as to support the under side and edges of the bar while being cut, the knife goes straight through, cutting the end of the bricks square, and leaving the angles unbroken and the corners sharp.

The bricks, thus cut from the continuous bar, are separated and carried by another endless belt through the dusting or sanding machine, which consists of a chamber, into which is thrown by centrifugal force or a blast of air a continuous cloud of dust or fine sand which adheres to the surface of the bricks, rendering them much nicer to handle, preventing them from sticking together on the barrows or in the hacks on the drying-cars, and much improving them in color when burnt. The bricks are stiff enough to wheel away and hack up in the drying-sheds immediately without sun-drying.

The severed bricks on the off-bearing belt could not conveniently be taken up by hand unless they were separated from each other by a greater distance than the thickness of the severing knife. To secure this separation the off-bearing belt is geared to move somewhat faster than the one which carries the uncut bar, so that the moment a brick is received upon the former it is moved forward more rapidly than the bar behind it, thus opening out an interval between it and the one which follows.

The wheel carrying the cutting-knife is accurately geared to make one revolution while the bar is moving forward the length of a brick. Fig. 3 shows a side view of wheel and knife, the latter being in the position just before it begins to cut the clay, *L*. The knife is so set by a spring that it will fly up to the position shown by the dotted lines, without breaking, if it strikes a stone in the bar.

It is presumed that in feeding the clay to the machine no large stones will be allowed to enter, and in order that the smaller stones of from two to three inches in diameter shall not stop the machine nor

Fig: 1

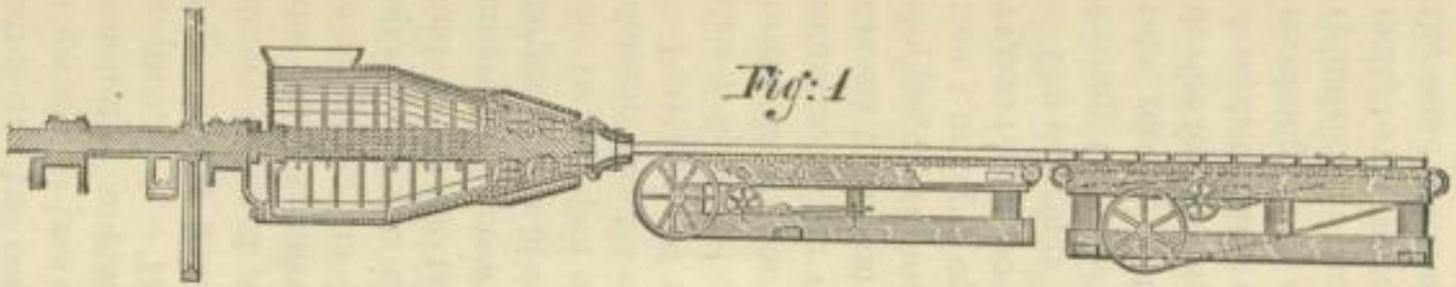


Fig: 2

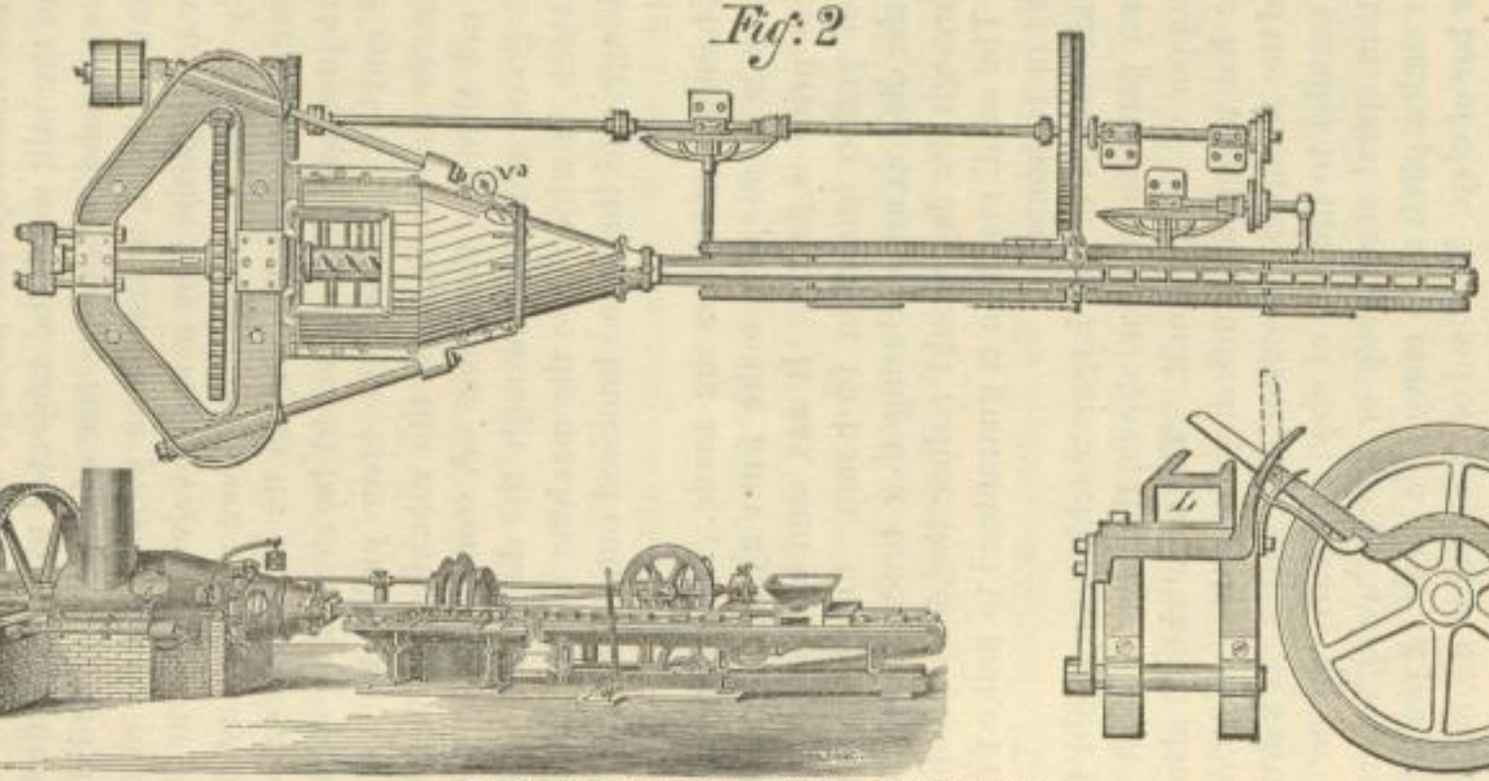
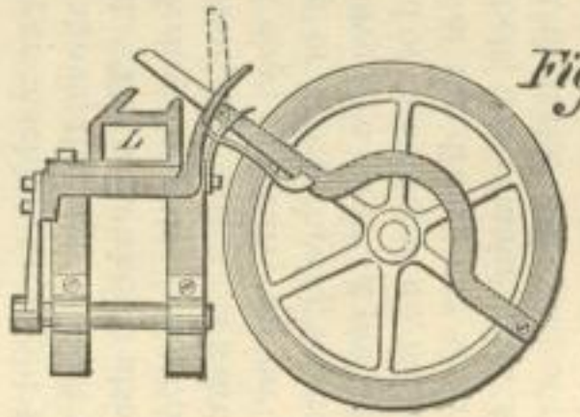


Fig: 3



THE CHAMBERS BRICK-MACHINE.

break the knives while they are passing through the pug-mill, the knives are made a few inches shorter than the interior diameter of the casing. A stone may imbed itself in the stationary clay occupying the space between the ends of the knives and the case, or it may lodge at the entrance to the screw and stop the passage of the clay. In the latter case the casing of the mill would be subjected to extra strain in a greater or less degree, depending on the size of the stone and the amount of stoppage caused by it, unless some provision were made to prevent it. This is accomplished by a safety-valve, shown at V^3, Fig. 2, kept habitually closed by a weighted lever against any ordinary outward pressure exerted by the clay in its passage towards the die. Against extra pressure, such as would be caused by stones stopping at the large end of the screw, the lever yields, the valve opens, and the clay issues therefrom, until the machine is stopped and the stone taken out through the valve. A stone, having once entered the screw, will go on and pass through the die unless it be larger than a brick is thick, in which case the machine is stopped, the die swung open on a hinge, and the stone knocked out. This can be done in about a minute.

Two sizes of the Chambers machines are made. The largest, if driven by a 40-horse-power engine, can make from 25,000 to 35,000 bricks in 10 hours; its price is $2000. It was seen working for 40 minutes, at the rate of 31,800 bricks in 10 hours. One stoppage, caused by a stone in the die, occurred during that time. One such stoppage per hour through the day would reduce the daily production 5 or 6 per cent. The small machine is guaranteed to make from 15,000 to 25,000 bricks in 10 hours.

The drawings include a view of the larger machine, arranged for feeding the clay from a platform or floor above, through a shaft or tube resting on the hopper of the pug-mill. The view shows also a device for cutting the bar into bricks, differing from the one above described. It is called the Archimedean cutter, and consists of a drum revolving on an axis parallel to the bar of clay, and carrying on its cylindrical surface a thin spiral steel plate or screw-thread, set normally to the surface at such a pitch as to move, as a screw, at precisely the same speed as the bar of clay. The end of this steel plate, nearest the mill, cuts the clay at each revolution of the drum; the severed brick moving forward on the off-carrying belt, but remaining in the space between the threads for a short time, until the other end of the spiral leaves it. It then goes to the faster belt, as in the case of the other cutter. The Archimedean cutter was not seen at work, and it is not known whether it operates as well as the radial knife or otherwise.

GEORGE S. TIFFANY, *London, Canada.*

This exhibit is a horizontal expressing machine, of the pug-mill class, embodying the novel feature of 2 two-bladed screws behind the die, revolving in opposite directions. The design of the machine is shown by the drawings.* Fig. 1 is a perspective view; Fig. 2, a central longitudinal section, taken vertically; Fig. 3, a vertical transverse section on *a a* of Fig. 2; Fig. 4, an end view of the screw nearest the die; and Fig. 5, a transverse section of the cutting-table.

The pug-mill shaft *F*, Fig. 2, is armed, in the usual manner, with spirally-set tempering-knives (of which only a few are represented), and with a two-bladed screw, *L*, fixed about fifteen inches in rear of the forming-die, *C*. Between this screw and the forming-die is another similar screw, *N*, seen also in Fig. 4, carried by the shaft *K*, working within the mill-shaft *F*. It revolves about six times as rapidly as the shaft *F*, and in an opposite direction, the objects being to reduce the strain on the mill-shaft, and confine the pressure by which the clay is forced through the die more nearly to the area of the die. The gearing is shown in Fig. 3. The gear-wheels, *i* and *e*, are on the driving-shaft, to which motion is given by the band-wheel *U*, Fig. 1. Wheel *e* meshes with wheel *f*, and gives motion to the shaft *K* and the screw *N*. Wheel *i* meshes with wheel *b*, on intermediate shaft, and gives motion to wheel *c*, represented by dotted lines, on same shaft, and wheel *C* meshing with wheel *D*, moves the pug-mill shaft *F* and the screw *L*.

The device for cutting off the bricks from the bar as it issues from the die is shown in Figs. 1, 2, and 5. The bar, which has a thickness and width corresponding to the width and length of a brick, is first received upon the carrying-band *P* (Figs. 1 and 2), and thence passes to the rollers on the rack of the cutting-table. This rack rests on rockers, *v v v v*, which permit it to have a reciprocating motion to and from the forming-die, and is provided with a cutting-frame, E, pivoted at *o*, Fig. 5, armed with small wires, *E E E*, for severing the bar into bricks. The man attending the cut-off holds the rack in position close to the die until he wishes to cut, when he allows the rack to move forward with the clay, and while moving, and while the clay and the cutting-frame are thus relatively in a state of rest, he draws the bar of the cutting-frame, *E*, over to the opposite side of the rack, causing the wires to pass through the bar and cutting it

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* See next page.

Fig: 1

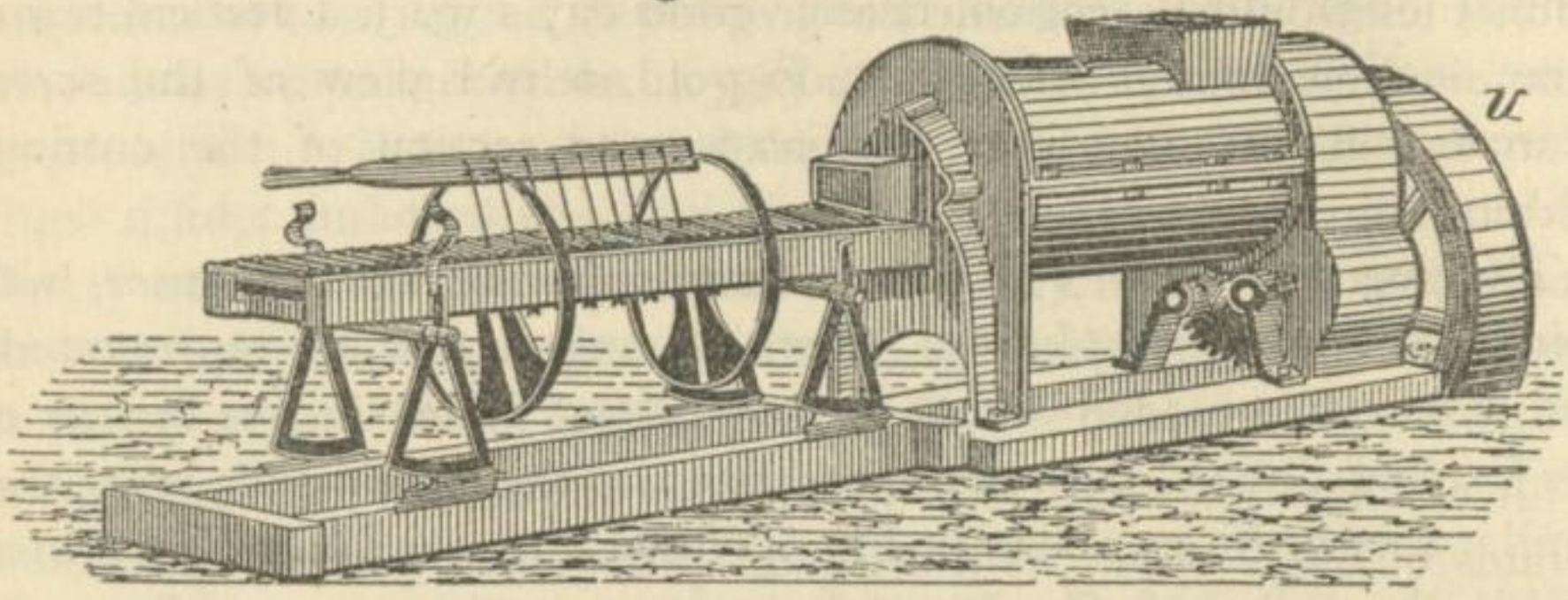


Fig: 2

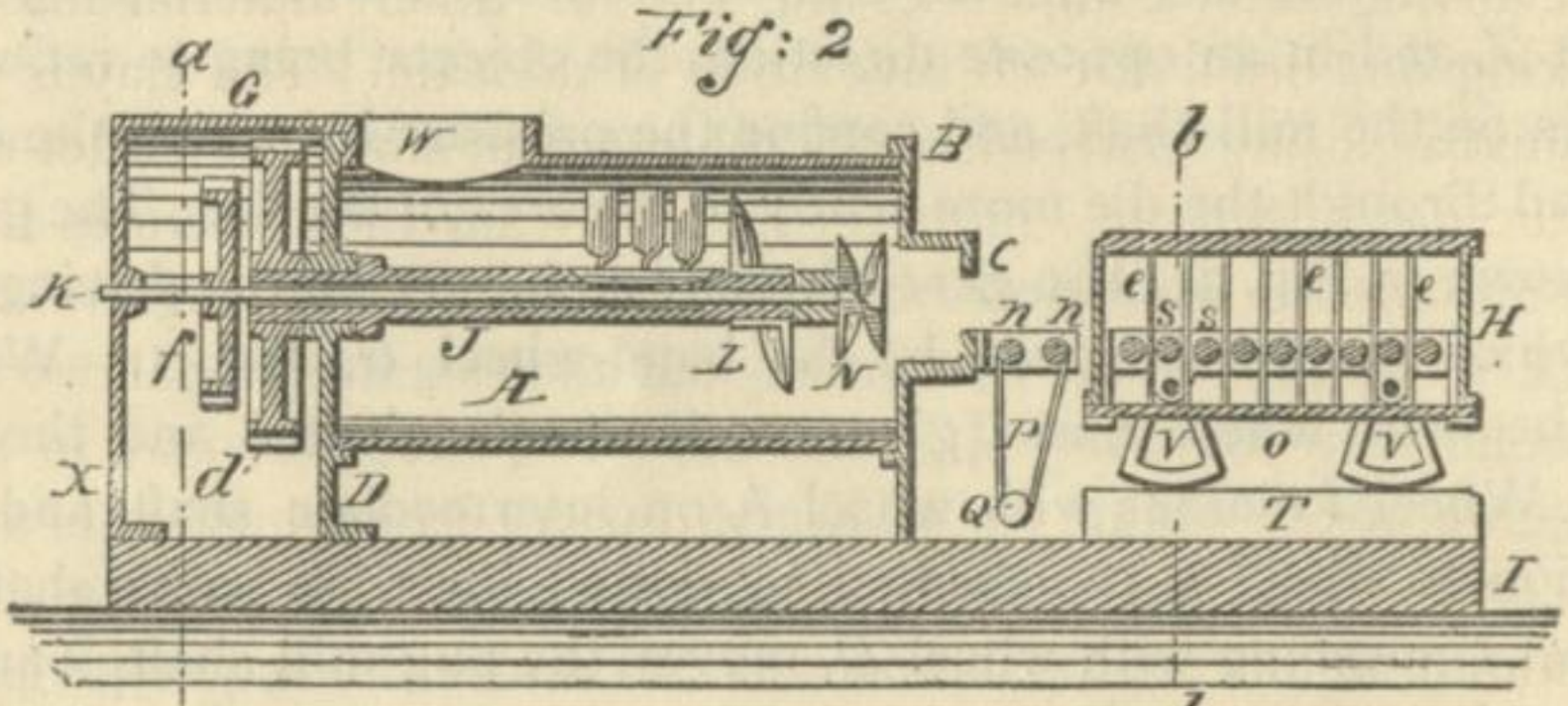


Fig: 3

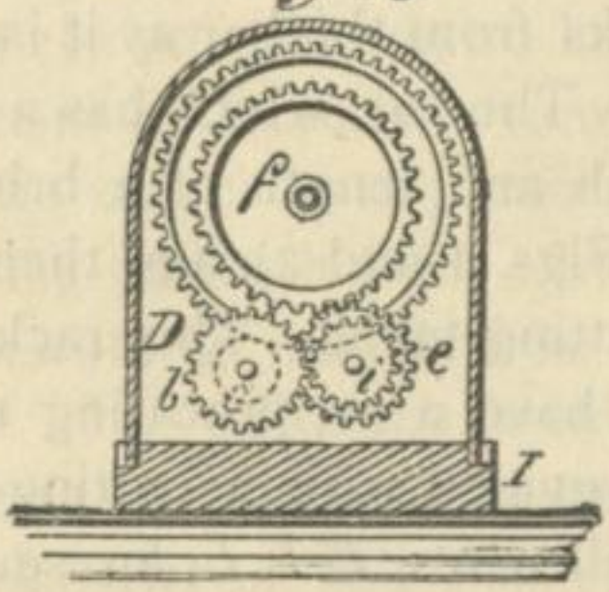
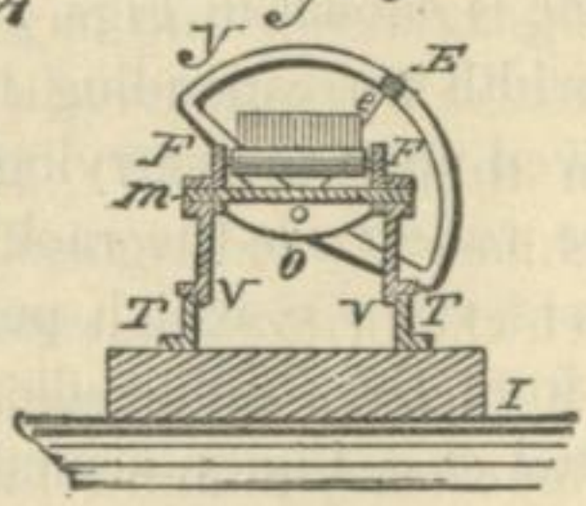


Fig: 4

Fig: 5



TIFFANY'S COMBINED BRICK- AND TILE-MACHINE.

into bricks. These are taken off, and the rack moved back towards the die to cut again.

This machine will easily make 14,000 to 15,000 bricks in 10 hours, and can be pushed to 20,000. It will make tiles equally well, and is highly commended for both brick and tile by those who have used it. When working on tiles 2500 six-inch, 3000 five-inch, or 4000 four-inch tiles would be regarded as a good day's work. Its price, with one die for common bricks, is $400, gold, delivered on cars in London, Canada. The Tiffany machine has a good reputation. The one on exhibition worked very satisfactorily, and possessed in a high degree the important qualities of strength and simplicity.

DURAND & MARAIS, *Paris, France.*

A machine for manufacturing bricks, compressed fuel, and agglomerates of every kind. A horizontal plunger, or piston, operated by a revolving cam, compresses the clay or other material into a die, making one brick at each revolution of the cam. The clay is pressed against a closing-plate, which for the moment stops the outlet-opening of the die. A long arm of the plunger-cam then operates to thrust the moulded brick forward upon a platform. The plunger is brought back by continuing the revolution, and additional material drops down in front of it from the hopper above. The excess of clay in front of the compressing-plunger escapes through an opening in its axis, the size of this opening being so adjusted, with reference to the kind and condition of the material in use, as to insure the requisite degree of compression. The mould appears to be filled equally and homogeneously, the pressure of the central portions being so far relieved by the axial opening in the piston that the material in the angles and edges is thoroughly compacted.

In the drawing Fig. 1 represents a longitudinal section of the machine; Fig. 2 a plan; and Fig. 3 an elevation of the end through which the bricks come out.*

The machine is mounted on a cast-iron frame, *A A*. On this frame are four heavy plumber-blocks, *b, b, c, e*, in which the two parallel shafts, *d* and *f*, work.

On the shaft *F* are placed the fast and loose pulleys *g*, g^1, and also the pinion *h*, which is geared into the large cog-wheel h^1 on the shaft *d*. The fly-wheel h^2 is also fixed on to shaft *f*. On the shaft *d*, driven by the cog-wheel h^1, are placed three cams. The principal cam, *i*, which is in the middle of the shaft, sets the compressing-plunger *F*

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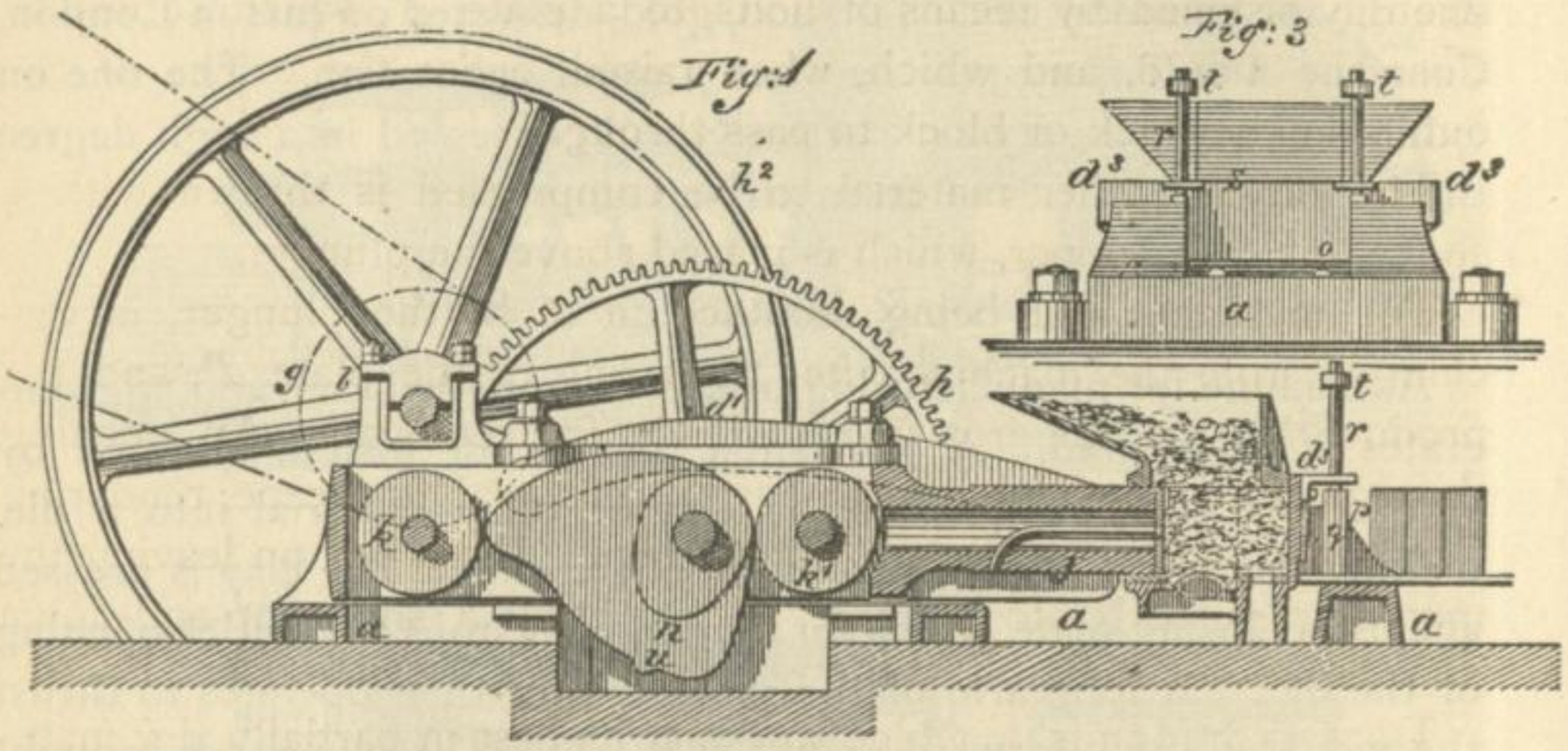
* See next page.



THE DURAND AND MARAIS BRICK-MACHINE.

in motion. The shape of that cam is such as to cause, in succession, 1st, the bringing together and closing up of the material to be compressed; 2d, a short but very powerful compression; and 3d, the expulsion of the finished brick or block.

The cam *I* acts on the plunger *J* by means of the two rollers *k* k^1.

The two outside cams *n n* act simultaneously on the two levers *d* d^1 fixed to the frame at the points d^2 d^2. The two other extremities are strongly fastened by means of bolts to a plate, d^3, which serves to close the mould, and which, when raised, opens the orifice of the outlet for the brick or block to pass through.

The clay or other material to be compressed is thrown with a shovel into the hopper, which is placed above the plunger.

The material, after being moulded in *A* by the plunger, is discharged from the machine after the rising of the plate d^3, and the produce lies on the iron bars *o* ready for removal. An opening through the plunger allows the surplus material to escape, rendering the pressure at the centre and edges equal. The block on leaving the mould is pushed into a frame, *q*, which by a slight up-and-down motion loosens it from the end of the plunger.

Durand & Marais' machine works at its best in partially dry material, like clay directly from the bank which has been disintegrated between rollers, or like coal-dust, with just sufficient tar to produce firm cohesion under pressure. A fitness for agglomerating the materials for artificial stone, after they have been suitably mixed together, is claimed for it.

As a brick-machine it is a variety of the crude or moist-clay type, and does not, therefore, produce what is styled a plastic brick. It can turn out 9000 to 10,000 bricks in 10 hours, and its price is $750. It is simple, strong, easily kept in working order, and requires only a small motive-power to run it.

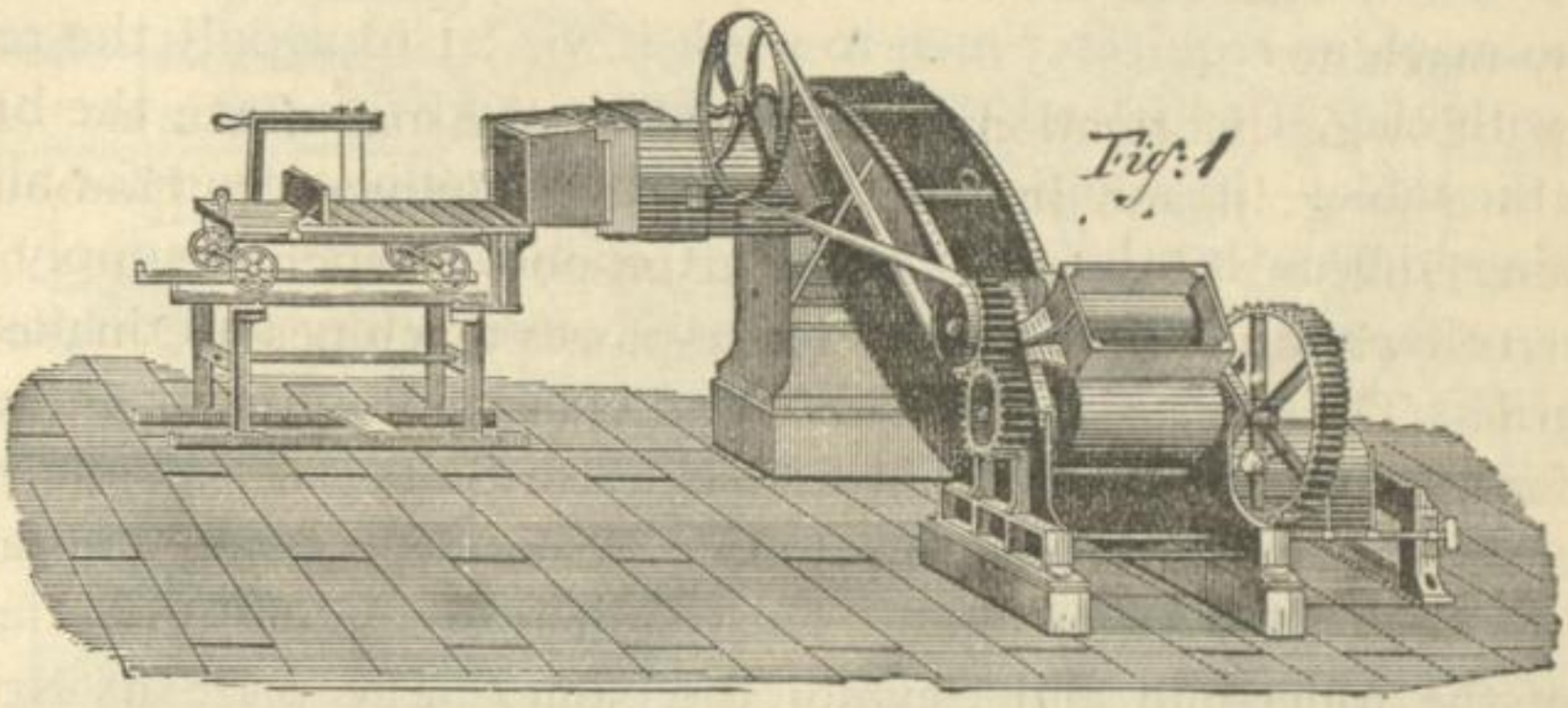
C. SCHLICKEYSEN, *Berlin, Germany.*

This maker, one of the oldest and most extensive manufacturers of brick and tile machinery on the Continent of Europe, had several of his horizontal patent brick-machines on exhibition. They are expressing machines, of strong and simple designs, and complete in all their appointments, consisting of a horizontal pugging-mill with suitable double driving-gear, surmounted with a water-box for moistening the clay, a die, and a cutting-table. They are arranged to be fitted when desired with a chilled-iron roller-mill for disintegrating the clay, and an elevator for conveying it to the pug-mill. One machine, with a complete set of dies, will make in turn solid bricks, perforated bricks,

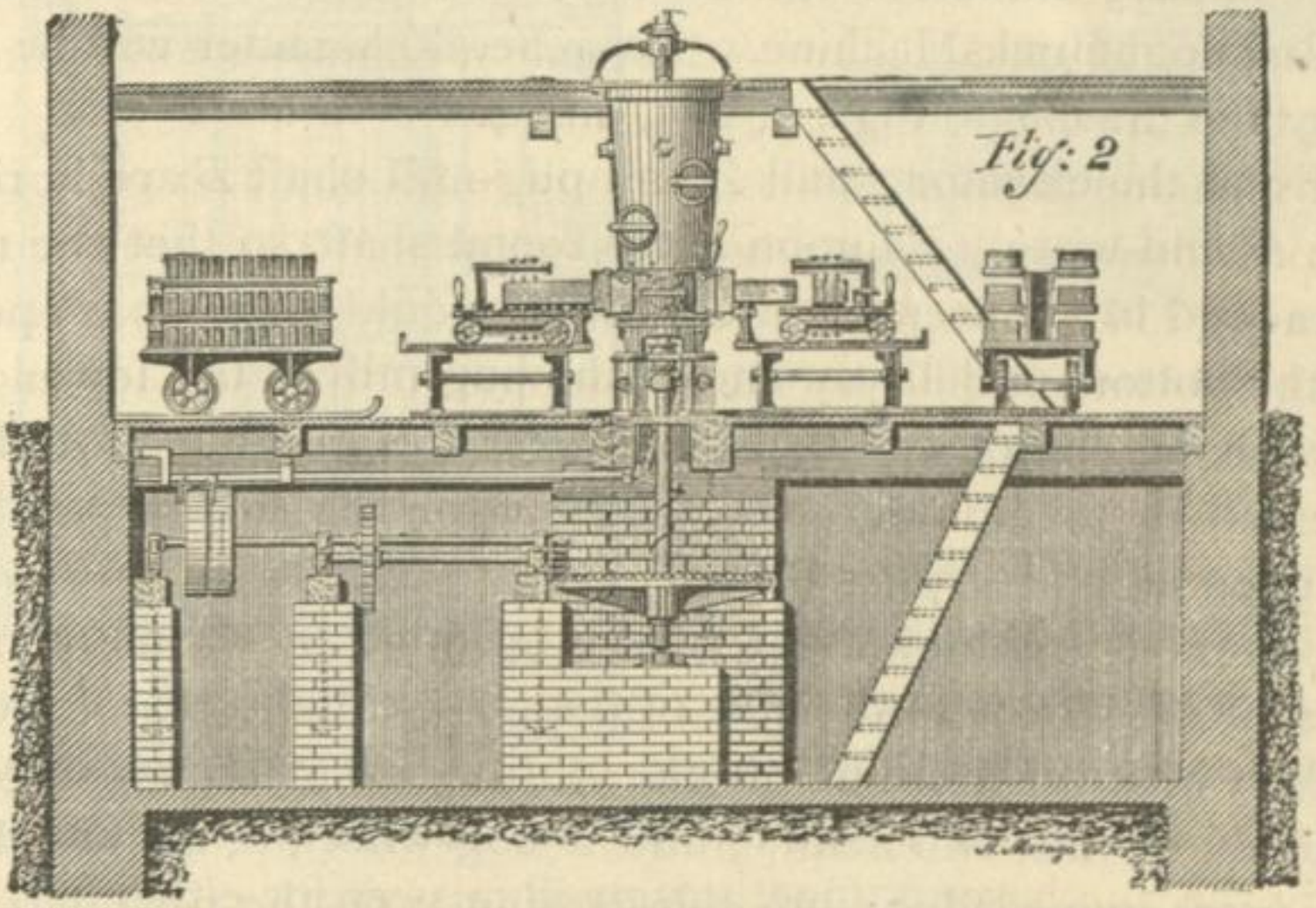
tiles, and cornice bricks. They are also suitable for reducing and compressing peat. Several sizes of machines are made by this house, and all the dies and cutting-tables are interchangeable between them. They can be easily and quickly opened for inspection or cleaning, and are run with comparatively light motive-power. The cutting-rack moves to and from the die on wheels, instead of on rockers, like the Tiffany machine.

The following information is furnished by the manufacturer. The prices are in gold, and include packing and delivery in Hamburg, Bremen, Hull, or Liverpool. Only steam-power machines are here referred to, although four sizes of horse-power machines are made by this firm. The price of No. 1, with one die and cutting-table, is $320, gold, and that of the roller-mill and elevator $215. Its productive capacity in 10 hours is 3000 to 5000 solid bricks, or 5000 to 6000 tiles, perforated bricks, or pipes. Its weight is 600 kilogrammes, and that of the roller-mill and elevator the same. The price of No. 2, with one die and cutting-table, is $530, and that of the roller-mill and elevator $320. It can make in 10 hours 8000 to 10,000 solid bricks, or 6000 to 7000 tiles, or perforated bricks, and its weight is 1200 kilogrammes, and that of the roller-mill and elevator 1000 kilogrammes. The price of No. 3, with one die and cutting-table, is $800, and that of the roller-mill and elevator $430. It can produce in 10 hours 15,000 to 18,000 solid bricks, or about 7000 perforated bricks or tiles. It weighs 2000 kilogrammes, and the roller-mill and elevator 1500 kilogrammes. The price of No. 4, without elevator and roller-mill, is $1070, and its production in 10 hours 25,000 bricks. The price of the elevator and rolling-mill is $860. The price of No. 5 is $1350, and that of roller-mill and elevator $1070. It can manufacture 30,000 to 35,000 bricks in 10 hours. For the No. 6 machine the price is $2400, and for the corresponding roller-mill and elevator $2050. A productive capacity of 5000 bricks per hour is claimed for this machine. It is a vertical machine, with two dies working simultaneously. The amount of steam-power required to drive machines 3, 4, 5, and 6, with roller-mill and elevator, is an engine of 10, 12, 16, and 20 horse-power respectively.

The four smallest machines made by this house are the only ones arranged to be driven by animal power, when that method is preferred by the purchaser. One horse will answer for either 1, 2, or 3. For No. 4 two horses are necessary. When driven by horses the productive capacity of the machines is reduced about one-half, and no roller-mill is used. The price is only about half as much as when geared for steam-power, and for Nos. 1 and 2, less than half.



SCHLICKEYSEN'S HORIZONTAL BRICK-MACHINE, No. 2.



SCHLICKEYSEN'S STATIONARY BRICK-MACHINE, No. 4.

The solid brick referred to are those of the usual German size, measuring, when burned, 250 by 120 by 65 millimetres, and containing about 119 cubic inches. Machine No. 3 would probably produce from 20,000 to 25,000 common American bricks in 10 hours. A perspective view of the Schlickeysen machine No. 2, with roller-mill and elevator, is given.

The machine requires 3 men to work it, viz.: 1 to supply the roller-mill with clay, 1 to attend the cutting-table, and 1 to take the bricks from the table. In addition, there must be 1 engine-driver for all the machines driven by the same power, 1 or more carts to supply clay to the roller-mill, and 1 or more men to convey away and dispose of the bricks. Mr. Schlickeysen also had on exhibition a machine for moulding sewer- and water-pipes from plastic clay. It stands vertically, and is run by steam-power, the plastic pipe being expressed from the bottom. After running out to a length of about three feet, it is cut off at the die, and the moulded section removed for drying and burning. Before the expressing of a section of pipe begins, a sleeve flange is formed on the lower end of it by a separate die. When this is finished the end is neatly cut off, so as to leave only 4 to 4½ inches in length of flange, firmly joined to the body of the pipe. A vertical pugging-mill for manufacturing drain-tiles was also shown.

THE GREAT AMERICAN BRICK-MACHINE CO., *Croton Landing, N. Y.*

This company exhibited the Gard Brick-Machine, under the name of the Imperial Brick-Machine. Its general character will be understood by the drawings, Figs. 1, 2, 3, and 4.

In this machine the pug-mill *A* and pug-mill shaft *B* are horizontal, and the mould-wheel *C* is upon a horizontal shaft, so that the moulds *a*, *a*, arranged in a concentric circle in the mould-wheel, pass properly across the bottom or delivery end of the pug-mill in the lower part of their revolving circuit, and the bricks, as fast as they are moulded and compressed in the moulds, are delivered in the upper part of the circuit upon an off-carrying belt, *E*.

The power is communicated to the machine by means of a horizontal shaft, *F*, placed at the side of the pug-mill and parallel with its shaft *B*, to which it transmits motion through the cog-wheels *b* and *c* respectively on the two shafts; and a cog-wheel, *d*, on the driving-shaft *F* gears immediately into cog-gearing, *e*, on the periphery of the mould-wheel *C*, so that the pug-mill shaft turns in the same direction as the mould-wheel, and the cog-gearing, which transmits the motions to them, is relatively so proportioned as to impart the desired velocity to all the parts. The brick-delivering belt *E* is driven by means of an

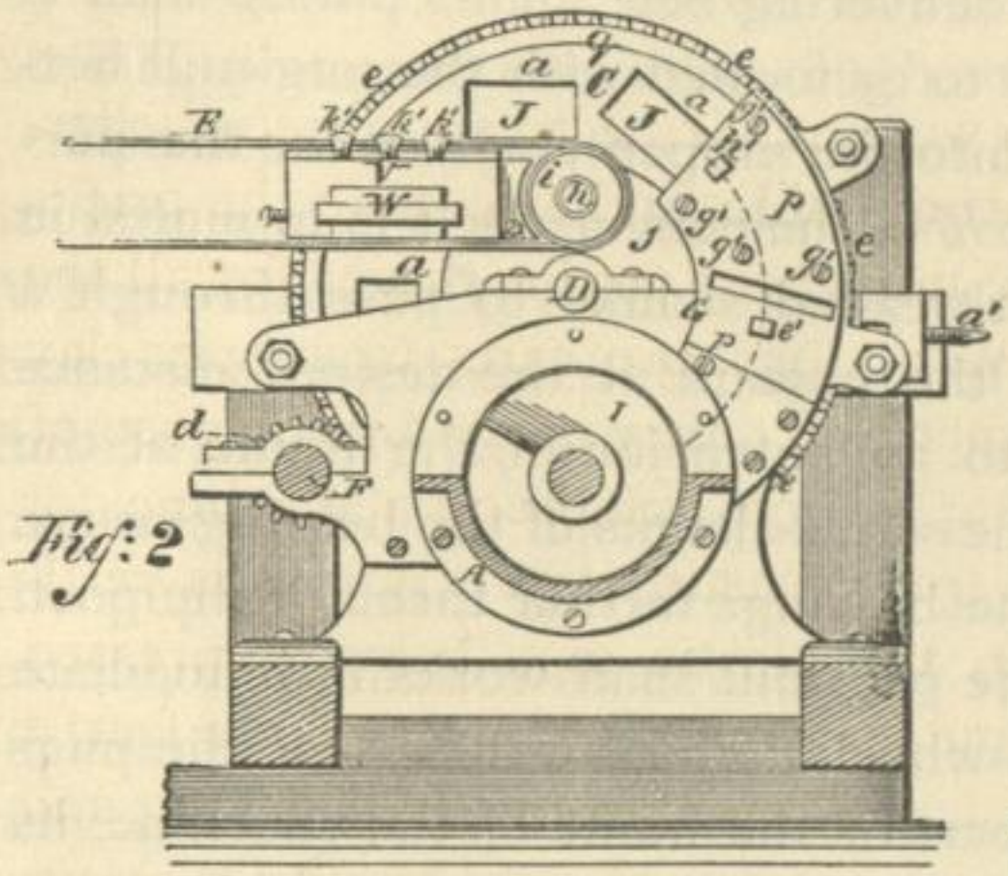


Fig: 2

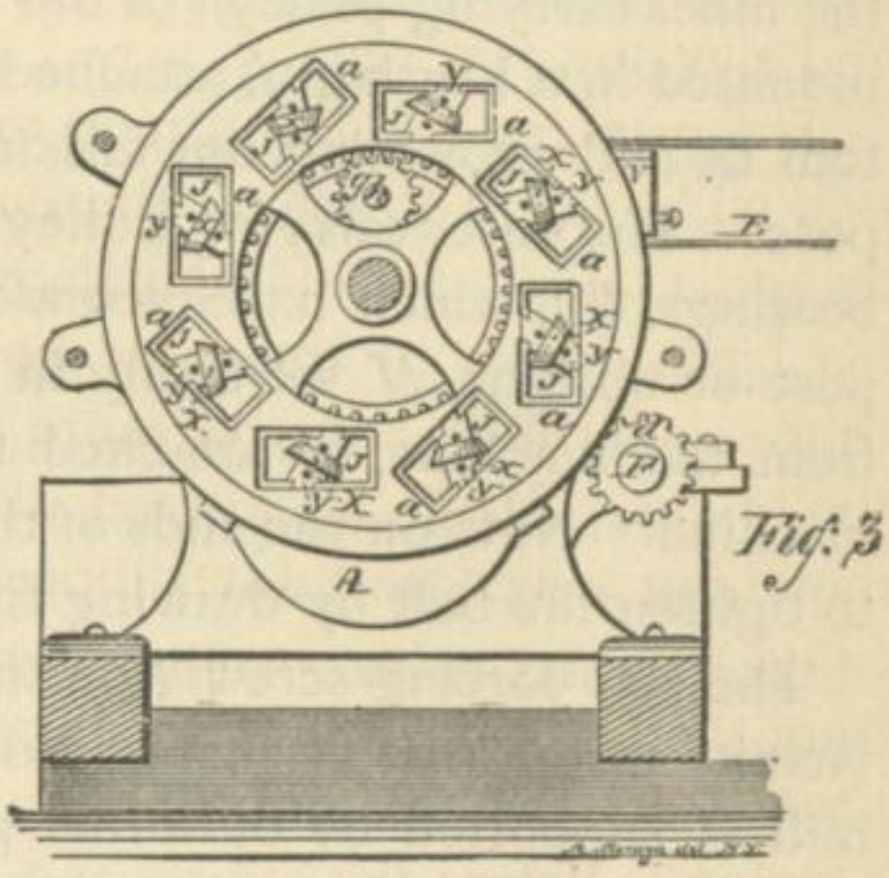


Fig: 3

Fig: 1

Fig: 4

FIG. 1.—Top view.

FIG. 2.—Section on *xx*.

FIG. 3.—Section on *yy*.

FIG. 4.—Section on *zz*, Fig. 1.

THE GARD BRICK-MACHINE.

internal gear, *F*, on an inner periphery of the mould-wheel, the mould-wheel being formed with a central cavity, as shown in Fig. 4, so that this movement for driving the belt is rendered practicable. This interior gear *F* matches into the cogs of a pinion, *g*, on the shaft *h* of the inner carrying-pulley *i* of the delivering belt. This pulley-shaft is mounted in a bearing, *j*, attached to or formed with the pug-mill bottom *G*, and projecting upwards into the proper position for the purpose. The outer carrying-pulley *K* of the delivery-belt is mounted in bearings, *l*, *l*, which have screw-threaded shanks to pass through a post or upright, *H*, set firmly in the ground at the desired distance from the machine, or attached to an extension of the frame of the machine. Nuts on the ends of the screw-shanks of the bearings serve to tighten the belt by drawing the bearings further through the post.

The clay-forcing screw *I* on the pug-mill shaft works in immediate vicinity to the face of the mould-wheel. The lower half of the pug-mill is supported by or forms part of the frame of the machine, its upper half being hinged to the lower half or made removable therefrom.

The inner end of the mould-wheel shaft has its bearing in an extension of the pug-mill bottom, and the inner bearing of the pug-mill shaft is in the outer end of the pug-mill. To secure the necessary strength of all the parts with this relative arrangement of the pug-mill screw and the mould-wheel, the face of the mould-wheel being made annular, with a central cavity therein, as above described, this annular part is made as narrow as practicable. Each side of the outer and inner corners of the moulds *a*, *a* are set oblique to the tangents of the mould-wheel, one end of each mould being at right angles to the radii of the wheel at those respective points, while the other ends of the moulds are considerably oblique to the radii of the mould-wheel at those points. An annular or arc-shaped opening is formed in the pug-mill bottom *G* to receive the annular part of the mould-wheel, allowing thereby the inner surfaces of the mould-wheel and of the pug-mill bottom to be flush with each other. The pug-mill screw *I* sweeps across this annular part of the mould-wheel and fills the moulds in the most efficient manner.

When the moulds are being filled, the adjustable bottom or followers *F F* in the moulds are forced backward therein by the pressure of the clay, itself driven forward by the screw *I*. After the moulds are filled they pass in succession behind a pressure- or striking-plate, which serves to cut off the clay in the mill from that in the moulds, and to receive the pressure from the rear produced by the followers *F F* when these are thrust forward by the passage of the friction-

rollers *X* over the cam *M* attached to the cam-track *K*. The pressed brick, arriving at the highest point in the revolution in the wheel, are expelled from the mould by the cam *S*, and are received on the off-carrying belt *E*. A surplus of clay is always forced into each mould by the screw *I*. The excess is cut off by a knife attached to the striking-plate and escapes through an outlet-aperture, *F*, in that plate.

This regulation of the movement of the followers while filling the moulds and the shape of the cam-track *K* to effect it are peculiar. When successively each follower in its circuit with the mould-wheel first comes opposite to the interior of the pug-mill, its inner surface is flush, or nearly so, with the inner surfaces of the mould-wheel and pug-mill bottom. Then, while it is traversing across the issuing of the pug-mill and the screw *I* is acting to press the clay into the mould, the follower is allowed, by the gradual retreat or backward inclination of the cam-track, as shown at *r*, Fig. 1, to move backward only gradually, so as to cause the mould to be continually filling during the whole, or nearly the whole, traverse across the pug-mill. Hence no air ever interferes to spoil the bricks, and the clay is always thoroughly compacted in the moulds.

For oiling the faces of the followers without oiling the face of the mould-wheel the followers are caused at proper times to be pushed out somewhat beyond the inner surface of the mould-wheel, when, or immediately after, they deliver the bricks upon the carrying-off belt. While in this projecting position the faces of the followers pass in contact with a brush or sponge, *W*, which is kept saturated with oil from the oiling-box *V* by a suitable device for gradually supplying the oil without waste.

The Gard Machine delivers a stiff, plastic brick, well moulded, and with good edges and angles. It is strong and simple, and does its work well. A good rate of speed is five revolutions of the mould-wheel per minute, producing 24,000 bricks in 10 hours. Its price, with right to use, but not the exclusive right in any place, is $2000, delivered on cars at Croton, New York, the place of manufacture.

The same company exhibited a brick-truck to run on iron rails, for conveying the bricks from the machine to the drying-yard. It runs over a rack containing a truck-frame loaded with bricks, picks up the frame and holds it suspended under the axles while it is pushed forward by hand. The truck-frame holds 500 bricks.

The price of four trucks, namely, two switch-cars (one at each end of the yard) and two trucks, one to take the bricks from the machine to the yard and the other to take the dry bricks from the yard to the kilns, is $500.

GREGG'S IMPACT BRICK-MACHINE CO., *Philadelphia, Pa.*

One of the most complete impact machines is that invented by Isaac Gregg, Sr., owned and operated by the Gregg Impact Brick-Machine Company of Philadelphia. Although it could not be seen in operation by any of the Judges, it is believed to be entitled to a description here, as embodying in a powerful machine of large productive capacity the most essential merits of its class.

Its principal feature is a horizontal rotating mould-wheel containing near its perimeter thirty-two brick-moulds, divided into eight groups, four moulds firmly bolted together forming a group. The moulds have movable bottoms, firmly attached below to followers (*H*, *H*, Fig. 1).

Crude clay from the bank is first broken up between a pair of cone-shaped rollers, which throw out the large and grind up the small stones, and is then carried up by means of an elevator and fed into the hopper *B* (Fig. 1), into which water is admitted, and where the clay is ground up and tempered by three spirally-set agitators. The moulds pass directly under the bottom of the hopper, and are filled with clay, four at a time, by the action of the agitators, while the mould-wheel is at rest. The mould-wheel then revolves, bringing the four charged moulds directly beneath four stampers (*G*, *G*, Fig. 1) which fit into the moulds with precision. These stampers, which weigh about 125 pounds each, by falling from a height of 20 inches, each independently of the others, compact the clay in the moulds by one, two, or three successive blows. The shocks of these blows are received by the anvil *I* (Fig. 1), and therefore no serious jar is conveyed to the rest of the machine. While the stampers are delivering these blows another set of moulds is receiving clay from the hopper. When the requisite number of blows have been given the mould-wheel again rotates, and the followers under the stamped moulds begin to ascend the inclined plane *J*, gradually pushing up the bricks to the required distance and bringing them under the sizing-knife *K* (Fig. 2), which cuts off the superfluous clay always allowed in the moulds, and reduces the bricks to a uniform thickness. After leaving the sizing-knife the followers continue to ascend the incline, pushing out the finished bricks, which finally reach the level of the top of the mould-wheel, at some distance beyond 3, Fig. 1, when they are swept off by an automatic arm on to trays, or on to an off-carrying belt, and are taken in charge by the workmen. While ascending the incline *J* the followers receive in succession a momentary but powerful upward thrust, by which the impacted bricks are re-pressed against a pressure-

Fig. 1

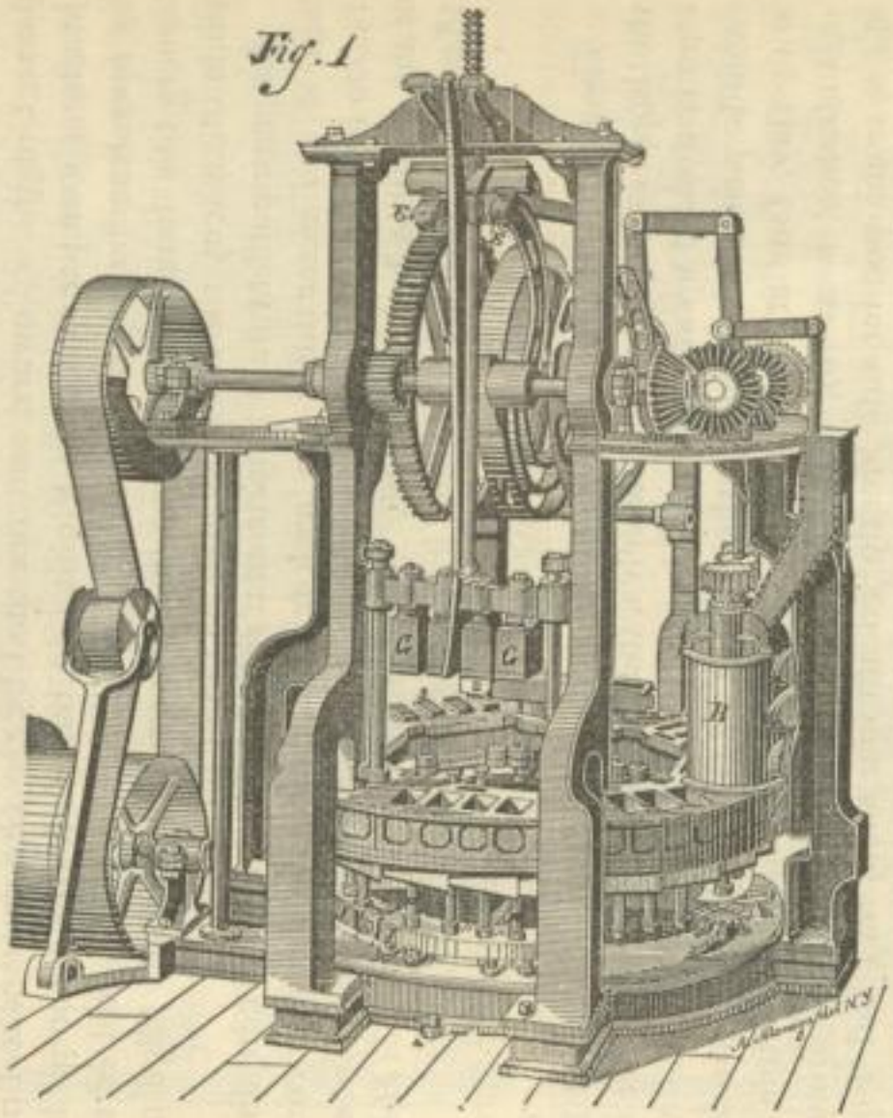
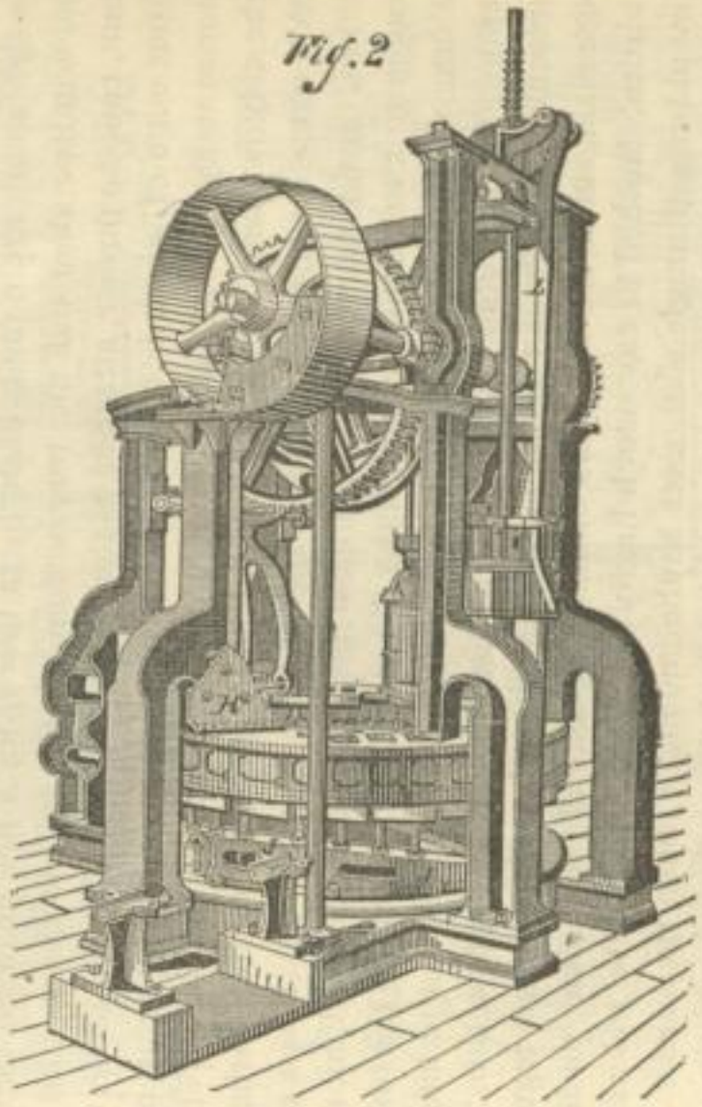


Fig. 2



GREGG'S IMPACT BRICK-MACHINE.

plate, under which the moulds pass after receiving the action of the sizing-knife *K*.

In the first machine constructed this re-pressing was secured by the passage of the followers, one after the other, over a small wheel projecting above the surface of the incline, but it is now accomplished by four levers operated by cams. While the mould-wheel is stationary the stampers are in operation at a group previously filled, and while the wheel is moving the stampers are held in suspension.

An engine of 15 horse-power is claimed to be sufficient to disintegrate and elevate the clay and drive the machine at the rate of 25,000 bricks in 10 hours, requiring a little more than 1¼ revolutions of the mould-wheel per minute. The weight of this machine is about 18,000 pounds (9 net tons), and its price $3000 to $3500.

F. L. & D. R. CARNELL, *Philadelphia, Pa.*

Though not regularly entered for competition, and therefore not entitled to an award under the rules, the Peerless Brick Machine was represented by a working-model in charge of F. L. & D. R. Carnell, exhibitors of brick hand-presses, and the machine itself was examined in operation in the Peerless Brick Company's yard in Philadelphia.

It consists essentially of an upright cylindrical pugging-mill, armed in the usual manner with spirally-set knives, which mix and temper the clay and force it down to and below a segmental false bottom placed in the lower part of the cylinder. In this space, a few inches in depth, between the false and the true bottom of the mill, works a kind of cam, called a pusher, attached to the pug-mill shaft. This pusher, the front edge of which is convex, forces the clay from the pugging-mill horizontally out through a die or mouth-piece into a mould. While the clay is being acted on by this outward pressure of the pusher a stop temporarily closes the space under the false bottom, like a partition, thus preventing the clay from going all the way around, and causing it to pass out through the die into the mould in the form of a bar, of which the breadth and thickness correspond to the length and width of a brick. Inasmuch as the pusher acts upon the clay intermittently, the bar issues forth intermittently. It stops at regular intervals, and while at rest six bricks are cut from it by seven thin steel blades, attached to a horizontal revolving shaft, which severs the clay by passing through thin slots in the mould. These six bricks are delivered alternately on the right hand of the machine and then on the left, the full mould giving place to an empty one in time for the latter to receive the bar of clay when it resumes its motion.

The different parts of the machine are shown in the drawings, Figs.

Fig: 1

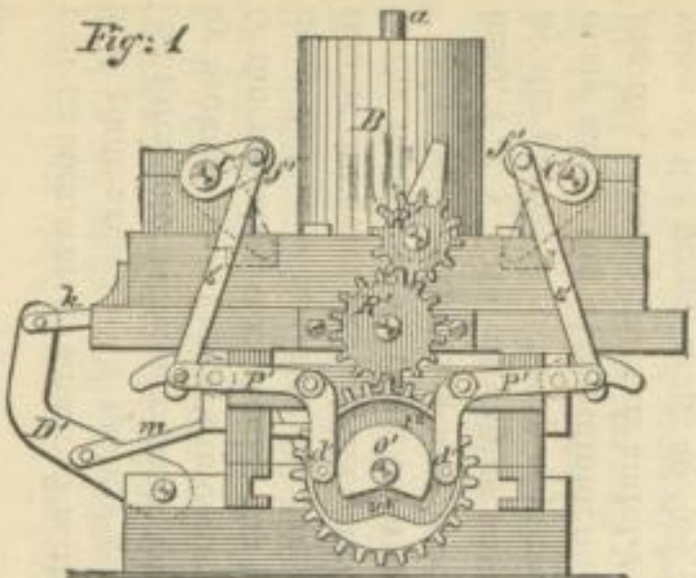


Fig: 2

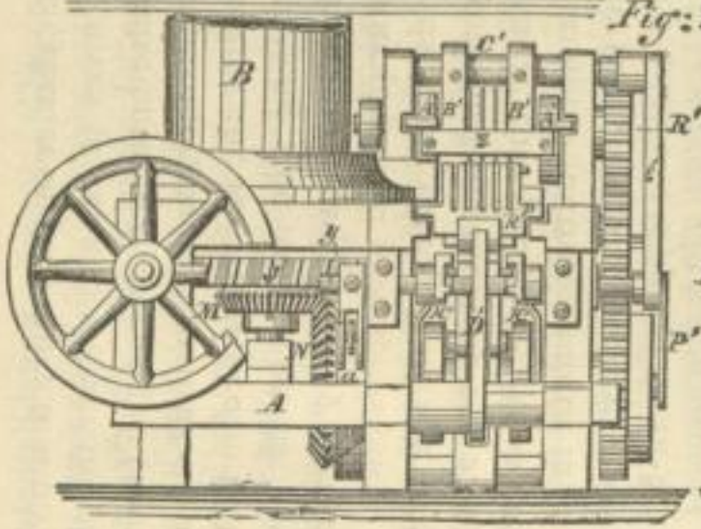


Fig: 3

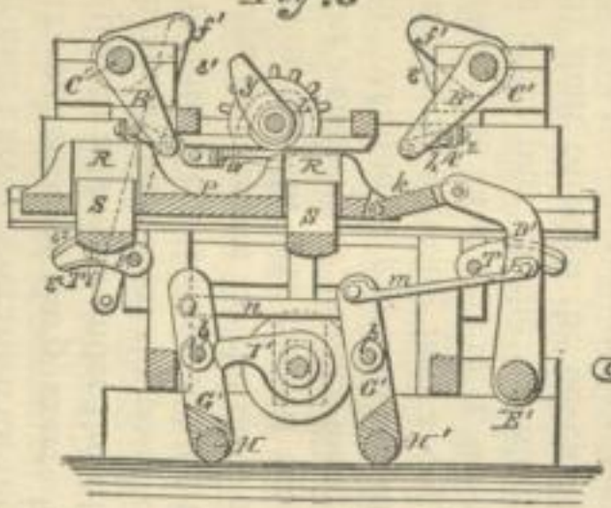


Fig: 4

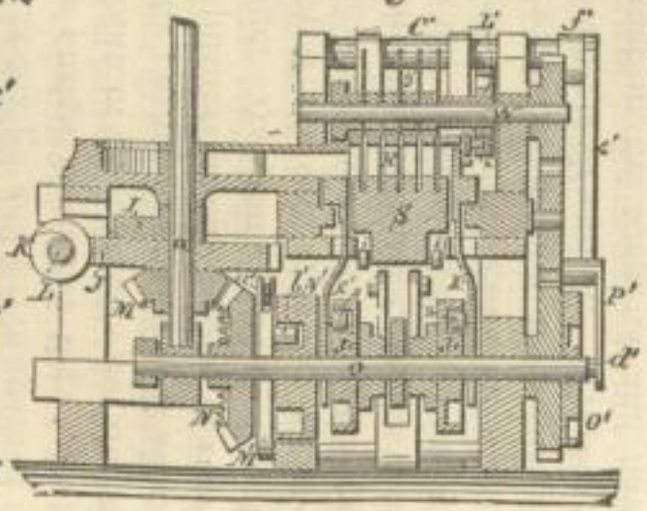


Fig: 5

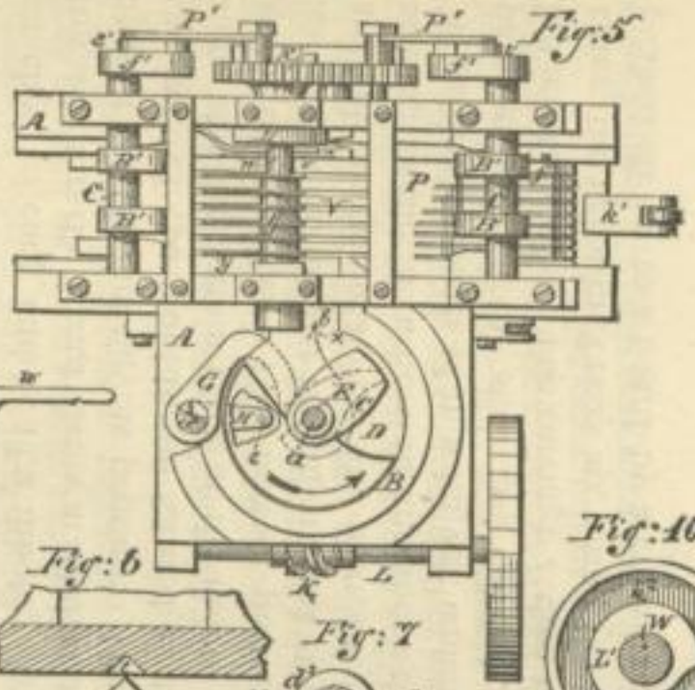


Fig: 6

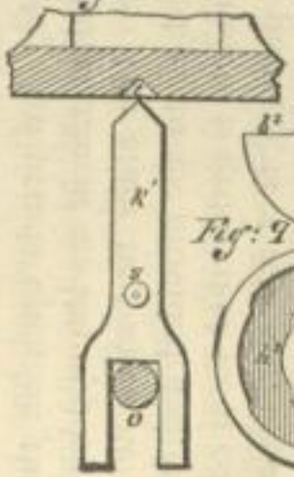


Fig: 7

Fig: 8

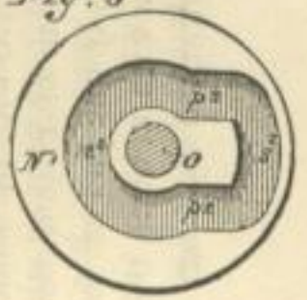


Fig: 9

Fig: 10

THE PEERLESS BRICK-MACHINE, Crabtree & Melcher, Inventors.

1 to 10 inclusive, in which *B* is the cylinder of pug-mill; *a* the vertical shaft armed with spirally-set knives to cut and temper the clay and force into the space under the false bottom *D*, Fig. 5; *E* (shown by broken lines, Fig. 5) the convex pusher attached to shaft *a;* and *G* the movable stop rigidly attached to the vertical rod *d*. To the same rod is secured an arm, *H*, carrying stud-roller *e* on its under side at the outer end. This roller bears on a cam, *I*, Fig. 7, attached to the shaft *a* below the bottom of the pug-mill.

The shaft of the pug-mill revolves in the direction of the arrow-head, Fig. 5. As the clay is forced toward the mouth-piece or die *b* by the pusher *E*, the stop *G* prevents it from going around continuously under the false bottom, but compels it to issue forth through the die. These parts, *E* and *G*, by their motion, produce a safety-valve at the proper time, so that any excess of clay fed down by the pug-mill knives is returned for the next charge, and fed in again at the next revolution of the pusher. This pusher is seen in Fig. 5, for, as the pusher advances under the false bottom *D*, it presses out the stop *G* before it, and when the point of the pusher has passed the side, *Y*, of the die, there is room behind the pusher for any excess of clay to escape and remain for the next charge. As soon as the pusher after passing the die has cleared the stop *G*, the cam *I*, acting upon the roller *e* and arm *H*, at once forces the stop inward to its original position. Motion is given to the machine by the shaft *L*, which carries a worm, *K*, working into a cog-wheel, *J*, attached to the pug-mill shaft. The shaft *O*, Fig. 4, which carries various cams for working the other part of the machine, receives its motion from the pug-mill shaft through the beveled cog-wheels *M* and *N*. *P* represents a movable carriage sliding on guides in the frame *A*, and having attached to each end of it a mould, *R*, which is open on the side towards the die *b*, and forms a solid abutment on the opposite side against which the clay is pressed. The other two sides, or rather the ends of the moulds, are formed of pieces provided with vertical slots, and the bottom piece of the mould is grooved to form continuations of the slots. This bottom piece, *S*, is a follower, raised and lowered at the proper time by means of two cams, *T*, *T*, Fig. 3, operated by the pinions *i i*. The stationary slat-work *V* forms the top of each mould in succession, and above this slat-work is a cross-shaft, *W*, carrying a series of thin knives, which revolve with the shaft, and, passing between the slats and through the bar of clay, divide the latter into bricks. The carriage *P* then moves to one end of the machine, the follower *S* rises up, lifting the bricks with it, when they are pushed off on to a board by a cross-bar, *Z*, attached to beads A^1 A^1

which slides in grooves. The cross-bar is worked back and forth by the rock-shaft C^1, C^1, through the medium of the links h h and the arms B^1 B^1. The carriage, followers, and push-bars are operated by the following means: At one end of the carriage is a hinged link, k, the outer end of which is pivoted to an elbow-lever, D^1, pivoted to a rock-shaft, E^1. The elbow-lever D^1 is, by a rod, m, connected with the upper slotted end of a straight lever, G^1, attached at its lower end to a rock-shaft, H^1. The two levers G^1 G^1 are connected by means of a bar or rod, n, as shown in Fig. 3, and in the slot of each lever is mounted a roller, p, for a cam, I^1, to operate against said cam, being secured on the shaft O. By the revolution of this shaft the cam I^1 operates alternately on the two rollers p p, to move the carriage endwise a suitable distance to bring first one mould, R, and then the other mould opposite the die or mouth-piece b.

To insure that the carriage shall stop and be held stationary at the exact point where the moulds will be opposite the die, so that the sides of the die and sides of the mould will be flush with each other, the shaft O is provided with two cams, $\mathcal{F}^1$ $\mathcal{F}^1$, each of which operates an arm, K^1, vertically up and down by means of a roller, S, mounted on a stud in the side of the arm, and working in the cam. The arm K^1 moves in suitable guides, and its upper end is pointed or V-shaped, as shown in Fig. 6. When the carriage arrives in position to bring either mould opposite the die, the arms K^1 are raised by the cams $\mathcal{F}^1$, so that their pointed ends will enter correspondingly-shaped notches, t, in the under side of the carriage, and hold it perfectly rigid while the clay is being forced into the moulds, and while the knives are cutting the clay into bricks. As an additional security against any vibration or movement of the carriage while the arms K^1 are being raised and lowered, a hook, w, pivoted to the inside of frame A catches on a pin, v, in the side of the carriage. This hook is raised and lowered by having a stud and roller, x, working in a cam, L^1, on the knife-shaft W.

The grooved cams T, which raise and lower the followers S in the moulds, are secured on a shaft, y, to the inner end of which is attached an arm, z, and this arm is, by a rod, a^1, connected with a lever, M^1, pivoted at its lower end to the frame, and provided near its upper end with a stud and roller, b^1, that works in a cam, N^1, on the shaft O. By these means the followers in the two moulds are raised and lowered at the proper time, it being understood that the mechanism just described is the same at both ends of the machine, and the rollers b^1 of the two levers M^1 both work in the same cam, N^1.

On the rear end of the shaft O is secured a cam, O^1, in which work

two studs and rollers, d^1, attached to the lower ends of two elbow-levers, P^1 P^1, mounted upon posts projecting from the frame. The other arms of these levers are, by rods e^1 e^1, connected with arms f^1 f^1, attached to the shafts C^1 C^1. These shafts having the arms B^1, to which the push-bars Z^1 are connected, the push-bars move at the proper times to move the bricks from the moulds. The knife-shaft W is rotated by suitable gearing, R^1 R^1, from the shaft O.

The operation of the machine is briefly as follows: The machine being in motion, the knives C on the shaft a in the pug-mill cut the clay and force it downward until the pusher E presses the mould full that is then opposite the die or mouth-piece b. As soon as the mould is full, and the pusher E has passed the mouth of the die, the knives Y descend through the slat-work V, and through the slots and grooves of the mould, cutting the clay into the proper size for bricks. Just before the knives clear the clay, the arms K^1 are moved downward to clear the notches t therein, and when the knives have entirely cleared the moulds, the hook W is raised by its cam from off the pin v. The carriage will then be moved so as to bring the other mould opposite to the die or mouth-piece b, and while this mould is being filled and the clay cut, the followers S in the first mould are raised by its cams T, and the brick then pushed off by the push-bar Z. The various cams mentioned are constructed in the following manner: The cam I, which forces the stop G inward, is shown in Fig. 7, and has a semicircle, a^2, concentric with the shaft a, and from each end of the semicircle is a straight side, b^2, extending radially inward for a suitable distance, and then a smaller semicircle, d^2, in the opposite direction, also concentric with the shaft a. The cams T, for operating the followers S in the moulds, are shown in Fig. 3, and consist simply of curved concentric flanges, e^2 e^2, between which the rollers I on the followers are caught and pass as the cams revolve. The cams $\mathcal{F}^1$, for operating the bars K^1, are constructed, as shown in Fig. 9, with two quarter-circles, f^2 f^2, of the same diameter, and concentric with the shafts O, upon which the cams are secured. The two quarter-circles, f^2, are connected by curves, h^2 h^2, and straight portions, i^2 i^2, at each end of the curve.

The cam L^1 on the knife-shaft W, for operating the hook w, is shown in Fig. 10, and has a groove, k^2, of nearly three-fourths of a circle, and concentric with the shaft, the two ends of the groove being connected by an irregular groove, m^2, which causes the hook to lift off of the pin V instantaneously, and return it, in like manner, into the pin, where it remains, while the roller x of the hook passes through the three-quarter circular groove k^2. The cam N^1, which

operates the cams T, is shown in Fig. 8, and is constructed with a groove, n^2, about two-thirds of a circle, and concentric with the shaft O, on which the cam N^1 is secured. From the ends of the groove n^2 extend two parallel grooves, p^2 p^2, the outer ends of which are connected by a curved groove, S^2. In these grooves work the rollers b^1 of the levers M^1, for imparting the proper motion to them. The cam O^1, for operating the pusher-bars Z, is shown in Fig. 1, and has a two-thirds circular groove, t^2, connected by means of two inwardly-inclined grooves, v^2 v^2.

The machine delivers a stiff plastic brick at the rate of 18,000 to 20,000 in 10 hours. Its weight is about 8000 pounds, and its price is $3500. The use of a roller-mill in connection with it is recommended, so that the lumps of clay and the small stones may be pulverized and the large stones thrown out.

The machine was not seen at work under favorable conditions, having been specially started for the Judges, after a season of disuse. It however showed itself capable of doing good work.

ISAAC GREGG, JR., & CO., *Philadelphia, Pa.*

This firm exhibited a working model of their "Combination Brick-Machine;" and the machine itself, which belongs to the class which operates upon crude clay in a moist state, was seen at work in the yard at Thirty-first Street and Lehigh Avenue, Philadelphia.

The machine consists essentially of a horizontal revolving mould-table, made of cast-iron, containing a number of brick-moulds near the perimeter, into which the clay is fed in succession, usually by hand from a hopper. The pressure is applied by means of plungers operated from below. Each brick receives three compressions, the last one leaving it one-eighth inch thinner than the second pressure. After the last compression the brick is expelled upward and delivered on the top of the mould-table, and is then removed by hand. It is claimed that this machine will work equally well in either tough or weak clay, and that it will produce a fair face brick without the necessity of resorting to hand-pressing, by passing the bricks a second time through the machine after they have been dried a few hours. Each mould, after delivering its brick, is automatically cleaned out with an oiled sheep's-pelt. With 8 moulds in the table, 10,000 bricks can be produced in 10 hours. An engine of one-horse power will run a machine of this capacity.

In the accompanying drawings Fig. 1 is an elevation of the machine; Fig. 2, a plan of bed-plate, showing inclined plane and press-

ure cams; Fig. 3, a vertical central section; and Fig. 4, a top view of mould-table.

The machine is mounted upon an annular bed-plate, *A*, which is substantially secured to a suitable foundation. A circular mould-table, *B*, provided with a series of mould-boxes, B^1, is mounted upon an upright stationary shaft, A^1, secured to the bed-plate *A*, and is free to rotate around the shaft. A spur-wheel, B^2, is formed upon the periphery of the mould-table, to which an intermittent rotary movement is imparted by a mutilated spur-pinion, C^1, which meshes into the spur-wheel B^2. The pinion C^1 is mounted upon an upright shaft, *C*, which is rotated by the driving-shaft *D*, through the intermediation of the mitre gear-wheel *c* and *d*. The mould-boxes B^1 are respectively provided with followers, each of which is secured upon an upright stem, B^4. Friction rollers are fitted to the bottom of the stems to facilitate their circular traverse, and the pins *b* are projected to draw the followers to their lowest extremity, as will be hereafter described.

The driving-shaft *D* carries a pulley, D^1, to which the motive-power is applied, and is provided at its end nearest the centre of the machine with a bevel-wheel, a^1, which meshes into corresponding wheels, *e*, *f*, respectively secured upon the horizontal shafts *E F*, which rotate in bearings upon the bed-plates. A bolt or detent, *G*, secured in a guide upon the frame is operated by a cam, C^2, secured to the upright shaft *C*. The end of this detent *G* is V-shaped, to fit corresponding openings, *g*, in the ends of the mould-boxes. When the teeth of the mutilated spur-pinion C^1 are in gear with the spur-wheel B^2, the cam C^2 holds the detent out of gear so as to admit of the rotation of the mould-table; but as soon as the latter ceases to rotate the cam causes the detent *G* to be projected into the openings provided in the mould-boxes, and the mould-table is thereby held stationary.

In the rotation of the mould-table, which is in the direction of the arrows, Fig. 2 and Fig. 4, the follower-stems B^4 traverse a series of circular inclines, bearing-pieces and cam-yokes, the relative arrangement of which is as follows: Beginning at the point marked * on Fig. 2, the follower-stems first ascend the incline *H*, from which they pass to and over the cam-yoke e^1. This yoke is located immediately above, and periodically elevated by, a cam, e^2, the stems pass to and over the segmental bearing-piece H^1, which is slightly inclined upward in the direction of the rotation. The stems next pass to and over another cam-yoke, d^1, located above, and operated by a cam, d^2, on the shaft *D*, the throw of the cam d^2 being greater than that of the cam e^2; thence over another inclined bearing-piece, H^2, to and over a third cam-yoke,

Fig: 1

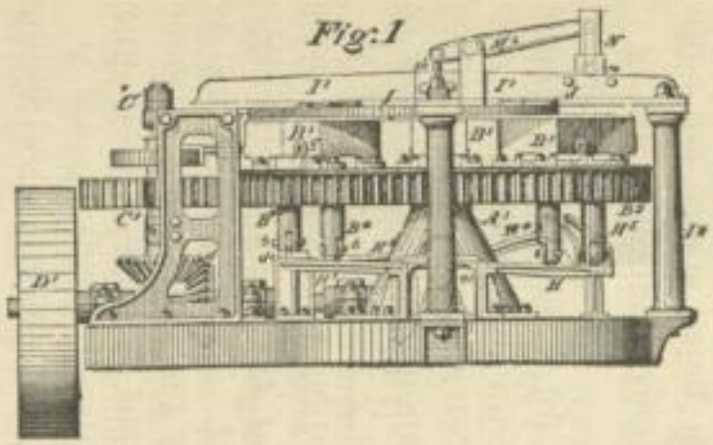


Fig: 3

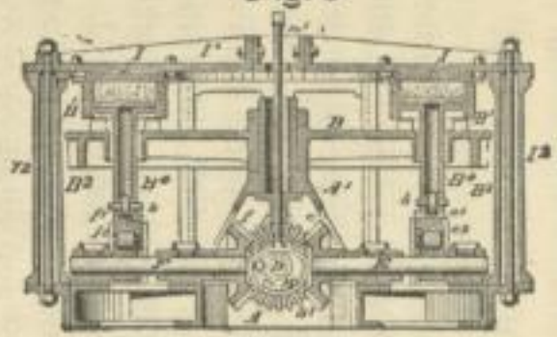


Fig: 2

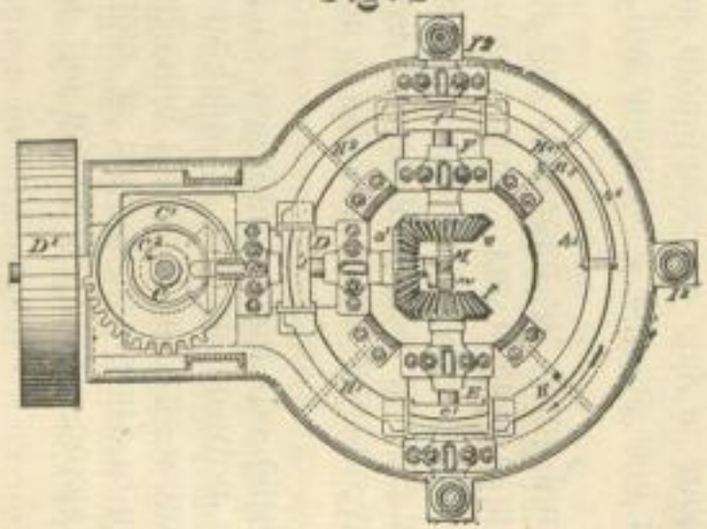


Fig: 4

THE COMBINATION BRICK-MACHINE, Isaac Gregg, Jr., Inventor.

f^1, operated by the cam f^2, on the shaft F, the throw of the cam f^2 being again a little greater than that of the cam d^2. Then the follower-stems traverse over the ascending incline H^3 to a bearing-piece, H^4, and thence down a descending incline, H^5, to the point where the mould-boxes are oiled previous to being filled with fresh clay. Flanges h^5 upon the incline H^5 engage the pins b^1 of the follower-stems, and thereby maintain the ends of the latter in contact with the incline H^5 during their descent.

A pressure-plate, I, extends over the top of the mould-boxes B^1, with the exception of such a number as may be necessary to have uncovered for oiling and cleaning, feeding the clay, and the removal of the finished bricks. The pressure-plate is held in position and strengthened by braces, I^1, secured to columns, I^2, and the upright frame mounted upon the bed-plate.

A gauge or scraper, J, is attached to the end of the pressure-plate to remove the superfluous clay from the mould-boxes as they pass beneath the pressure-plate, and a hopper is provided from which the clay is fed to the mould-boxes by an attendant. The oiler N is intermittently reciprocated by means of the cam-yoke M, crank-pin m, rod m^1, and lever M^1.

In the continuous operation of the machine, it will be seen that while the clay is being fed to one mould-box, the clay in another box is undergoing the preliminary pressure; that the clay in a third box is receiving the second pressure; that in the fourth box it receives the final pressure; and that in a fifth box the brick is being expelled.

The number of boxes, and number of moulds in each box, can be increased, thereby adding to the capacity of a machine at a small additional expense. A machine with 6 moulds has a capacity for making about 10,000 bricks per day. The machine is simple in all its parts; not liable to get out of order; requires only small power to run it; the wear and tear is moderate; it requires no skilled labor, and is adapted to work all kinds of clay, strong or weak, with equal facility.

THE EXCELSIOR BRICK AND STONE COMPANY, *Philadelphia, Pa.*

This company exhibited a model of their brick-machine, and afforded an opportunity to witness the operations of the machines in their yard in Philadelphia. Four of them are at work in this city, two in Chicago, one in Richmond, Va., and one in St. Louis, Mo., all of the same pattern and capacity.

The machine has 2 sets of moulds, 7 in each set, fixed in an alternating carriage that passes under a feeder which fills the moulds with

clay; and these, when filled, pass and repass under a transversing pressure-wheel that gives to the brick in the mould two distinct downward pressures. To the plate bottom of each mould is attached a piston, which is made to pass up an inclined plane as the carriage moves to its point of alternation, and as these pistons move on that plane, they give to the bricks in the moulds an upward pressure; and when all the pistons have passed the summit of the inclined plane they rest on the level plane of a lever, which in its turn lifts the bricks to the surface of the moulds, from whence they are removed by means of a sweep. The feeder is supplied with clay by elevators, which get their supply from the pit of two grinding-rollers, which take the clay fresh from the bank and prepare it for the moulds. The bricks produced are stiff, and slightly plastic, not differing materially in these respects from those turned out by other crude-clay machines.

It has a productive capacity of 30,000 bricks in 10 hours, and can be run considerably beyond that number. It does not appear to give as regular and sharp edges to the bricks as the Isaac Gregg, Jr., and the Wm. L. Gregg machines.

This Excelsior machine was invented by Wm. L. Gregg, who states that no more of them are to be manufactured, as it is intended to replace those in the market by the triple-pressure machine described below.

GREGG'S TRIPLE-PRESSURE BRICK-MACHINE, *Philadelphia, Pa.*

Wm. L. Gregg, of Philadelphia, exhibited his triple-pressure brick-machine in complete working order. It consists essentially of an intermittently revolving mould-table, with suitable devices for filling the moulds with clay; for compacting the clay by pressure from above and below; for compensating for unequal filling of the moulds by yielding plungers, which impress upon the sides of the brick panels or recesses with depths varying with the quantity of clay in the mould; and finally for expelling the bricks upward from the moulds to the level of the upper surface of the mould-table.

In the accompanying drawings Fig. 1 is a perspective view of the machine; Fig. 2 a vertical section on the line *x x* of Fig. 4; Fig. 3 a vertical section on the line *y y* of Fig. 4; Fig. 4 a sectional plan taken just above the mould-table; Fig. 5 a view of the triple crank and connection for giving the final pressure to the brick; and Fig. 6 a section on an enlarged scale of the device for paneling the bricks. The bed-plate *U* is connected by columns *V* to an upper frame, *W*. A lighter frame, *X*, secured to the columns *V*, carries a central cylindrical bracket, *Y*, and the circular mould-table *A* is secured upon the

vertical shaft A^1, and rotates in the step u, on the bed-plate. a a are mould-boxes, in groups, near the rim of the mould-table. Each set of mould-boxes is provided with a series of pistons, I, one for each box, working from the lower side upward therein, the separate pistons of each set being secured to blocks, i, carrying rollers, i^1, which traverse upon a circular track, K. An intermittent rotary motion is given to the mould-table in the following manner: A driving-shaft, g, is mounted in bearings in the frame H, and carries a fast and a loose pulley g^1, g^1, for the reception of a belt for transmitting the power from any suitable prime mover. A bevel-pinion, G^2, upon the driving-shaft g gears into a larger wheel, G^1, upon the vertical shaft G. A connecting rod, h^1, is journaled at one end to a crank upon the shaft G, and at the other end to a rocker-arm, D, which is loose upon the shaft A^1, and carries a pawl, d, upon its outer end. The shafts G and A^1 are so located relatively to each other, and the lengths of the crank and rocker-arm are so proportioned, that each revolution of the crank-shaft oscillates the rocker-arm forward and backward one-eighth of a revolution. At each forward movement of the rocker-arm its pawl engages one of eight ratchet-teeth, a^1, on the upper portion of the mould-table, said ratchet-teeth being placed thereon at equal distances apart in a circle, the radius of which is equal to the length of the rocker-arm D. The mould-table will, therefore, be moved forward for one-eighth of a revolution by each forward movement of the rocker-arm, and will remain stationary while the latter is making its backward movement.

A bevel-gear, a^2, is formed upon or secured to the periphery of the mould-table A, and gears with a corresponding pinion, B^2, upon a horizontal shaft, B^1, which shaft also carries a press-wheel, B, and a bevel-wheel, B^3. The press-wheel B rotates within a feed-box, c, and its shaft B^1 rotates in vertically-sliding boxes placed in guides in the sides of the feed-box, being pressed downward by rubber springs and adjusting screws, c^4. The object of this elastic adjustment of the press-wheel shaft is to insure sufficient, but not excessive, pressure being applied by the press-wheel to compact the clay in the mould-boxes as they successively pass beneath it. A mixer-wheel, C, having a cylindrical hub and a series of knives and beaters, arranged spirally thereon, is journaled in the feed-box c, and is rotated rapidly by means of gear-wheels b^1 b^2 upon the shaft b, one of which wheels, b^1, meshes with the bevel-wheel B^3 and the other with a corresponding wheel upon the shaft of the mixer-wheel. The mixer-wheel is arranged in advance of the press-wheel,—that is to say, in such relative position thereto that in the traverse of the mould-table the mould-boxes will pass

Fig: 1

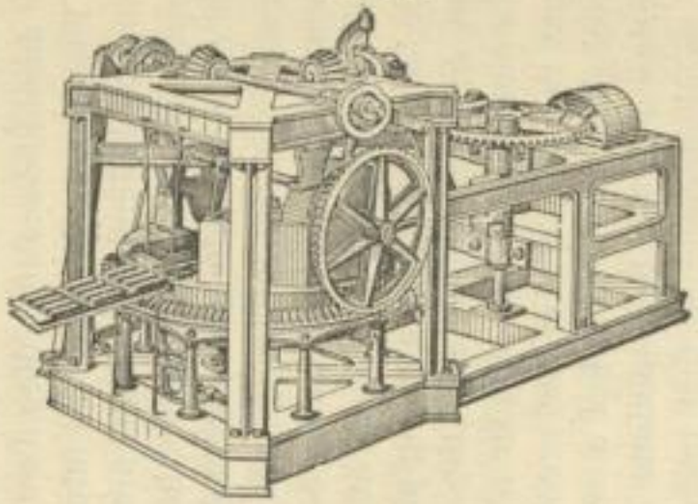


Fig: 5

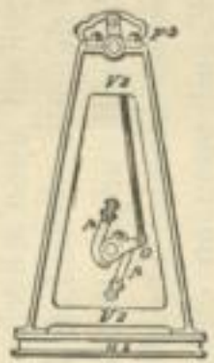


Fig: 2

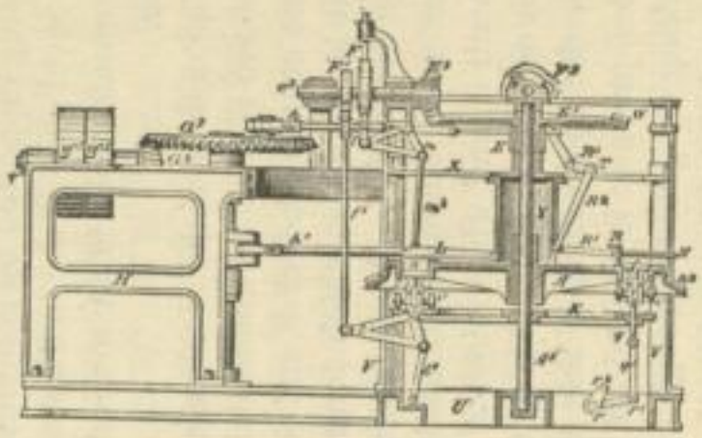


Fig: 3

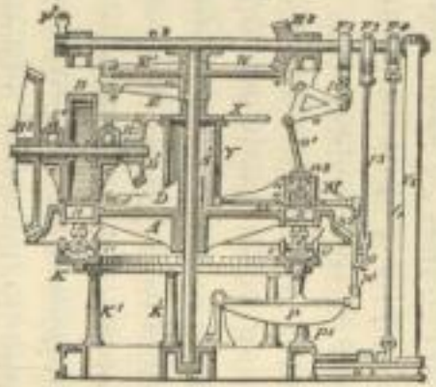
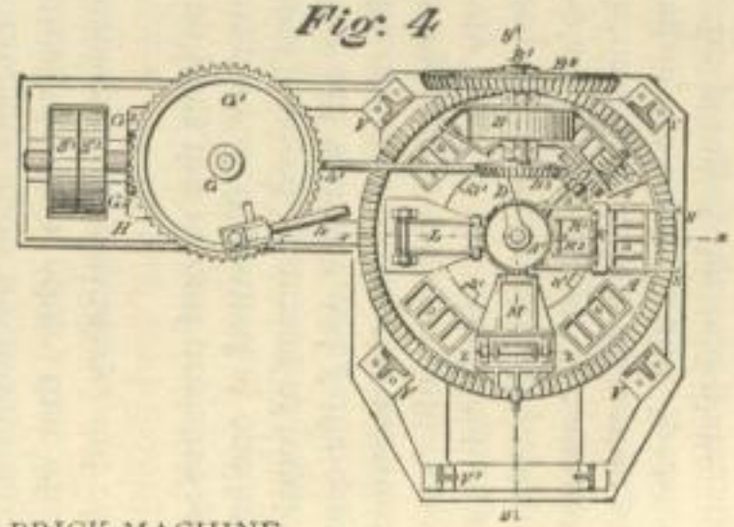


Fig: 6

Fig: 4



WM. L. GREGG'S TRIPLE-PRESSURE BRICK-MACHINE.

beneath it before reaching the press-wheel, and in the opposite end of the mould-box a knife is provided to remove the surplus clay from the mould-boxes after they have passed the press-wheel.

The clay, having been fed into the mould-boxes from the feed-box, compacted therein by a light pressure from the press-wheel, and the surplus removed by the knife (these operations being performed during the rotation of the mould-table), is next subjected to two successive pressures in the following manner: A bevel-gear, E^1, turns loosely upon the shaft A^1, immediately below the upper frame, and is provided with four ratchet-teeth, e^1, set at equal distances apart upon its lower side, and actuated by a spring-pawl, e, upon the free end of a rocker-arm, E, placed loosely upon the shaft A^1. The rocker-arm is coupled to a pin upon the bevel-gear G^1 by a connecting-rod, h, and is oscillated thereby, so that one revolution of the gear G^1 will rotate the bevel-gear E^1 one-fourth of a revolution. The bevel-gear E^1 in turn meshes with the bevel-pinions E^2 E^3, each one-fourth the diameter of its pitch circle, so that one-fourth of a revolution of the gear E^1 will impart one revolution to said bevel-pinions. The bevel-pinion E^3 is secured upon a horizontal shaft, e^3, set at right angles to the shaft of the mixer-wheel, and the pinion E^2 upon another horizontal shaft, e^2, at right angles to the shaft e^3, and directly opposite the shaft of the mixer-wheel. The shaft e^2 rotates in bearings upon the upper frame W, and upon an outer column, V^2, and the shaft e^3 also has its bearings upon the upper frame, and, in addition, has an outer bearing supported by columns. The ratchets upon the mould-table and bevel gear E^1 are so disposed, relatively to each other, that when the mould-table is in motion the bevel-gear is stationary, and *vice versa*.

The details of the mechanism for applying the second pressure are shown in Fig. 2. A horizontal pressure-plate, L, is pivoted at one end to the central bracket Y, and is raised and lowered by means of toggle-joint levers m^1 m, which connect its free end with the rod f of a cam, F, on the shaft e^3. When lowered by the cam and levers, the pressure-plate is applied and held firmly to the top of the set of mould-boxes beneath it, and when raised it is entirely clear of the mould-table, so as to oppose no resistance to the movement thereof. Simultaneously with the application of the pressure-plate to the tops of the mould-boxes, pressure is applied to their pistons from below by a plunger working in guides through an opening in the track K, and operated by toggle-joint levers l l^1, pivoted to the plunger, the bed-plate, and the rod f^1 of a cam, F^1, on the shaft e^3. The plunger in its upward movement compresses the clay in the mould-boxes, and in its down-

ward movement is drawn clear of the piston-blocks before the mould-table commences its movement.

The details of the mechanism for applying the third and final pressure to the clay, and for recessing or paneling the bricks, are shown in Figs. 4, 5, and 6. In this instance a lower pressure-plate, *P*, is hinged at one end to a standard, *Z*, upon the bed-plate, and has a pin upon its opposite end connected by a link, p^1, to a triple crank, *O*, from which a connecting-rod, f^3, extends to a cam, F^3, on the shaft e^2. A plunger, *k*, passing through an opening in the track *K*, rests upon the pressure-plate *P*, and is applied and held firmly to the bottom of the piston-block of the mould-boxes by the cam F^3.

When the pressure-plate *P* is lowered, it rests upon a short column, P^1, on the bed-plate. A pressure-box, *M*, is pivoted at one end to the bracket *Y*, and connected at the other end by a link, *p*, to one arm of the triple crank *O*, so as to be applied to and held against the top of the mould-table at the same instant as the plunger *k* is applied to the piston-block. A series of guides are formed in the pressure-box *M* at such a point therein that each guide shall be immediately above one of the mould-boxes of a set when the mould-table is stationary. Each guide serves to contain and direct a small plunger, *n*, the bottom of which plunger is of such form and dimensions as may be desired for the panel or recess to be made in the brick. A rubber spring, n^1, is placed upon the top of each plunger, and a plate, n^2, rests upon the springs n^1. The plate n^2 and the plunger *n* are pressed down by toggle-joint levers $o\,o^1$, pivoted to the upper frame *W*, and to the rod f^2 of a cam, F^2, on the shaft e^3.

By means of the mechanism just described, the clay is compressed between the pistons *I* and pressure-box *M*, and held there while the panels or recesses are sunk in the upper faces of the bricks, the additional pressure of the plungers *n*, as modified and regulated by the interposition of the springs n^1, serving to insure equal density and equal outside dimensions to the bricks in the several mould-boxes, irrespective of the amount of clay in each, as a deeper panel will be sunk if there is not sufficient clay in a mould-box, or a shallower one if too much.

The final operations of expelling the finished bricks from the mould-boxes and removing them from the mould-table are performed by mechanism shown in Figs. 1 and 2. The pistons of the mould-boxes are elevated high enough to bring the lower edges of the bricks to the level of the top of the mould-table by a plunger, *q*, which is connected by a link, q^1, with a crank, r^1, on a horizontal shaft, *r*, which shaft is oscillated in its bearings by a cam, F^4, the frame of which is connected

by a rod, f^4, with a crank, r^2, on the shaft r. The plunger passes through an opening in the track K, and, when raised, bears against the bottom of the piston-block, and thereby elevates the pistons of the mould-boxes to the desired height. As soon as the bricks are raised to the upper level of the mould-table they are pushed off the same by a sliding plate, R, moving on horizontal guides S, and operated by a cam, F^5, upon the shaft e^1, the plate being connected to a horizontal rock-shaft, T, by links R^1 R^2. The rock-shaft and cam are connected by a rocker-arm, R^3, and connecting-rod, Fig. 2. The bricks may be received either upon boards or upon an endless conveyer-belt as they are pushed off the table by the plate R.

In the operation of the machine, as before stated, the clay is fed to the mould-boxes, compacted therein, and the superfluous clay removed by the knife while the mould-table is in motion. The subsequent pressing and paneling of the bricks, and their removal from the mould-boxes and table, are all effected during the intervals of rest of the mould-table, these operations being respectively performed simultaneously on the clay in different sets of mould-boxes. The action of the machine is continuous by reason of the progressive movements of the mould-table. The machine requires the clay to be in a certain condition of disintegration, such as would be secured by passing crude clay just from the bank through an ordinary roller-mill. The bricks produced are stiff and moderately plastic. The machine exhibited contained 8 groups of brick-moulds, of 4 moulds each. Two revolutions of the mould-table per minute, yielding 38,400 bricks in 10 hours, is believed to fairly represent the productive capacity of this machine, when operating under ordinarily favorable conditions. With some clays it could be pushed to from 44,000 to 45,000 in 10 hours. Its price, fitted up with steel moulds and a roller-mill and elevator, is $3000, which does not include a small royalty on the bricks.

HENRY AIKEN, *Philadelphia, Pa.*

Mr. Aiken exhibited a working-model of an expressing brick-machine. The machine itself was not seen at work, and therefore its comparative merits cannot be asserted in positive terms. Its price is low, and its average productive capacity 20,000 bricks in 10 hours. The cross-section of the expressed bar is the length by the breadth of a brick. It runs out upon a cutting-table arranged with wires to cut off eight bricks at one stroke, and in the act of cutting the bricks are pressed to one side, forcing back the eight previously cut upon a board, on which they are carried away.

Mr. Aiken also exhibited a working-model of a clay-cleaning and

tempering mill, which, it is claimed, will thoroughly separate all stones, roots, and pebbles from the clay, and temper it ready for use in a few minutes after it leaves the bank. The mill consists essentially of a horizontal pug-mill, armed, as usual, with spirally-set knives, working in both directions, from the middle towards the ends of the mill, so that all thrust upon the bearings of the shaft is eliminated. The case of the mill is cylindrical at the middle and tapers in a frustum of a cone towards each end, and both ends are open. The case, or at least the lower half of it, from end to end, is composed of longitudinal bars, which form a grating, through which the clay drops, while the stones, roots, etc., are forced forward and delivered at the open ends. (See drawing.) One of these mills will clean clay enough, ordinarily, to keep two brick-machines running.

Roller-mills for disintegrating the clay and bringing it to a fit condition for making bricks have been referred to. They are sometimes called crushing-rollers, as they not only crush and grind up the clay, but they are generally made strong enough to pulverize any small stones which pass through them, while the larger pebbles are rejected. These mills consist of one or two pairs of iron rollers, which may be cylinders or frustums of cones, the rollers of each pair being set side by side in a strong frame, and geared or belted to revolve in opposite directions towards each other, as seen from above, so as to draw the clay down between them. When only one pair of rollers is used they should revolve at different rates of speed, usually about 2 to 1, so as to exert not only a crushing, but a grinding and rubbing effect. In a mill of two pairs of rollers, one pair is placed above the other, and those of the upper pair may revolve at the same speed. The rollers are generally about 2½ to 3 feet long and 18 to 20 inches in diameter, and the clay is commonly fed to them through a hopper, and passes from the mill to an endless-belt elevator, which carries it directly to the hopper of the brick-machine, as shown in the drawing of Schlickeysen's machine No. 2.

Sometimes conical rollers are used for the upper pair and cylinders for the lower, the diameter of the latter being about the same as the smallest diameter of the cone. A conical roller 3 feet long may be about 16 to 18 inches in diameter at one end, and 22 to 24 inches at the other. Suitable rates of speed would be from 100 to 200 revolutions per minute for one of the rollers, and from 200 to 300 for the other. The conical shape facilitates the separation of the larger stones by throwing them off at the larger end of the rollers.

CERAMIC KILNS.

The best kiln for any special purpose is undoubtedly that in which the requisite intensity of heat can be produced and maintained under the most perfect control at the least expense for fuel and labor. Judged by this standard, the modern kiln, in which the firing takes place by successive chambers, and the waste heat from one chamber is used for drying and gradually heating the wares in those which follow, is vastly superior in economy of fuel, simplicity of management, and uniformity of burning,—whether for bricks, fire-bricks, cement, or pottery,—to the best kilns in use twenty years ago. The advance in the improvement of kilns for firing bricks has been fully as great as in the machinery for moulding them.

AUGUSTUS MORAND, *Philadelphia.*

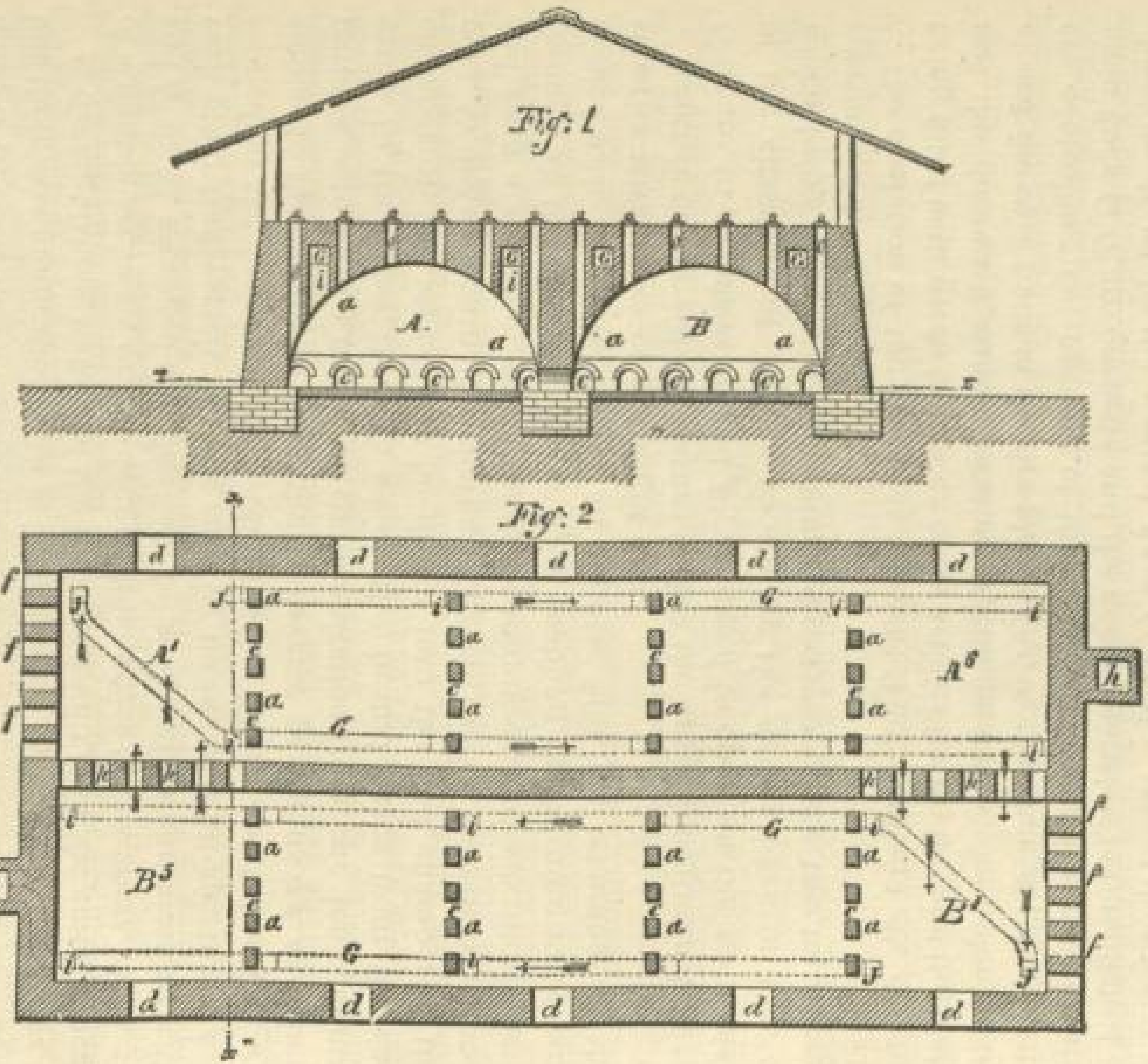
This was shown by a model, and the kiln itself was seen in the exhibitor's brick-yard.

Fig. 1 of the drawings is a vertical section taken on line *x x*, of Fig. 2. Fig. 2 is a sectional plan on line *Z Z*, of Fig. 1, the flues *G G*, situated over the chambers, being shown in dotted lines.

As represented in the drawings, A^1 to A^5 are the drying- and burning-chambers of the kiln, which are preferably built in a right line with each other, and which are inclosed with strong, well-built outer walls, and arched roof, lined with fire-proof material. The chambers are separated by transverse partitions, *a a*, in which air-holes, *c*, are left to be opened or closed at pleasure in the operations of the kiln.

Each chamber is also provided with an outer doorway, *d*, through which the brick or other wares are conveyed in filling or emptying the chambers, and which are likewise closed in the customary manner with temporary walls of brick. In chamber A^1, and situated preferably in the outer wall thereof, is arranged a series of fire-places, *f f*, and each chamber is provided with a series of stoking-holes, *o o*, which are formed in the arched roof.

The entire kiln is preferably covered, and the workmen protected by a shed or roof, as seen in Fig. 1. *G G* are horizontal steam- and



MORAND KILN FOR BURNING BRICKS, TILES, ETC.

smoke-flues, formed longitudinally through the arched roof of the kiln, one being on each side, as shown in Fig. 1. Vertical connecting flues or passages, *c c*, are formed on each side of the arch through the top of each chamber, and preferably at the end farthest from the fire-places *f f*, so as to communicate with the flues *G G*, as shown more clearly in Fig. 1. The flues *i i* are controlled by dampers arranged to be operated from the top of the kiln. The two main flues, *G G*, open into a common chimney, *h*, at one end of the kiln, but there communication with it is controlled by suitable dampers.

A distinguishing feature of the improved kiln is in the employment of a double archway, or two longitudinal series of chambers, A^1 to A^5, and B^1 to B^5, arranged together side by side, and communicating with each other transversely at their ends by means of draft-apertures, *k k*, formed in the longitudinal dividing wall. These apertures, *k k*, are similar to the apertures *c c* in the transverse partitions *a a*, and their purpose is to form a means of communication from one longitudinal series to the other, through which the heated gases from the end chamber of one series may be drawn into the end chamber of the next, to dry and burn the charge of green bricks therein contained, and form a means of establishing a continuous and circuitous draft through all the chambers of the kiln, enabling the burning to be proceeded with, as in the case of an annular kiln, yet retaining all the superior advantages of a straight kiln.

Another distinguishing feature is that the upper longitudinal flues, *G G*, are, in chambers A^1 and B^1, arranged to open on the same side of the chambers at *J J*, as shown by the dotted lines in Fig. 2, which bring both vertical openings directly opposite the transverse apertures *k k*.

The operation of the kiln is as follows: The chambers A^1, A^2, etc., being filled with green bricks or other articles for drying and burning, and the doorways, communicating openings, and stoke-holes being closed, fires are built in the fire-places *f f f*, in chamber A^1; the dampers controlling the opening of the flues *i i*, communicating with the main flues *G G*, are opened; and the communication is established in chamber A^1, while the vertical flues *i i* in the other chambers are closed.

As the bricks gradually become heated and give off their steam or vapor in drying, this vapor is at once carried off through the flues *G G*, and from the position and peculiar arrangement of the opening into the flues, on either side of the crown of the arch, the moisture is carried off from all parts of the chamber uniformly and expeditiously. When the bricks, or other articles in the first chamber, A^1, are suffi-

ciently dried, instead of wasting the heat therein by continuing the draft directly with the chimney through the upper flues, *G G*, the passages *i i*, in chamber A^2, communicating with these flues, are opened, and those in A^1 are closed. The surplus heat necessarily obtained in finishing the burning in chamber A^1, is thus utilized in drying and burning the charge of bricks in chamber A^2, and this process is repeated as the burning progresses until the last chamber, A^5, is reached. When the bricks or other articles in this last chamber, A^5, are sufficiently dried the surplus heat is drawn through the openings *k k* into the adjoining chambers, B^1 of the other series, to dry the charge of green bricks therein, which is effected by directing the draft into the main flues *G G*, through the two vertical openings *f f*, situated directly opposite the openings *k k*, the flue *i* in this chamber being closed.

It will be perceived that, as these flues *f f* are placed directly opposite the openings *k k*, the draft through the latter is equal, and the heated gases are drawn through the charge of bricks, so as to dry and burn them equally throughout; whereas, if the openings were not thus placed, the burning would not be equal in the different parts of the chamber. When the bricks in this chamber are sufficiently dried the heated gases produced by its burning are drawn into the next chamber, and this operation is repeated until the end chamber, B^5, is reached, when the gases are drawn into A^1 (which has been previously refilled with green bricks) in the same manner that it was drawn from A^5 into B^1, as before described.

This process may be continued for an indefinite period, the drying, burning, and cooling of the bricks, or other articles in each successive chamber of the kiln, being conducted continuously, regularly, and uniformly, and with very great economy of fuel.

WILLIAM L. GREGG, *Philadelphia, Pa.*

This exhibit consisted of a model of a kiln for burning bricks and other ceramic products by the combustion of gas, and some bricks burned in the kiln at Gregg, Illinois. The kiln consists of a series of separate chambers so constructed with flues and valves that the burning may be accomplished with either an upward or a downward draft, and a gas-producing apparatus in which carbonic oxide and other gases are produced by the slow combustion of coal. In the drawings which follow, Fig. 1 is a horizontal section, at the line *x x* of Fig. 2; Fig. 2, a vertical section of the same at the line *y y* of Fig. 1; Fig. 3, a similar section of a portion of one of the chambers, showing the device for indicating the settling of the bricks;

and Fig. 4, a view in perspective of the kiln. The kiln is shown as consisting of four chambers,—1, 2, 3, 4,—having arched tops, and separated by partition-walls, which meet at a central stack or chimney, *C*. Access is had to each compartment by a hinged door. The inside of the kiln should be lined with fire-brick. The burning of the bricks is effected by the combustion of gases generated in a gas-producer, *B*, which is in general terms a furnace wherein fuel undergoes slow combustion, constructed upon the plan of Siemens or of Frank, or upon any other manner or plan found most desirable.

A gas-conduit, B^1, extends from the producer to the kiln, and is connected by branches, each provided with a proper valve or gate, with the chambers 1, 2, 3, 4; the several branches opening into the bottoms of the chambers. Similar conduits, B^2, B^3, B^4, B^5, are connected with that leading from the producer by the vertical conduits B^6, B^7, each provided with a series of valves or gates, and leading respectively into the tops of the chambers 1, 2, 3, 4. The lower conduits are here shown as opening into chambers beneath the compartments, such chambers communicating with the compartments by a series of openings. The object of the arrangement described is to enable the gas to be led into any one of the compartments at either its top or bottom, as preferred. The partition-walls separating the several compartments of the kiln are each provided with a series of upper draft-passages, A^1, near their tops, and a similar series of lower draft-passages, A^2, contiguous to the floor of the kiln. These passages are governed by dampers or doors operated by suitable rods from the exterior of the kiln. Each compartment is likewise provided with an upper stack-damper, *C*, and a lower stack-damper, C^1; these dampers governing openings in the central stack for the escape of vapors and products of combustion from the several compartments.

A suitable number of "peep-holes" are to be provided in each compartment, as well as proper openings for the admission of air to support combustion, which air may, when convenient to do so, be previously heated.

In order to provide means for clearing obstructions from different portions of the kiln, a steam-boiler, *D*, is provided, from which pipes, *d*, lead to the various compartments, and may be furnished with separate branches or issues contiguous to the various draft-passages and dampers. Steam from the boiler can be blown through the pipes whenever necessary for the purpose of dislodging obstructions that may accumulate in the compartments and passages. In the progress of burning, the mass of bricks gradually shrinks and settles in the kiln; and the period and extent of such settling enable the burner to

Fig: 1

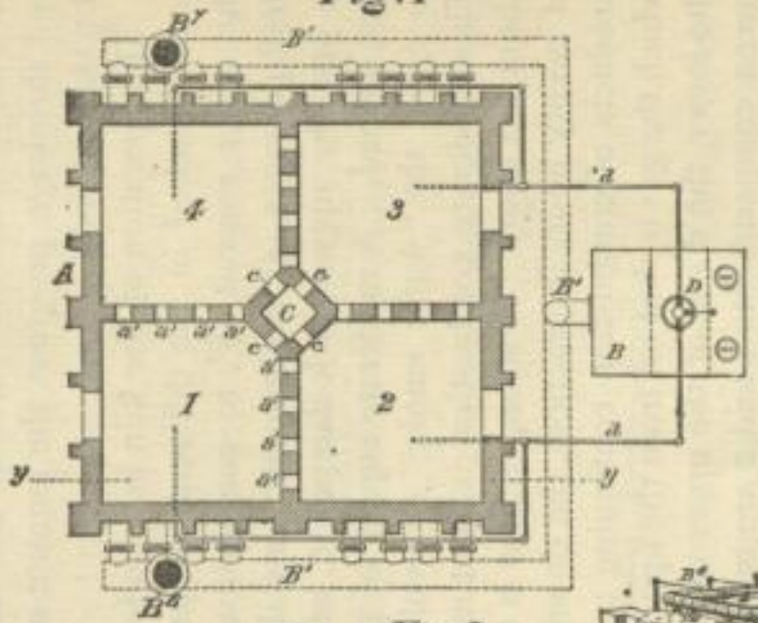


Fig: 2

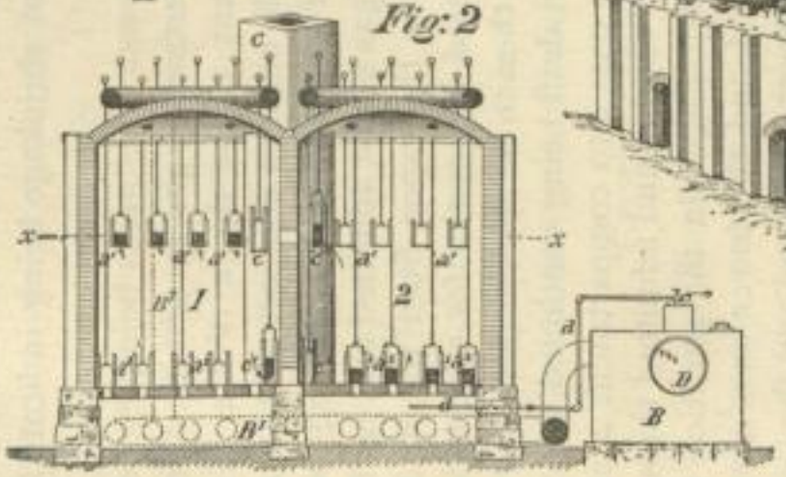


Fig: 4

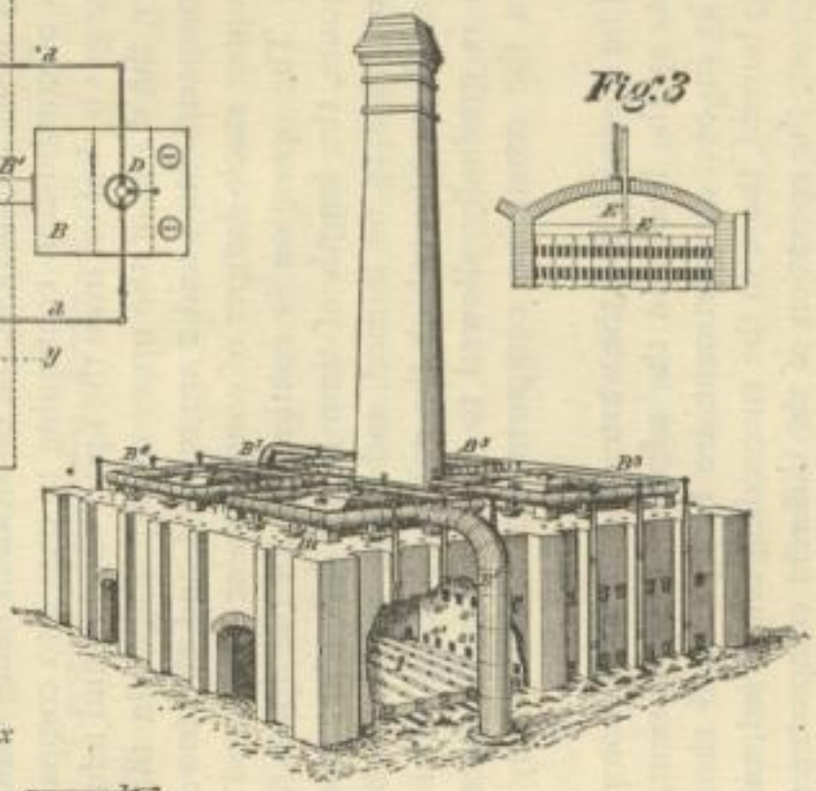


Fig: 3

WM. L. GREGG'S CERAMIC GAS-KILN.

determine when to slacken or extinguish his fires. In order to indicate the settling or shrinkage of the brick, test-floats or gauges, *E*, are provided, which may be of iron covered with fire-clay or other non-conductor, and are united to vertical rods, E^1, passing through openings in the arched tops of the compartments. The floats rest on the top of the mass of brick and settle down with it as the burning and shrinkage progress, the amount of shrinkage being indicated by the vertical rods.

The operation of the kiln is as follows: The bricks being properly set or hacked in the different compartments, gas is admitted from the upper conduit, B^2, to compartment 1; the doors of the lower draft-passages, A^2, in the partition-wall between compartments 1 and 2, and the upper stack-damper *C*, of compartment 2, having been first opened. A moderate supply of gas is first admitted and ignited to expel the "water smoke" or evolve the vapor from the bricks. This moderate combustion is continued in practice for a period of about ten hours. A stronger heat is then to be applied (for a period of twenty hours in practice), the down-draft being continued, and the products of combustion continuing to pass into compartment 2, after which the gas is shut off from the upper conduit and admitted through the lower, the doors of the upper draft-passages in the partition between compartments 1 and 2 are opened, and the lower ones closed, and the upper stack-damper of compartment 2 is closed and the lower opened. The operation is continued with the up-draft for a period of ten hours, the length of time being dependent upon the nature of the materials to be burned, and being regulated by observation of the test-floats, after which the gas is shut off from compartment 1, which is gradually allowed to cool, while the operation is continued in the remaining compartments consecutively in a similar manner.

It will be observed that the waste heat from one compartment dries and heats up the bricks in the adjacent compartment, so that while the bricks in one compartment are being cooled those in the next are being burned, those in the succeeding one dried, and those in the last being set, the operation of the different compartments of the kiln thus being consecutive and continuous. From the certificates submitted by Mr. Gregg from competent and well-known experts who have witnessed the operations of this gas-kiln, its prominent merits would seem to consist:

1st. In the gradual application of heat by which the water smoke is expelled without cracking or checking the brick.

2d. In the easy management of the up- and down-draft, by which

uniformity of burning is secured, and loss from vitrified and salmon bricks diminished.

3d. In utilizing the heat by passing it from one compartment to another, thereby greatly economizing fuel, and in using an inferior quality of coal for producing gas.

4th. In economy of labor, as after the kiln is once charged it requires but one man to generate the gas and one to manage its distribution and combustion. The time usually required for burning in most other kinds of kilns may be greatly shortened.

5th. In the simplicity of the apparatus.

The cost of constructing a kiln with four compartments each 25 feet square, 12 feet high at the springing line and 18 feet at the crown of the arch, is at present prices about $6000. A royalty of one-half the amount saved on the cost of the old processes of burning is charged for its use.

Each compartment will hold about 100,000 bricks, and the productive capacity of the kiln in a working season of eight months is 5,000,000 and upwards of bricks.

GEORGE MENDHEIM, *Berlin, Prussia.*

Mr. George Mendheim is the inventor of a kiln for firing ceramic wares by the combustion of heating-gases, which he exhibited by means of drawings and a small model. There were also shown a variety of excellent articles, ranging from fine porcelain to common fire-bricks, fired in one of these kilns in Germany.

The kiln consists of a series of connected firing-chambers, having distinct and independent series of gas-flues and air-flues for supplying to the chambers the gases and the air necessary for their combustion. The gases are produced on the spot, by any suitable process, from coal, peat, wood, or other material.

Fig. 1 shows a horizontal section of kiln on the irregular line *v v*; Fig. 2, a vertical longitudinal section on the irregular line *x x*; Fig. 3, a vertical transverse section on the line *s s*; and Fig. 4, a vertical transverse section on the line *z z*.

A A are gas-generators, of which there may be any desired number. *B B* are connected chambers for the reception of the wares to be fired. *C* is a chimney common to all the chambers.

The gas is conveyed by means of the flues *a*, provided with valves, *b*, to either or opposite sides of the kiln, where the chambers *B* are arranged in two contiguous rows, which is the arrangement preferred. In the flues *a*, on either side of the kiln, are also valves, *c*, corresponding with the number of firing-chambers, and which, on being opened,

admit the gas separately or collectively as may be desired in the chambers *B*. Each chamber is separated from the succeeding one in the same row by a wall, *z*, so that they communicate with each other only by channels or flues, *f*, in the walls of the kiln, provided with dampers or valves worked through the slots *y*. Accordingly as these dampers are opened or closed, the chambers which they control are in communication with or isolated from each other.

The last chamber of each row is connected in like manner with the adjacent chamber of the other row by a flue, *W*, provided with a damper for opening or closing the communication as required.

The hearth or sole of each chamber is so constructed as to secure an equal distribution of the gas and air throughout the chamber, in the following manner: The gas is admitted into each chamber, *B*, through its respective valve *c*, by means of a flue *g*, and openings *h* in the arch of said flue into flues *i*, from whence it passes into the the chambers by numerous openings, *l*, in the hearth.

There are also small openings, *m*, in the arches of the flues *f*, which admit heated air to the gas, so that the air and gas are mingled and ignited at the openings *l*, or points of entrance into the chambers. The direction of the flame within the chambers *B* may be regulated either by the peculiar arrangement of the charge in the chambers, as, for instance, when burning brick, or by means of fire-bridges built up for the purpose, as when burning pottery-ware or earthen pipes.

The general operation is as follows: Supposing three or four chambers *B* to be charged with ware to be burned, and the last one of these chambers to be closed from communication with the remaining chambers by means of the dampers in the flues *f;* then a valve, *d*, in the last chamber of the row is opened to bring that chamber in communication with the chimney *C* by or through a flue, *r*. A temporary fire is then started in the flue *f* of chamber *B*, access being obtained to the flue through the preceding chamber of the series for the purpose. The requisite draft for this operation is produced by the chimney *C*, which draws the products of combustion of the temporary fire through all the chambers *B* in connection with one another, and through the open valve *d*.

As soon as the first chamber is sufficiently heated, gas is admitted through its valve *c*, and is ignited by the flame of the temporary fire and the air which is admitted at the same time. The heat of the burning gas, added to that of the temporary fire, completes the burning or hardening of the charge in the first of the charged chambers.

Fig: 1

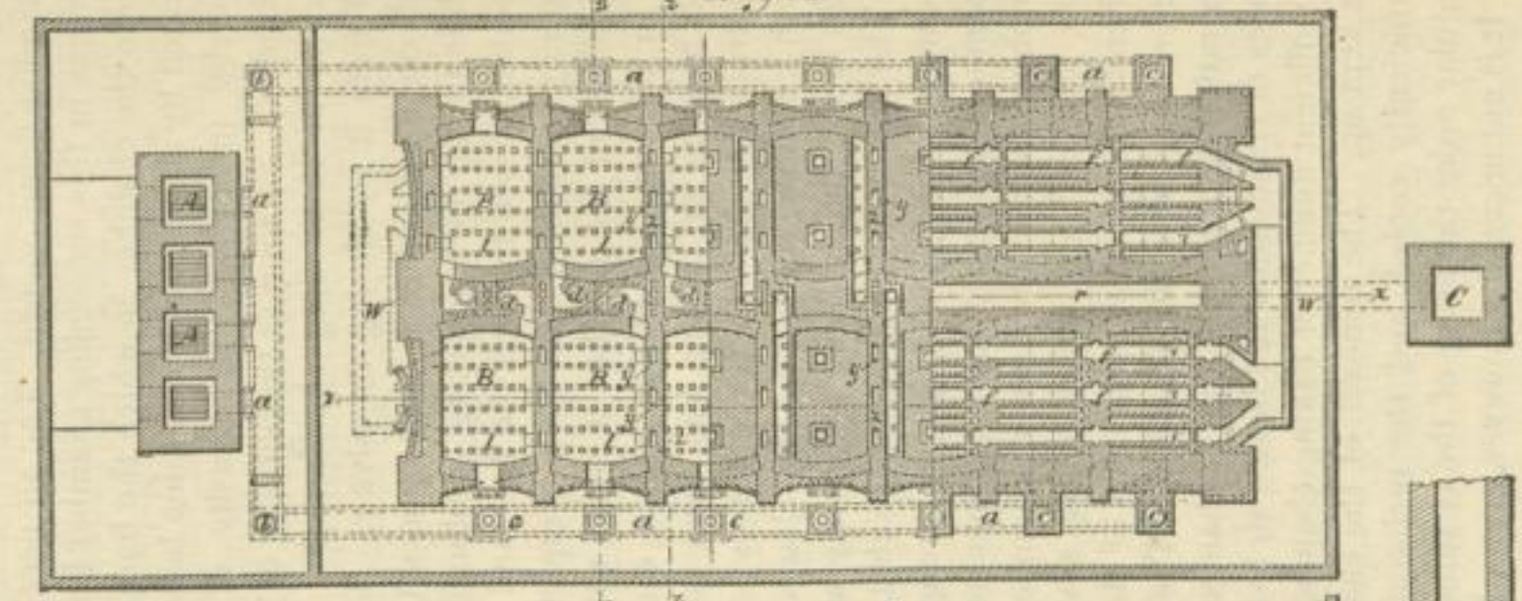


Fig: 2

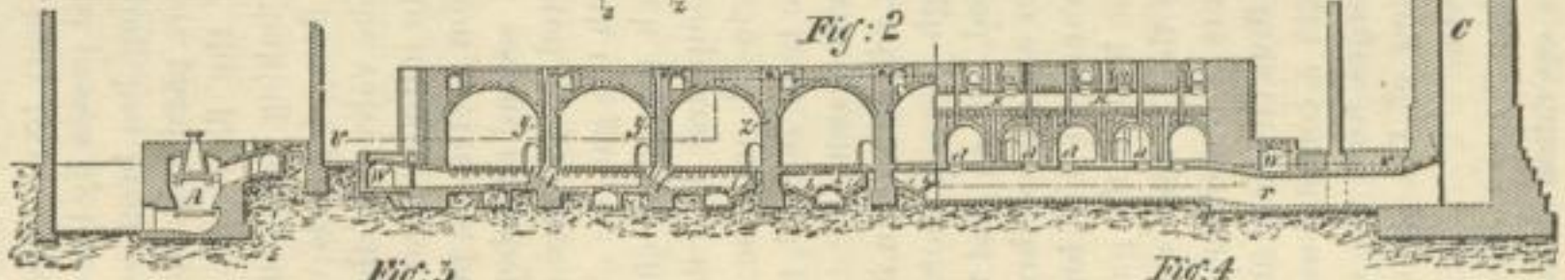


Fig: 3

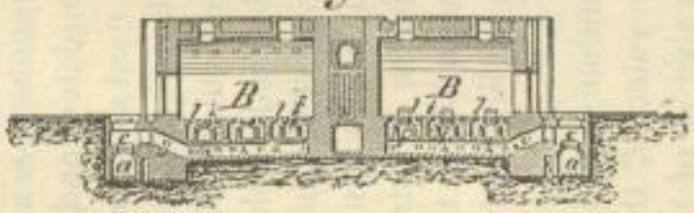
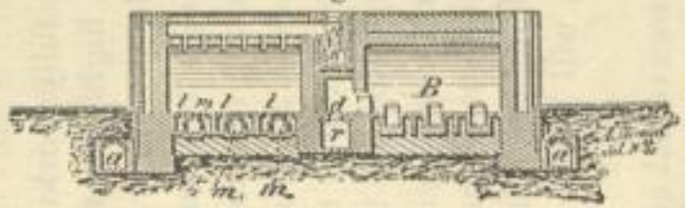


Fig: 4



GEORGE MENDHEIM'S GAS-KILN.

The heating of the next chamber in succession is then sufficiently advanced to cause the gas introduced into it to ignite when the gas comes in contact with the heated air introduced at the same time for the purpose, upon the valve *c* of the chamber in which a charge has been burned being closed, and the valve *c* of the next succeeding chamber being opened. The air necessary to produce combustion of the gas in this succeeding chamber first passes by the openings *m* and *l* into the chamber in which the burning has been completed, and is heated by absorption in the same before passing to the next chamber, thereby increasing the intensity of the flame in the succeeding chamber. So soon as the burning or baking has been effected in this second or succeeding chamber, the flow of gas is checked or shut off from it by closing its valve *c*. The valve *c* of the next or third succeeding chamber is then opened to introduce gas into the same, while the air for producing combustion therein is, prior to its introduction, passed through the first and second chambers, in which the burning or baking has been completed, to produce a highly-heated condition of the air when it mixes with the gas.

In following out this operation each preceding chamber in which the burning or baking has been completed has its valve *d*, that controls the draft to the chimney, closed, and the valve *d* of the fresh chamber, containing the charge to be burned, open, the dampness in the flues *f* being previously withdrawn.

The operation is conducted so that when the kiln is fully working a current of air always passes through three or more highly-heated chambers before the same is consumed, and so that the products of combustion from the burning-chamber are passed through from, say, two, four, or more chambers in advance of the burning-chamber, whereby the greatest proportion of the heat of the gases is absorbed before they enter the chimney. The flue *W* serves to continue the operation from the one row of chambers to the other by allowing the gases of combustion and heated air to thus circulate, and by supplying a sufficient number of baking-chambers a continuous operation may be kept up. The removal of the charges from the chambers, when sufficiently cooled, and the recharging of the same, will follow in regular order the firing of the chambers.

It is not necessary, however, even when two or more rows of baking-chambers are used, that a continuous operation should be kept up; and in the case of a kiln having only a single row of chambers, the action, though generally intermittent, may be continuous. In working a kiln of this description the firing of the chambers is effected successively, as in the continuously-operating kiln, by preliminarily

firing the first or any other single chamber, the flame of the last chamber escaping directly into the chimney.

When a chamber has become so much cooled by passing air through it, and heating that air to a degree suitable for combustion, it still contains such a high temperature that the goods cannot immediately be withdrawn. Then by opening the valve *n* of this chamber a current of air is caused to pass through the channel *k*, and this air may either be carried into the atmosphere or into rooms that require heating or ventilating. This air thus heated may also be used for heating up the goods in a chamber freshly charged, by opening the valve *n* and smoke-valve *d*, and by closing the valves *f* of that chamber, the air now passing through the chamber which is cooling and through the chamber being heated into the chimney. In this way fresh goods may be heated to a temperature of 180° to 212° Fahrenheit, after which the gases can be admitted without any danger of steam condensing on the goods.

The advantages claimed for the Mendheim kiln are that it enables a uniform firing to be secured, avoids the annoyance of ashes, and the injurious tincturing or coloring of the ware, and prevents breakage and refuse by gradually heating and cooling the charge.

A very great economy of fuel is claimed for it over any method of burning with coal; but to what degree this claim is well founded, when coal is used for firing a kiln by successive chambers, as in the Morand and similar kilns, I am not prepared to say.

The method of distributing the gas under the hearth, before it enters the firing-chamber through the openings *l*, where combustion begins, seems to possess great merit.

The kiln has achieved a good reputation in Germany.

The Cedar Hollow Lime Company, *Philadelphia, Pa.*

This company exhibited a jar of good quicklime, a model of the kiln in which it was burned, models of a house for the storage and preservation of lime, and a car for transporting it.

At the time these articles were explained to the Judges no sufficient evidence of the merits of the kiln was submitted. Had it been as fully understood then as it is now, one feature of it, called the *cooler*, would have been mentioned for an award. As no such recommendation was made, it is deemed proper to supply the omission as far as possible in this report.

The kiln belongs to the upright, continuous class, with firing-places on two opposite sides, near the base. The fuel, therefore, is not mixed with the stone to be burned. Below the firing-places an

arched opening passes through the base; and there may be two such archways at right angles to each other, in which case the kiln would rest upon four piers or columns. In the centre of this arched space, and directly beneath the chamber of the kiln in which the stone is burned, an iron cooler, shaped like the inverted frustum of a hollow cone, is fixed to the crown of the arch, the upper end of the cooler being fitted against the lining of the lower portion of the kiln-chamber. The lower end of the cooler, which is placed at such height above the ground as to enable carts to back under it to receive the burned lime, dips into a shallow tray suspended to it by chains, and is closed or opened at pleasure by two horizontal sliding-gates worked by levers. When the gates are closed, and the tray is hooked up to its place, access of external air into the cooler is prevented by depositing fine lime-dust upon the rim of the tray, so that the lower end of the cooler dips into the dust. The lime as it is burned settles into the cooler, which, being surrounded by external air, facilitates the more or less rapid cooling of its contents. When it has become cool enough to be discharged into carts or trucks, the tray is unhooked, and the sliding-gates opened sufficiently to allow the desired quantity to run out, after which they are closed, and the tray returned to its place. As the drawing of the burned lime goes on, fresh limestone is added above, and the fires in the side fire-places are kept up. A damper for regulating the draught is placed in the upper part of the kiln-chamber, above the charge. Just below the damper there is a side opening for charging the kiln, habitually kept tightly closed with an iron door.

BRICK-PRESSES AND TEMPERING-WHEELS.

A fine display of brick hand-presses was made, all the exhibitors being from Philadelphia. They are used for pressing hand-made bricks, and re-pressing those made by machinery, after they have been suitably dried in either case.

F. L. & D. R. Carnell, *Philadelphia, Pa.*

Messrs. Carnell showed a press for red front bricks of the Philadelphia size, another for 9-inch fire-bricks, and another for 15-inch furnace-blocks, and a good assortment of the several kinds of brick pressed in their machines.

This firm, known also as the Cohocksink Brick-Machine Works, manufacture a great variety of brick-machinery besides hand-presses, such as brick-machines, clay-tempering wheels, pipe-machines, tile-

machines, grinding-pans or "edge-runners," roller-mills, stamping-mills, and all kinds of brickmakers' tools in common use.

S. WILLIAMS & SON, *Philadelphia, Pa.*

This firm exhibited a hand-press claimed to be suitable for pressing a dry clay brick. It is favorably spoken of by parties who have used it.

GEORGE CARNELL, *Philadelphia, Pa.*

Mr. Carnell showed a clay-tempering wheel, which appears to possess very considerable merit, and also a brick-press, of which the mould is lined with an alloy of tin and copper, which is claimed to be superior to the ordinary steel lining, in giving a smoother skin to the bricks. Conceding this point, there is still a question whether the brass will not wear so much more rapidly than steel as to prevent its general adoption.

S. P. MILLER & SON, *Philadelphia, Pa.*

Messrs. Miller & Son exhibited five patterns of brick-presses, all bearing evidence of excellence in design and workmanship; also a small model of a clay-tempering wheel.

All the brick-presses manufactured in Philadelphia for pressing front bricks resemble each other in this, that they press one brick at a time, flatwise, by the upward movement of a plunger in the bottom of the mould, the top of the mould being closed for the time by a pressure-plate. Three styles of presses are made, viz., single lever, double lever, and treadle. A single-lever press is so constructed that one lever presses the bricks, and also raises them to the top of the mould; a double-lever press has two levers, one to press the brick and the other to raise it to the top; a treadle-press is the same as a double-lever press, except that it has a treadle, which is worked by the foot to lift the brick to the top. The single-lever press is the one most generally preferred.

The clay-tempering wheel is arranged to run on the edge in a circular pit containing the clay to be tempered. The pit is usually about 28 feet in diameter and 18 to 24 inches deep, with an island or centre-piece about 8 feet in diameter. It is, therefore, annular, and has a width of about 10 feet. The wheel runs on a horizontal shaft, revolving about a central post by horse- or steam-power, and has an automatic movement alternately toward and from the centre over the entire width of the pit (10 feet), so that it never runs in the same track in consecutive revolutions. This movement is usually given by

an endless ratchet working against a cog-pin at the central post. The details are covered by patents, and differ from each other considerably in different wheels.

Tempering-wheels are used only for tempering clay to that degree of soft plasticity when it can be, and is very appropriately, called "slush." It is then in a suitable condition for being moulded into bricks by hand or by a slush brick-machine. The old method of moulding by hand was almost exclusively followed until within a few years in making the celebrated front bricks of Philadelphia, Wilmington, and Baltimore, and is followed still to a great extent in those localities and elsewhere in producing the choicest grade of front bricks. It is, however, gradually going out of practice in proportion as the results obtained with the improved brick-machines of recent invention are more excellent and satisfactory.

It seems to be entirely within the range of probability that in the near future, possibly within the next four or five years, all the highest grades of building-bricks, not even excepting those for the construction of city fronts, will be not only moulded, but re-pressed by steam machinery, thus doing away with the use of tempering-wheels as well as hand-presses. Indeed, the tempering-wheel is practically obsolete already, as the best quality of "Philadelphia fronts" are now moulded in the crude-clay and tempered-clay machines within half an hour after the clay is dug from its natural bed. But the moulded brick, after suitable drying, has still to be hand-pressed in order to give to it the requisite smoothness of surface, sharpness of edge, and accuracy of form and dimensions. It is expected that the coming brick-making machine will be able to re-press the moulded and partially-dried bricks as well as it can now be done with hand-presses.

As already stated, the hand-presses in present use re-press the bricks on the side, or flatwise, giving bricks all of the same length and width, but not all of exactly the same thickness, there being a slight variation, due in part to varying quantities of clay in the successive moulds, and in part to varying pressure applied to the hand-press. It is necessary, therefore, for the mason to gauge the bricks for the construction of the best quality of front-brick masonry, in order to guard against the unsightly, or at least unworkmanlike, appearance produced by bricks of random thickness in the same course.

ISAAC GREGG, JR., *Philadelphia, Pa.*

Mr. Gregg exhibited some front bricks pressed edgewise. They are of course all of the same thickness, although they vary in width, which is not at all objectionable. These bricks have but one perfect

or finished face or edge; the other face being distinguished by three transverse grooves, about ¼-inch deep and ½-inch wide, so that in all the successive stages of manufacture, transportation, and use, the attention of the workmen is directed to the care and preservation of only one face of each brick. In setting them in the kiln for firing, the finished faces or edges of the bricks are always placed longitudinally in contact with each other throughout; and in crossing the courses the grooved edges only come into contact transversely. The streaks of color caused by the crossing are thus confined exclusively to the grooved faces, and are, therefore, of no consequence. This invention marks a decided improvement in the manufacture of the choicest quality of front bricks.

PERFORATED BRICKS, SHAPED BRICKS, ETC.

Several forms of perforated bricks for walls and arches and of cornice and jamb bricks are exhibited. Among the exhibitors were C. G. L. Koolemans, of Willeskop, Netherlands; Doulton & Co., of London, England; the Fire-Proof Building Company, of New York City; C. W. Boynton & Co., of Woodbridge, New Jersey; A. B. Holmber, of Christiania, Norway; Mary Nolan, of St. Louis, Missouri; Vaisse, Martin, & Co., of Constantinople, Turkey; and Romeu & Barella, of Barcelona, Spain. It should be stated that Miss Nolan's exhibit was considered to belong, technically, to the group on architecture.

The capabilities of perforated bricks for the construction of fire-proof buildings,—dwelling-houses in particular,—without sacrificing the advantages to health, always promoted by hollow walls, upon which the moisture in the atmosphere never condenses, and which are therefore always dry upon the interior surfaces, have never received any practical recognition in the United States, although in Europe the subject has been carefully considered by architects and builders. With us a hollow brick wall is understood to mean not a wall built with hollow or perforated bricks, but with solid bricks so arranged as to leave an interior air space next the inside facing, crossed at frequent intervals with transverse or diagonal headers, to insure a strong bond. Such a wall is less homogeneous in mass, and possesses less strength and stability, than one laid with perforated bricks of proper form containing the same aggregate weight of material.

With two forms of perforated bricks, such as can readily be produced from two dies with any of the expressing-machines heretofore described, a wall of 6 inches, 9 inches, 12 inches, 15 inches, or 18

inches in thickness can be laid with a strong bond, and with sufficient interior air space, in the form of horizontal longitudinal tubes, to secure thorough dryness on the interior face, so that plastering can go directly upon it without the intervention of wooden furring. One of the forms of brick should be the shape of a capital L, with the height, which may be 5½ to 6 inches, equal to the width, the height of the horizontal arm equal to half the total height, and the width of the vertical arm equal to half the total width. Each brick should have three longitudinal perforations, one in each arm, about 1 inch by 1½ inches, and one in the angle about 1½ inches by 1½ inches. The other brick is smaller, and should be rectangular in cross-section, and have two longitudinal perforations. Its width should be 5½ to 6 inches, or the same as that of the larger brick, and its thickness or height 2¾ to 3 inches scant, so that two courses separated by a thin joint will rise as much as one course of the others. The lengths of the two former should be the same, and need not exceed 10 to 11 inches. Owing to their cellular structure these bricks, although comparatively large in outside dimensions, can be easily and uniformly fired. The weight of the largest size will not exceed 15 to 16 pounds. It can, therefore, be easily handled and laid by one man. If two other perforated forms of brick be added, by the use of two additional dies with the same brick-machine, one for a skewback and the other for an arch brick or voussoir, neither of which will be as heavy as the largest of the wall bricks, we have the means of erecting cheap fire-proof buildings of ample strength, admirably adapted to all the requirements of such dwellings as are not expected to contain rooms of large span, the only iron necessary being light tension bars to take the thrust of the arches, while the amount of combustible material employed is reduced to a minimum.

If objection be made to the use of wall bricks of 5½ to 6 inches in thickness, as being unusual or unsightly, bricks of small dimensions may be used in all the walls, and they may all be of rectangular shape and of uniform size, say 8¼×4⅛×2⅜ inches, the headers being perforated transversely with two holes, and the stretchers longitudinally with one.

ENAMELED BRICKS.

There were only a few exhibits of enameled and glazed bricks, none of which more deserves special mention for any noteworthy progress in both the useful and the beautiful in brick-making than that of the Brick Enameling Company of Philadelphia, which made a fine display of red bricks, enameled on one face, or a face and an end, some

in pure white and others in various attractive shades of yellow, green, blue, brown, and slate.

The enamel is a hard glazing of feldspar, flint, oxide of zinc, porcelain clay, and Paris white, fluxed with boracic acid. The coloring matters are black oxide of cobalt for blue, oxide of copper for green, oxide of uranium for canary, the Brandon mineral paint for drabs (this paint containing oxide of iron and an ochreous earth), and oxide of manganese and burnt umber for slate colors.

The glaze is first prepared of the required color, and then calcined to nearly a white heat. It is then crushed and ground between millstones to an impalpable powder, and mixed with water to the consistency of cream. The brick, previously burned in the usual way,—the finest quality of front brick being preferred for this purpose,—is then dipped into the glaze by immersing the face to be enameled to the depth of about one-fourth of an inch. After suitably drying they are refired in seggars in a crockery-kiln for about thirty hours, at a temperature of about 2000 degrees Fahrenheit, or nearly a white heat, by which the opaque glaze or enamel is fused, and unites with the face of the brick, becoming inseparable from it. All the colored enamels, as well as the pure white, are densely opaque and very hard. They cannot be scratched with a steel point. Several nails were driven into tough pine with one of the bricks, without leaving the slightest mark upon it. The enameled faces are thoroughly impervious to moisture, the color is unchangeable, and nothing can permanently soil or mar their beauty.

The prices of the Philadelphia front bricks, enameled in white on one edge, is $60 per thousand, and in canary $100 per thousand. Other colors range between these prices. Assuming the enameled bricks to be laid as stretchers only, they will cost—according to the color—from 54 cents to 90 cents per superficial foot of enameled face, exclusive of the expense of laying them, and exclusive, of course, of the cost of the backing, which would be laid with cheaper bricks.

PAVEMENTS.

The Exhibition contained a meagre display of materials and devices for paving carriage-ways, and none from which useful information could be drawn by any but experts.

For paving foot-paths, areas, warehouses, etc., most of the specimens of artificial stone referred to in the report upon that subject would answer very well, and would naturally be sought after for such purposes in localities not within cheap freighting distance from sup-

plies of good flagging-stones, like the Hudson River bluestone and similar varieties. But wherever the natural flagging can be procured at a moderate cost for transportation, no artificial stone or concrete of good quality,—either hydraulic or bituminous,—can successfully compete with it. Even good paving-bricks and burnt tiles would almost invariably be less costly than flags made with either hydraulic cement or bitumen as the cementing medium, after the most approved methods. When a water-tight wearing surface is required, the question of cost must give way to that of fitness or suitability, and either natural bitumen or some artificial imitation of it is usually resorted to. Pavements of coal-tar concrete belong to the last-named class, and, when properly laid, make good and reasonably durable foot-paths. Indeed, they are not in all cases to be rejected, even for carriage-ways, when properly constructed. Foot-paths of hydraulic concrete, suitable also for paving alleyways, cellars, areas, etc., may be constructed at a considerable saving in the cost of labor by compacting the mixed materials *in situ*. Their thickness, if the subsoil be firm, need seldom exceed 4 to 4½ inches, of which all, except about ½ inch on the surface, may be composed of good Vicat or Portland cement 1 measure, and sand and gravel 3 measures. When the natural quick-setting cements are used, their proportion to the sand and gravel should be doubled, and the pavement made at least 1 inch thicker. The surface layer should be rich in cement, containing say 1 measure of Portland cement and 1 to 1½ measures of sand, and no gravel. The materials for the body of the pavement should be well mixed together, and thoroughly compacted in place by running in a single layer. Immediately thereafter its surface should be roughened by scratching, and the mixture for the wearing layer spread over it to a uniform thickness of about 1¼ inches, and then compacted by light blows to the required ½ inch. Water should be used sparingly, so as not to produce plasticity in the materials. A plastic mixture cannot be compressed by ramming, a process which is essential to good results.

This kind of foot-path is almost certain to crack from unequal settlement, or, in cold climates, from the upheaving power of frost. As a precaution against the last-named cause they require under-draining. To avoid cracking entirely they may be laid in rectangles, squares, or other shapes by compacting the material between stout planks set on edge, every alternate space being omitted in the first instance, to be filled in afterwards, when those first laid shall have become sufficiently hard to sustain without injury the ramming of the fresh concrete against them. By the use of various pigments different shades of color may be given to the different forms.

PAVEMENTS OF COAL-TAR CONCRETE.

A. G. DAY, *Seymour, Conn.*

Mr. Day exhibited some "vulcanized paving-blocks," composed of 70 per cent. of sand, 20 per cent. of good clay, and 8 to 10 per cent. of peroxide of iron. These are cemented together with a composition made with 2 parts of crude coal-tar and one of Trinidad asphaltum, to which are added a quantity of sulphur equal to from 3 to 6 per cent. of both ingredients, and a quantity of oxide of iron about double that of the sulphur.

The coal-tar and bitumen having been heated and mixed together, the sulphur and oxide of iron are added, care being taken not to raise the heat high enough to drive off the lighter oils. A temperature of 270 degrees Fahrenheit will suffice. When a thorough mixture of the bitumen, coal-tar, sulphur, and oxide of iron has been secured, the clay and sand, previously heated, are mixed in, and the hot composition is then compacted in moulds in the form of paving-blocks for carriage-ways. When intended for sidewalks or other foot-paths, broken stone and gravel are added. Special machinery is necessary for mixing and compacting the materials in order to obtain satisfactory results.

The foregoing description was given by the exhibitor, and although the process is believed to be an improvement on the usual methods of treating a mixture of crude coal-tar and bitumen for paving purposes, it should be stated that the "vulcanized paving-blocks" have not yet been sufficiently tested by actual use upon streets to justify any expression of opinion concerning their merits. Neither has it yet been proved by experience that a coal-tar paving composition is as durable when moulded and laid in blocks as when properly applied in a continuous sheet. It is claimed that the material can be more firmly compacted in small moulds than in a continuous layer applied hot upon the street, which is admitted to be true only when the compression in the latter case is attempted to be accomplished by rolling instead of tamping. The superiority of the block pavement in giving a more secure foothold for animals is conceded, and if they can be made sufficiently hard and tenacious to be capable of sustaining the ordinary street traffic without wearing away too rapidly at the edges of the blocks, which is the place where failure in endurance is to be specially apprehended, they will doubtless supplant the monolithic coal-tar pavements for streets of steep grades and slopes.

It is yet to be ascertained that even a moderately good pavement can be made with crude coal-tar as one of the principal cementing in-

gredients of the wearing surface. But when coal-tar is distilled, and the lighter oils driven off at a temperature of 455 to 490 degrees Fahrenheit, the exact temperature depending on the manner in which it is to be used, the residuum may be employed with great advantage in preparing a concrete base for the pavement, and may enter to some extent even in the top layer when natural bitumen cannot be procured, or must be omitted in whole or in part on account of its cost. For the foundation, the residuum of a lower distillation is suitable.

The Abbott Pavement Co., *Brooklyn, N. Y.*

This company exhibited a model of a carriage-way and sidewalk paved with what appeared to be coal-tar concrete, that on the carriage-way being laid directly on an old cobble-stone pavement. A great deal of merit is claimed for it in the papers submitted, which it is not deemed proper here to either deny or concede, as no person was at hand to explain the exhibit, and no opinion upon its worth can well be ventured in the absence of positive information concerning the materials used and the methods of manipulation followed in its preparation.

A coal-tar concrete pavement, excellent of its class, may be made in the following manner, viz.:

The base or foundation is from 6 to 8 inches in thickness, depending on the weight of the traffic to be accommodated, and the character of the subsoil. It is formed of broken stones, varying in diameter from 1 to 2½ inches, thoroughly mixed with from 2½ to 3 gallons to the superficial yard of a paving composition obtained as the residuum of coal-tar distilled at a temperature of 340 to 350 degrees Fahrenheit. The stone may be carried to the street in wheelbarrows, and before each barrow is dumped in its allotted place, about half its required charge of the composition is poured over it. It is then dumped, and the other half poured over it, and then raked to a uniform thickness on the requisite grades and slopes, the incorporation of the composition and broken stone being completed in the operation. When a sufficient area has been thus prepared, it is thoroughly compressed and compacted to an even surface with heavy rollers. The base is then finished. If only 6 inches thick, it can be laid in one operation in a single layer; if 8 or 9 inches thick, it should be in two layers, each of 4 to 4½ inches in thickness, spread and rolled separately.

A binder course, 2 inches in thickness, follows next. It is composed of fine crushed stone of all sizes, up to those 1 inch in diameter, or a mixture of this stone with gravel, to be first heated, and then mixed

while hot with from one-fifth to one-fourth of its volume of hot paving composition, obtained as a residuum in distilling coal-tar at a temperature of 490 degrees Fahrenheit. This binder is to be spread upon the foundation and rolled while hot, preferably with a steam-roller.

The wearing surface is then applied in a layer not less than 2½ inches in thickness. It is composed of a mixture, in equal proportions, of coarse and fine, sharp, clean sand, to each cubic yard of which a peck of good, finely-ground hydraulic cement is added, and mixed with it. The sand is then heated, and mixed with from one-fifth to one-fourth of its volume of a hot composition, made by melting together 60 parts of the residuum obtained in distilling coal-tar at 450 degrees Fahrenheit and 40 parts of refined Trinidad asphaltum, or any other equivalent asphaltum. This surface material is dumped hot upon the binder course from carts or barrows, raked to a uniform thickness, and compacted by a heavy steam-roller. During the process of rolling, a thin coating of finely-ground hydraulic cement is swept over the surface, and becomes incorporated with it. This completes the pavement, which is ready for traffic as soon as it gets cold. Its cost per superficial yard, not including that of the excavation, to grade, should not exceed $2.25 to $2.50, inclusive of a fair profit to the contractor.

By omitting the asphaltum from the top layer it would be classed as coal-tar concrete, and would be among the best of its kind. When subjected to the ordinary traffic of large cities, the top layer, if no asphaltum be used, would require renewal about every four or five years. The addition of the asphaltum doubtless increases its durability fully one-half, and perhaps more.

The base course and binder, aggregating 8 to 10 inches in thickness, would be a suitable foundation for either of the asphalt pavements hereafter described.

ASPHALT PAVEMENTS.

Bitumen is extensively used for paving both foot-paths and carriage-ways. It is generally applied in a continuous sheet, about ½ inch in thickness for sidewalks, and 2 to 3 inches for carriage-ways, although in some cases compressed into small blocks, and laid on a foundation of concrete, or in a form of sand.

H. F. ONDERWATER, *Dordrecht, Netherlands.*

Mr. Onderwater exhibited a fine collection of these blocks, which he calls "asphalt-stones," intended to be used for paving sidewalks,

warehouses, etc., but not for roadways. They appear to be composed of asphaltum and sand, formed in moulds of various sizes, by compression while hot, the smallest being 11 centimetres square on top, 4 centimetres deep, weighing $1\frac{1}{10}$ kilogrammes, and sold free on board for 25 francs per thousand. All the other sizes have a uniform depth of 10 centimetres, while the length and width vary from the smallest, which are 8 by 10 centimetres, sold for 50 francs per thousand, to the largest, which are 16 by 20 centimetres, and sold for 130 francs per thousand. They are all a little smaller on the bottom than on the top, and are recommended to be set in cement. Their cost would somewhat exceed that of good paving bricks, or tiles, for a pavement of equal thickness.

The Neuchâtel Asphalt Co. (limited), *Travers, Canton Neuchâtel, Switzerland.*

This company exhibited a pyramid of bituminous limestone from Val-de-Travers, which is very rich in bitumen, and of excellent quality. This material, usually called "asphalt-rock," and sometimes Neuchâtel rock, is extensively used for pavements in European cities, and has achieved an excellent reputation for that purpose. The rock, found in both Seyssel and Val-de-Travers, and other localities in the Jurassic region, is an amorphous, pulverulent carbonate of lime, uniformly impregnated throughout, and held compactly together, with from 5 to 15 per cent., and sometimes as much as 20 per cent., of the variety of bitumen known as mineral tar. The rock is liver-brown in color, is tough and difficult to break with a hammer, may be cut with a knife, and is to some extent malleable, even when cold, and much more so when warm. It should contain 11 to 12 per cent. of mineral tar to be suitable for carriage-way coverings. When heated to 200 to 212 degrees Fahrenheit the bitumen becomes soft, and the rock crumbles and falls into a slightly coherent powder, which, if powerfully compressed by ramming, while hot, reunites into a solid mass, superior to the original rock in toughness, hardness, and incompressibility. This is the whole theory of asphalt pavements.

In the approved practice the crude rock is first ground to a coarse powder, then heated to 250 to 260 degrees Fahrenheit in a revolving wrought-iron cylinder set in a furnace, and at once conveyed to the street and deposited on the pavement foundation (one barrowful at a time), and spread out with a rake to a uniform depth, exceeding by two-fifths the ultimate thickness required. It is then immediately compacted with hot iron rammers, the edges of each batch being left loose and unrammed, so that the material which follows may readily

unite with it. A thickness of 1½ to 1¾ inches, after ramming, is considered to be ample. The foundation should be hard and firm, and may be composed of either hydraulic, asphaltic, or coal-tar concrete.

When the asphalt-rock is used for paving foot-paths, it is softened by adding some heavy petroleum, or some "dead-oil," and sometimes crude bitumen, like that from Trinidad. Sand and gravel are also added. The mixture is then called bituminous mastic, and is applied on the foundation with a wooden trowel, in a coat about ½ inch thick. It is of course laid on while hot. A suitable formula for the mastic is 36 measures of ground asphalt-rock, 4 measures of crude Trinidad asphaltum, 1⅓ measures of heavy petroleum, or the residuum of refined petroleum, 4 measures of clean, fine sand, and 8 measures of fine gravel.

As no asphalt-rock at all resembling that of Seyssel and Val-de-Travers has yet been discovered in the western hemisphere, it may be well to describe very briefly the latest discoveries and improvements in constructing pavements with natural bitumen, artificially combined with suitable sands and earths. The variety of bitumen known as asphaltum is used for this purpose. It is found in the islands of Cuba and Trinidad; in Ritchie County, West Virginia; in the province of New Brunswick; at Santa Barbara, California; and in many places in Mexico and elsewhere.

The Trinidad asphaltum is the one most extensively employed in the eastern portions of the United States, and is that to which this description refers, although the method of manipulation is substantially the same for all.

The first step in the process is to obtain a suitable asphaltic cement to bind the body of sand together in a compact mass possessing the requisite hardness and toughness to enable it to withstand the traffic, through all the changes of temperature to which it will be subjected on the street. It must not become too brittle in winter, nor too soft in summer.

The asphaltum, which at ordinary temperatures is hard and brittle, is first refined by melting and boiling in furnace-kettles, at a temperature of 250 to 300 degrees Fahrenheit, for one or more days, depending on the capacity of the kettles and the quantity under treatment. The heat is gradually raised to the point named, and is kept up until every trace of moisture is driven off. There is then gradually added to it in the kettles, accompanied by constant stirring, 20 per cent. of its own weight of the residuum of refined petroleum, left in the manufacture of kerosene-oil, or, instead of this, 20 per cent. of heavy petro-

leum, of a fire-test of 150 degrees Fahrenheit,—that is, a petroleum which, when heated to that temperature, will not give off a vapor that will take fire and flash in the blaze of a burning taper held in it. When the two ingredients are thoroughly incorporated, the mixture is called asphaltic cement. It is then dipped from the kettles, leaving all earthy and other solid impurities behind, and is ready for use. When properly prepared, it is not brittle when cold, but is somewhat soft, pliable, and quite ductile, and does not contain any water, nor any ingredient soluble in water or in the urine of animals, or that can be affected by the elements to any serious degree.

The sand for the body of the pavement should be fine-grained, and composed of from 70 to 75 per cent. of silex, and 25 to 30 per cent. of a mixture of calcareous and argillaceous particles, possessing absorbent properties. The argillaceous ingredient should be in the form of very fine powder.

The sand and the asphaltic cement are heated separately, and then thoroughly mixed together at a temperature of 250 to 300 degrees Fahrenheit, in a horizontal twin pug-mill set in a furnace. The proper proportion by weight is 80 parts of sand to 20 of cement. The mixture is then ready for laying, and resembles, in many respects, the powdered asphalt-rock when heated for use, although it is blacker and less incoherent than that material. It may be applied upon the pavement foundation by substantially the same method followed with the Neuchâtel rock, although it has been found advantageous to lay it in two coats, the first one, only ½ inch thick, being compacted with hot iron rollers, while the surface or wearing layer is rammed with hot iron pestles, and should be not less than 2 to 2½ inches thick. The foundation should be firm and solid.

The kind of pavement above described has been in use upon several streets in the city of New York for more than four years, and maintains its first promise of superior excellence. It is now being laid by the United States Government upon Pennsylvania Avenue, Washington City, between Sixth and Fifteenth Streets.

The most serious difficulty to be overcome in its construction is to obtain a mixture that will be neither too soft and yielding in summer, nor too hard and brittle in winter. With suitable materials and intelligent supervision this is believed to be attainable with reasonable certainty.

When used for foot-paths, 75 parts by weight of fine calcareous sand is heated to about 300 degrees Fahrenheit, and mixed with 25 parts of the melted asphaltic cement, and then moulded into blocks of convenient size for handling and transportation. At the time of

using it, 100 parts by weight of this mixture are melted and mixed with 25 to 30 parts of hot, fine gravel. The hot composition is then spread on the foundation, with a wooden trowel, to the required thickness of one-half to three-fifths of an inch, and while still warm is covered with a light sprinkling of dry sand.

Some of the advantages possessed by monolithic pavements of asphalt are, (1) that they produce very little dust and mud; (2) are comparatively noiseless; (3) do not absorb noxious liquids, but discharge them promptly into the sewers; (4) they are impermeable, neither emitting poisonous vapors nor allowing their emission from the subsoil; (5) they reduce the traction and wear and tear upon vehicles and animals to a minimum; and (6), although affording to animals a less secure foothold than stone blocks, do not polish from continued wear, and are not slippery when clean.

They are believed to be well adapted to all streets with gentle slopes, —say about 1 in 48,—except such as are thickly crowded with a large traffic, and more or less constantly wet and slippery from the urine of animals, and where the animals are subjected to frequent halts, starts, and quick turns. In such localities, the roughness of surface possessed by a pavement of blocks seems to be very desirable. But where the traffic is comparatively light, with ample room for conducting it, or where a large part of it is pleasure-driving, and particularly upon streets lined with dwelling-houses on either side, the marked advantages of such a street surface—its imperviousness to noxious fluids, and its freedom from dirt and noise—appear to place it beyond successful competition.

Pavements of coal-tar concrete, if properly constructed, and thoroughly maintained by re-surfacing whenever required, possess many of the merits of asphalt. The dust produced by their disintegration is an objection to them, from which a surface of asphalt composition is a practical relief. In cost of construction, maintenance, and repairs, a pavement of coal-tar concrete, from the wearing surface of which asphaltum is entirely omitted, is more expensive than one made with asphaltum artificially combined with suitable sand, in the manner heretofore described.

STONE-BLOCK PAVEMENTS.

George Lütensee, of Christiania, Norway, exhibited some hornblende granite blocks, intended for street pavements, and a model, in the same stone, of a carriage-way paved with the blocks, with slabs of the same material for the sidewalk. This stone is no doubt

strong, tough, and durable, but no novelty is shown in the manner of using it.

The best form for stone paving-blocks, is doubtless that of a rectangular parallelopipedon, and the most desirable dimensions are 3½ to 4½ inches in breadth, measured lengthwise of the street, on the upper or wearing face, 9 to 12 or 14 inches in length across the street, and 8 to 10 inches in vertical depth, it being borne in mind that stones of about the same depth should be set together. The blocks should be set on edge, with the sides in contact, in lines or courses running directly or diagonally across the street, breaking joints in the other direction.

For streets with heavy traffic, a firm foundation, preferably one of good hydraulic, asphaltic, or coal-tar concrete, 6 to 8 inches in thickness, is necessary, to prevent unequal settlement, and the subsequent formation of ruts.

WOODEN PAVEMENTS.

There were exhibited in the French section, Agricultural Hall, two small squares of wooden-block pavement, called "Mineralized and Fire-Proof Wood Paving," Chanudet's system, but no person was at hand to give any information concerning them. A printed bill attached to the exhibit stated that the system had been tried in Paris and other Continental cities, and it was favorably spoken of by M. Alphand, Inspector-General of Bridges, and Director-General of Public Roads and Promenades in Paris. No description of the methods of treating the wood was given.

Wooden pavements have had a fair and patient trial in the United States, and are now very generally condemned, as unfit for streets subjected to heavy traffic. They are slippery in wet weather, and are very perishable from their inability to resist either the wear of street-traffic or the causes of ordinary decay. In some of our Western cities they have, however, been comparatively successful, especially in Chicago, where the streets are wide and the traffic greatly diffused. Other objections to them, besides their want of durability, will be referred to hereafter.

PAVEMENTS OF STONE, WOOD, AND ASPHALT COMPARED.

Durability. Assuming each of the pavements to be excellent of its kind, and the foundation to be solid, so that no ruts and depressions, except those produced by actual wear, can be formed, tough stone blocks will possess the longest life of the three, and wooden

blocks the shortest, asphalt lying between the two, and very near the stone. But unless the stone be of good quality for pavements it takes the second place, and asphalt the first. As a rule, wood is the least durable. When it begins to wear under heavy traffic, at the end of two or three years, it is destroyed rapidly.

First cost. This will vary considerably with the locality, but if exceptional conditions be excluded from consideration, the order of cheapness will be, first, wooden blocks; second, asphalt; and third, stone blocks.

Cost of maintenance and repairs. The life or endurance of the pavement enters directly into this question, and the total cost of maintenance and repairs must cover a length of time representing that life, and the pavement must be left at the end of that period in a condition as good as when it was new. In economy of yearly maintenance during the life of the pavement, inclusive of first cost, good stone stands first, asphalt second, and wood third, except in localities where wood is very cheap and stone very dear. In this case stone would stand third and wood first, and where both stone and wood are exceptionally costly, asphalt would rise to the first place.

Facility of cleaning. The order of merit, under this head, will invariably be, first, asphalt; second, stone; and third, wood, whether the cleaning be done by sweeping or by washing.

Comfort and convenience. Stone is by far the noisiest pavement. On wood a constant, though not always unpleasant, rumbling noise is produced by the traffic; on asphalt there is an incessant clicking of the horses' feet upon the surface, with very little noticeable noise from the vehicles, while on stone the din and rattle from feet and vehicles combined is always exceedingly disagreeable, and at times almost deafening.

Supposing the street to be kept reasonably clean, the difference in slipperiness between wood blocks, unpolishable stone blocks, and a continuous surface of asphalt is not great, although sufficient, perhaps, to place asphalt at a disadvantage, while a horse, if he does not fall more frequently upon it than upon the others, a point upon which there is disagreement, recovers himself less easily and less often. Asphalt cannot be said to be slippery when dry, or even when wet, if free from mud, but a very little mud makes it the most slippery of the three.

Under a sharp, dry frost asphalt and stone are usually quite dry and safe, while wood, which is generally moist in winter, is rendered slippery by freezing. The slipperiness caused by rain lasts much longer on wood than on either asphalt or stone.

In respect, therefore, to the comfort and convenience of persons using the street, as well as of those residing upon it, the order of merit would seem to be, asphalt first, wood second, and stone third, for all streets except such as are habitually crowded with heavy and busy traffic, in which case stone must be placed first and asphalt third.

Hygienic considerations. The hygienic objections to a pavement of granite blocks are, first, its constant noise and din, which exert an injurious effect upon persons suffering with nervous diseases, and especially upon infants, and all classes of invalids; and, second, its open joints, which collect and retain the surface-liquids, and throw off noxious vapors, and filthy and unwholesome dust.

Exceptions to wood may be made upon the same grounds, and, in addition to this, the material itself is subject to inevitable and often to early decay and decomposition, in the process of which poisonous gases and noxious miasma are set free.

M. Fonssagrives, Professor of Hygiene in the medical school at Montpellier, France, expresses the deliberate opinion "that a city with a damp climate, paved entirely with wood, would become a city of marsh fevers." He also says, in speaking of asphalt pavements, that "the absence of dust, the abatement of noise, the omission of joints,—permitting a complete impermeability, and thus preventing the putrid infection of the subsoil,—are among the precious benefits realized by asphalt streets."

Considered, therefore, with respect to the health of the people, asphalt stands conspicuously first, stone second, and wood third, in the order of value and merit.

The asphalt pavement referred to in the above comparison is that made with the Neuchâtel rock. This is more slippery than one composed of refined asphaltum, artificially mixed with sand, for the reason that sharp particles of silex enter largely into the composition of the latter.

REPORTS ON AWARDS.

GROUP II.

Benucci & Latti, Pesaro, Italy.

1 MODERN MAJOLICA.

Report.—Commended for successful work in the style of the majolica of the sixteenth and seventeenth centuries; also lustred colors in the style of Maestro Giorgio.

The Artistic Ceramic Farina Company, Faenza, Italy.

2 MODERN MAJOLICA AND DELLA ROBBIA WARE.

Report.—An important exhibition of successful reproductions of early majolica, Della Robbia ware, and Grafito ornament; ruby lustre used with judgment; large pieces showing considerable merit in design.

Manuel Cypriano Gomes Mafra, Caldas da Rainha, Estremadura, Portugal.

3 EARTHENWARE, "PALISSY WARE."

Report.—Commended for originality of character and design, good expression in the work, and for cheapness.

Barbizet Son, Paris, France.

4 MAJOLICA, PALISSY WARES, AND STATUETTES.

Report.—Commended for admirable modeling and artistic power in design well carried out in potting.

Rörstrand Company (Limited), Stockholm, Sweden.

5 FINE EARTHENWARE AND MODERN MAJOLICA.

Report.—Commended for good quality and cheapness of earthenware, good "majolica" of well-chosen colors; the porcelain is considered creditable in view of the progress made in the manufacture.

S. Williams & Son, Philadelphia, Pa., U. S.

6 BRICK PRESSES.

Report.—The machines show great excellence of design and workmanship, combined with strength, simplicity, and durability.

F. L. & D. R. Carnell, Philadelphia, Pa., U. S.

7 BRICK PRESSES OF VARIOUS SIZES.

Report.—The presses show great excellence in design and workmanship; the parts are few, simple, and strong, work with great accuracy and precision, and are durable.

Excelsior Brick & Stone Co., Philadelphia, Pa., U. S.

8 EXCELSIOR BRICK MACHINE.

Report.—The Excelsior machine is strong and not complicated in its parts, possesses the capacity to work rapidly in moderately moist clay, and delivers a good common brick.

I. H. Garretson, Richland, Iowa, U. S.

9 A TAMPING IMPACT BRICK MACHINE.

Report.—The machine, though not a fast worker, is exceedingly simple in design and low-priced, and makes a dry clay brick, by tamping, which is excellent of its kind.

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10 **Augustus Morand, Philadelphia, Pa., U. S.**

PLASTIC BRICK MACHINE, AND KILN FOR BURNING BY SUCCESSIVE CHAMBERS.

Report.—The brick machine very thoroughly mixes and tempers the clay, is strong and not complicated in its parts, and rapidly produces plastic bricks of sufficient firmness to go directly into the hand presses. The kiln is operated with great economy in fuel, is easily controlled when burning, and gives great uniformity in degree of firing.

S. P. Miller & Son, Philadelphia, Pa., U. S.

11 HAND PRESSES FOR PRESSING BRICKS AND FIRE-BRICKS.

Report.—Commended for the excellence of their design and workmanship, strength of the parts, and accuracy and precision of their motion.

Chambers, Bro., & Co., Philadelphia, Pa., U. S.

12 BRICK-MAKING MACHINE,—OPERATES BY EXPRESSING THE CLAY.

Report.—Commended for the strength and simplicity of its parts, the thoroughness with which it mixes and tempers the clay, the rapidity with which it produces good common plastic bricks, and its low price.

Isaac Gregg, Jr., & Co., Philadelphia, Pa., U. S.

13 BRICK MACHINE, AND ONE-FACE BRICKS PRESSED EDGEWISE.

Report.—The machine will work well in either strong or weak clay, gives three successive pressures to the brick, is strong, and runs with little wear and tear, and can be used for re-pressing as well as making the bricks; the edge-pressed bricks are precisely uniform in thickness, and can be laid without gauging and with a uniform thickness of joint. They have a fine body, are well fired, and are of excellent color.

The Great American Brick Machine Co., Croton Landing, N. Y., U. S.

14 IMPERIAL BRICK MACHINE, AND IMPERIAL BRICK TRUCK.

Report.—The brick machine is strong and simple in its parts, not liable to get out of order, and produces a well-moulded and moderately plastic brick. The brick truck is well adapted to moving bricks quickly and economically.

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15 **C. Schlickeysen, Berlin, Germany.**

BRICK AND DRAIN-TILE MACHINES; THEY ARE EXPRESSING MACHINES, AND WORK IN PLASTIC CLAY.

Report.—The machines are simple, strong, and of moderate cost; mix and temper the clay well; their running expense is low, and they deliver their products of uniform quality.

George Sylvester Tiffany, London, Ontario, Canada.

16 BRICK AND TILE-MAKING MACHINE,—AN EXPRESSING MACHINE.

Report.—The machine is simple and strong in the arrangement of its component parts, and its price is low. It also embodies the novel and valuable device of a propeller for forcing the clay through the die, which revolves in a direction opposite to the motion of the pug-mill, and much more rapidly.

F. Durand & Marais, Paris, France.

17 BRICK MACHINE.

Report.—The machine is very simple, strong, easily kept in order, and can be operated with small motive power. It is also a low-priced machine, and will mould artificial fuel, and other materials.

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18 A. J. Haws, Johnstown, Pa., U. S.

FIRE BOTTOM FOR BESSEMER STEEL CONVERTER—FIRE-CLAY TUYERES, PATENT NOZZLES, AND SLUICES FOR LADLE RODS AND FURNACE FIRE-BRICK.

Report.—These products are well made, and present every appearance of being refractory and in every way suitable for the uses designated.

George Carnell, Philadelphia, Pa., U. S.

19 CLAY TEMPERING MILL.

Report.—Commended for the strength and simplicity of its parts and the small power required to work it.

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20 George C. Hicks & Co., Baltimore, Md., U. S.

CLAY GAS RETORTS, LARGEST SIZE, GAS WORKS TILES, AND FIRE-BRICK.

Report.—A large exhibit of refractory clay articles for gas works, well made and good.

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21 Georg Mendheim, Berlin, Prussia.

MODEL AND DRAWING OF CONTINUOUS KILN FOR BURNING CERAMICS WITH GAS.

Report.—Samples of common and fine wares fired in one of these kilns are displayed, which show that the combustion is under good control and can be managed so as to give any required degree of burning at a comparatively low cost. The kiln is evidence of marked and intelligent progress.

Jules Brianchon, Senior, Paris, France.

22 LUSTRE ON PORCELAIN.

Report.—Commended for nacreous or pearl lustre of great brilliancy, of which he is the inventor.

Gustafsberg Manufacturing Co., near Stockholm, Sweden.

23 PARIAN, LARGE VASES.

Report.—Commended for fine body and color of parian; for pottery, and modeling large vases; for introduction of characteristic national ornamentation.

Homer Brooke, New York, N. Y., U. S.

24 PRESSES FOR GLASS.

Report.—These useful machines are recommended for simplicity in construction, practical design, easy management, and general adaptation to the purpose.

Samuel Bevington, Philadelphia, Pa., U. S.

25 FURNACE FOR DECORATING CHINA OR GLASS.

Report.—Commended for new form and admirable adaptation for the purpose.

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26 **The Patent Plumbago Crucible Co., London, England.**

ASSAY, DENTAL PORCELAIN, JEWELERS' AND CHEMISTS' FIRE-CLAY FURNACES.

Report.—Commended for good shapes, well made, and of excellent quality.

King Brothers, Stourbridge, England.

27 GAS RETORTS.

Report.—Commended for good quality.

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28 **J. Goebel & Co., New York, N. Y., U. S.**

CRUDE AND BURNED GERMAN CLAY, AND GLASS MELTING POTS MADE FROM SAME.

Report.—The clay is remarkably pure, and the pots possess superior durability for glass manufacturing purposes.

Keystone Flint Glass Manufacturing Co., Pittsburg, Pa., U. S.

29 LAMP GLASSES.

Report.—Commended for good quality of glass, and for forms of wares.

Excelsior Flint Glass Co., Pittsburg, Pa., U. S.

30 LAMP CHIMNEYS AND REFLECTORS.

Report.—Commended for good quality and low price of reflectors.

Smith Brothers, New Bedford, Mass., U. S.

31 OPAL OR BONE GLASS LAMP SHADES.

Report.—Commended for variety of form and good quality of wares.

J. M. Albertson & Sons, Norristown, Pa., U. S.

32 WINDOW GLASS AND SHADES.

Report.—Commended for good quality and useful wares.

Hartell & Letchworth, Philadelphia, Pa., U. S.

33 CUT AND ETCHED LAMP GLOBES.

Report.—Commended for decoration of glass globes.

Atterbury & Co., Pittsburg, Pa., U. S.

34 LIME GLASS LAMPS, LAMP CHIMNEYS, AND GLOBES.

Report.—Commended for good quality and variety of wares.

Elias Palm, Steinschönau, Bohemia, Austria.

35 CHANDELIERS OF GLASS LUSTRES.

Report.—Commended for quality and good designs of chandeliers.

Jules de Brunfaut, Vienna, Austria.

36 GLASS SILK AND SPINNINGS.

Report.—Commended for fineness and delicacy of the spun glass, and for utility, skill, and taste of bonnets and feathers made from glass; also glass wool for chemical filtration of vitriol; and for glass silk patterns.

M. A. Pelletier & Sons, St.-Just-sur-Loire, France.

37 STAINED WINDOW GLASS.

Report.—Commended for good and uniform colors and delicacy of tint.

Paul Bitterlin Son, Paris, France.

38 GLASS PAINTED WINDOWS.

Report.—Commended for good designs and quality.

Appert, Lengelé, & Co., Paris, France.

39 GLASS SHADES.

Report.—Commended for good quality of glass, and for forms.

E. Baudoux & Jouet, Lodelinsart, Belgium.

40 WINDOW GLASS, LARGE SIZES, OF VARIOUS COLORS.

Report.—Commended for good quality.

L. Baudoux & Co., Charleroi, Belgium.

41 WINDOW GLASS, PLAIN, COLORED, AND FIGURED.

Report.—Commended for variety and quality of colors and designs.

J. J. B. J. Bouvy, Dordrecht, Netherlands.

42 GLASS LENSES FOR LANTERNS.

Report.—Commended for good quality of metal and variety of forms.

Anonymous Society of Boussu, Boussu, Belgium.

43 BONE GLASS LAMP SHADES AND GLOBES.

Report.—Commended for good quality.

Tyrolese Glass Painting Manufactory, Innsbruck, Austria.

44 DECORATED WINDOWS AND STAINED GLASS.

Report.—Commended for variety of colors of window glass.

Bennert & Bivort, Jumet, near Charleroi, Belgium.

45 WINDOW GLASS, LARGE SIZES AND VARIOUS COLORS.

Report.—Commended for good quality and freedom from impurities.

Rochester Tumbler Co., Pittsburg, Pa., U. S.

46 GLASS TUMBLERS.

Report.—Commended for good quality of metal and great variety in forms.

George Duncan & Sons, Pittsburg, Pa., U. S.

47 LIME GLASS TABLE WARES.

Report.—Commended for good quality of metal and for good forms of wares.

Central Glass Co., Wheeling, W. Va., U. S.

48 LIME GLASS PRESSED TABLE WARES.

Report.—Especially commended for thin and good forms and for cleanness and sharpness of pressing.

O'Hara Glass Co. (Limited), Pittsburg, Pa., U. S.

49 LIME GLASS TABLE WARES.

Report.—Commended for good quality of glass and for forms of wares.

Bakewell, Pears, & Co., Pittsburg, Pa., U. S.

50 MOULDED GLASS TABLE WARES.

Report.—Commended for good quality of thin pieces of glass and for forms of wares.

New England Glass Co., Boston, Mass., U. S.

51 FLINT GLASS TABLE WARES AND DECORATIVE PIECES.

Report.—Commended for general good quality of the exhibition, for fine metal, engraving, and etching.

Boston and Sandwich Glass Co., Boston, Mass., U. S.

52 FLINT GLASS TABLE WARES.

Report.—Commended for the general good quality of collection, for fine metal, and cutting.

Mount Washington Glass Co., New Bedford, Mass., U. S.

53 FLINT GLASS TABLE WARES, CHANDELIERS, AND BONE GLASS.

Report.—Commended for engraving, for good quality of chandeliers, and for bone glass.

Gillinder & Sons, Philadelphia, Pa., U. S.

54 FLINT AND LIME GLASS WARES.

Report.—Commended for the size and interest of the exhibition made, for good thin blown glass, and for cheap pressed glass.

Dorflinger Glass Co., White Mills, Wayne County, Pa., U. S.

55 GLASS TABLE WARES.

Report.—Commended for good cutting and engraving of wares.

La Belle Glass Co., Bridgeport, Ohio, U. S.

56 GLASS TABLE WARES, MOULDED.

Report.—Commended for good quality of pressing or moulding.

J. H. Hobbs, Brockunier, & Co., Wheeling, W. Va., U. S.

57 LIME GLASS TABLE WARES.

Report.—Commended for good quality of lime glass.

J. B. Dobleman, Green Point Flint Works, Brooklyn, N. Y., U. S.

58 FLINT GLASS TABLE WARES.

Report.—Commended for good quality of glass and for fine cutting.

Alexander Jenkinson, Edinburgh, Scotland.

59 GLASS TABLE WARE AND DECORATIVE PIECES.

Report.—Commended for fine colors of old Venetian styles, for form, and general effect.

James Green & Nephew, London, England.

60 GLASS TABLE WARE, DESSERT PIECES, AND CANDELABRA.

Report.—Commended for excellent quality of glass, for fine cutting and engraving, for high quality of form, and for general excellence of the exhibition.

John Millar & Co., Edinburgh, Scotland.

61 GLASS TABLE WARE.

Report.—Commended for good quality of metal, for forms, and for engraving.

Elias Greiner Vetter's Son, Lauscha, near Coburg, Germany.

62 DECORATED GLASS MARBLES, BEADS, AND ORNAMENTS.

Report.—Commended for variety of marbles and beads, and for good enamel colors.

N. Wiederer, Fürth, Bavaria, Germany.

63 GLASS PLATES CUT IN VARIOUS PATTERNS.

Report.—Commended for good cutting and for low prices.

T. Olivotti, Venice, Italy.

64 GLASS BEADS AND FANCY ARTICLES.

Report.—Commended for good quality of beads and fancy articles.

David Bedendo, Venice, Italy.

65 GLASS MOSAICS AND BEADS.

Report.—Commended for good quality of mosaics and beads.

Ferro & Co., Venice, Italy.

66 GLASS WARES IN OLD VENETIAN STYLES.

Report.—Commended for good quality and style of Venetian glass wares.

The Ceramic Gas Kiln Co., Philadelphia, Pa., U. S.

67 GREGG'S CERAMIC GAS KILN.

Report.—The ceramic gas kiln can be operated with advantage, in economy of fuel and labor, and in uniformity of firing.

Count von Harrach's Glass Works, Neuwelt, Bohemia, Austria.

68 DECORATED GLASS TABLE WARES AND DECORATIVE PIECES.

Report.—Commended for variety of patterns.

Herman Müller, Ulrichsthal, Bohemia, Austria.

69 GLASS TABLE WARES AND DECORATIVE PIECES.

Report.—Commended for artistic designs and good engraving.

Grohmann & Kessler, Haida, Bohemia, Austria.

70 DECORATED GLASS ORNAMENTAL ARTICLES.

Report.—Commended for variety of good colors.

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71 **J. & L. Lobmeyr, Vienna, Austria.**

FINE GLASS TABLE AND DFSSERT SERVICES, AND ORNAMENTAL ARTICLES.

Report.—Commended for excellence of exhibition and general high character of wares, and for decorative design applied to unusually fine quality of glass.

Jos. Ed. Schmid, Annathal, Bohemia, Austria.

72 GLASS TABLE WARES AND ORNAMENTAL PIECES.

Report.—Commended for fine quality of glass and for variety of good forms.

Joseph Hoyer, Svetla, Bohemia, Austria.

73 LIME GLASS TABLE WARES, CUT AND MOULDED.

Report.—Commended for good quality of glass and moulding, and for low prices.

Clemens Rasch, Ulrichsthal, Bohemia, Austria.

74 DECORATED GLASS TABLE WARES, DECORATIVE PIECES.

Report.—Commended for good painting and general good taste.

C. Stölzle's Sons, Vienna, Austria.

75 GLASS TABLE WARES AND FANCY ARTICLES.

Report.—Commended for good quality of glass.

Meyr's Nephew, Adolf, near Winterberg, Bohemia, Austria.

76 GLASS TABLE WARES AND COLORED WINDOW GLASS.

Report.—Commended for good quality and variety of colors.

Reymyre Glass Factory, Reymyre, Sweden.

77 GLASS TABLE WARES AND CHEMICAL WARES.

Report.—Commended for good quality of metal, and for good cutting.

A. Farris & Co., Badalona, Barcelona, Spain.

78 GLASS TABLE WARES.

Report.—Commended for good quality of cutting and engraving.

Utzschneider & Jaunez, Wasserbillig, Grand Duchy of Luxemburg.

79 TERRA-COTTA PAVING TILES.

Report.—Commended for utility of quality and cheapness.

F. E. Palme's Son, Zvecevo, Austria.

80 GLASS TABLE WARES.

Report.—Commended for useful quality and low prices.

C. Newman & Co., San Francisco, Cal., U. S.

81 GLASS DEMIJOHNS COVERED WITH ELASTIC PACKING.

Report.—Commended for good quality and utility, and for ingenious application.

H. C. Fox & Sons, Philadelphia, Pa., U. S.

82 DRUGGISTS' AND PERFUMERS' GLASS WARES.

Report.—Commended for variety and utility of wares of good quality.

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83 **Whitall, Tatum, & Co., Philadelphia, Pa., U. S.**

CHEMISTS', DRUGGISTS', AND PERFUMERS' WARES OF LIME AND GREEN GLASS.

Report.—Commended for good quality of glass, and for useful productions in great variety.

Aire & Calder Glass Bottle Co., London, England.

84 GLASS BOTTLES AND JARS.

Report.—Commended for good quality and suitability to purposes.

Kilner Brothers, London, England.

85 GLASS BOTTLES AND JARS.

Report.—Commended for good quality of glass, and for fitting of stoppers.

H. Underberg-Albrecht, Rheinberg, Prussia.

86 GLASS WINE AND LIQUOR BOTTLES.

Report.—Commended for good quality and manufacture.

Austrian Glass Foundry Association, Aussig, Bohemia, Austria.

87 GLASS BOTTLES AND JARS.

Report.—Commended for regularity of make.

Richard C. Remmey, Philadelphia, Pa., U. S.

88 CHEMICAL STONEWARE.

Report.—Commended as well fitted for purpose, and cheap.

Franz Batka, Prague, Bohemia, Austria.

89 CHEMISTS' AND DRUGGISTS' GLASS.

Report.—Commended for good character of glass, variety of productions, and utility.

Chance Brothers & Co., Birmingham, England.

90 GLASS DISCS FOR OPTICAL PURPOSES.

Report.—Commended for fine quality of glass.

S. P. Sallandrouze, Cincinnati, Ohio, U. S.

91 SILVERING OF LARGE PLATE GLASS.

Report.—Commended for successful work.

D. Durand, New York, U. S.

92 MIRROR CUT AND ORNAMENTED IN THE VENETIAN STYLE.

Report.—Commended for design of cutting and ornamentation.

Louisville Plate Glass Manufacturing Co., Louisville, Ky., U. S.

93 LARGE GLASS PLATE.

Report.—Commended as an advance in manufactures.

Mirror and Chemical Manufactories of St. Gobain, Chauny, and Cirey, Stolberg and Mannheim, Germany.

94 THICK GLASS PLATES, CAST, ROUGH, AND POLISHED.

Report.—Commended for good quality of glass plates.

Cohansey Glass Co., Bridgeton, N. J., U. S.

95 WINDOW GLASS, FRUIT JARS.

Report.—Commended for utility of fruit jars and good quality of window glass.

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96 **Leopold Heilbronn, Fürth, near Nuremberg, Germany.**

BLOWN WHITE GLASS MIRRORS, POLISHED AND FOLIATED WITH QUICKSILVER.

Report.—Commended for utility and cheapness.

Christian Winkler & Son, Fürth, near Nuremberg, Germany.

97 COMMON BLOWN GLASS MIRRORS SILVERED, AND CYLINDERS.

Report.—Commended for good quality and cheapness.

Luigi Olivieri, Venice, Italy.

98 GLASS MIRRORS AND FANCY ARTICLES.

Report.—Commended for good quality of mirrors and candelabra.

Mirror and Chemical Manufactories of St. Gobain, Chauny, and Cirey, Paris, France.

99 PLATE GLASS AND MIRRORS, AND LARGE CASTINGS OF GLASS.

Report.—Commended for excellent plate and for good moulding in glass, and for extraordinarily large sizes of plates.

A. Schmidt & Co., Jumet, near Charleroi, Belgium.

100 CORRUGATED GLASS PLATES FOR REFLECTORS.

Report.—Commended for good quality.

Alphonse Morel, Lodelinsart, Belgium.

101 WINDOW GLASS OF LARGE SIZE.

Report.—Commended for good quality.

Schmidt, Devillez, & Co., Dampremy, near Charleroi, Belgium.

102 VERY THICK AND LARGE WINDOW GLASS.

Report.—Commended for good quality of very thick window glass.

L. Lambert & Co., Jumet, near Charleroi, Belgium.

103 WINDOW GLASS, LARGE SIZE.

Report.—Commended for good quality.

Casimir Lambert Son, Charleroi, Belgium.

104 WINDOW GLASS OF LARGE SIZES.

Report.—Commended for good quality.

A. Fourcault-Frison & Co., Dampremy, near Charleroi, Belgium.

105 WINDOW GLASS OF LARGEST SIZE.

Report.—Commended for good quality and for large sizes.

De Looper, Haidin, & Co., Gosselies-Courcelles, Belgium.

106 WINDOW GLASS AND CYLINDERS OF LARGEST SIZE.

Report.—Large cylinders of good quality.

L. de Dorlodot & Co., Lodelinsart, Belgium.

107 WINDOW GLASS FOR VARIOUS PURPOSES.

Report.—Commended for good quality.

A. Bougard, H. Le Brun, & Co., Roux, near Charleroi, Belgium.

108 THICK WINDOW GLASS PLATES.

Report.—Commended for good quality.

Anonymous Society of Courcelles, Courcelles, Belgium.

109 GLASS PLATES, LARGE, AND OF TRIPLE THICKNESS.

Report.—Commended for very good quality.

Anonymous Society of Hainaut, Roux near Charleroi, Belgium.

110 GLASS MIRROR OF LARGE SIZE.

Report.—Commended for good silvering and polishing.

Floreffe Company, Floreffe near Namur, Belgium.

111 GLASS MIRRORS OF LARGE SIZE.

Report.—Commended for good quality.

A. B. Daniell & Son, London, England.

112 PORCELAIN POTTERY.

Report.—Commended for a very important and instructive exhibition, and for some of the wares, the excellent decorations of which have been either designed or suggested by the exhibitors.

Kawamoto Masukichi, Nagoya, Province of Owari, Japan.

113 DECORATIVE PORCELAIN.

Report.—A most important collection of specimens, some of which are in the highest degree remarkable for skill in potting; also for excellent decoration.

Maurice Fischer's Sons, Herend, Hungary, Austria.

114 PORCELAIN.

Report.—Commended for general accuracy of reproduction of the styles of the last century, and for delicacy of perforated work.

Hanske Seto, Owari, Japan.

115 DECORATIVE PORCELAIN.

Report.—Commended for good potting and delicate decoration.

Kanzan Denshichi, Kiyoto, Japan.

116 PORCELAIN WITH ORIGINAL DECORATION.

Report.—Commended for original and excellent decoration.

Shippo-Kuwaisha, Nagoya, Japan.

117 PORCELAIN COATED WITH CLOISONNÉ ENAMEL.

Report.—Commended for successful manufacture; some ingenious designs skillfully carried out, producing good decorative effect.

K. Shinoda, Kaga, Japan.

118 DECORATIVE PORCELAIN.

Report.—Commended for good design of some forms, and good and artistic decoration.

Hiyochiyen-sha, Tokio, Japan.

119 DECORATIVE PORCELAIN.

Report.—Commended for admirable decorative painting, showing in some pieces a very high artistic feeling for color and ornamental design.

Museum of Fine Arts applied to Industry, Moscow, Russia.

120 ENAMELED TERRA-COTTA.

Report.—Commended for brilliant decoration in early styles, retaining national characteristics.

Astbury & Maddock, Trenton, N. J., U. S.

121 SANITARY EARTHENWARE.

Report.—Commended for good quality and fitness to purpose.

Laughlin Brothers, East Liverpool, Ohio, U. S.

122 WHITE GRANITE WARES.

Report.—Commended for serviceable body and glaze; well fitted for purposes intended.

William Young's Sons, Trenton, N. J., U. S.

123 WHITE GRANITE TABLE WARES, "C. C." WARES.

Report.—Commended for good quality of body and glaze; "C. C." wares very good; also "dipped" wares.

Joseph H. Moore, Trenton, N. J., U. S.

124 WHITE GRANITE TABLE WARES, BISCUIT, AND PARIAN.

Report.—Commended for good quality of body and glaze of "granite" ware; biscuit flowers delicately modeled.

Isaac Davis, Trenton, N. J., U. S.

125 WHITE GRANITE WARES.

Report.—Commended for good quality of body and glaze, and for fine blue color; also for improvement in avoiding the too frequent clumsiness of this ware; some pieces are thin and delicately formed.

Glasgow Pottery Co., Trenton, N. J., U. S.

126 WHITE GRANITE WARES.

Report.—Commended for good quality of body and glaze; good "pen" gilding.

American Crockery Co., Trenton, N. J., U. S.

127 WHITE GRANITE WARES.

Report.—Commended for good quality of body and glaze; decoration neat and effect satisfactory.

Manufactory of Artistic Faïence of Gien, Loiret, France.

128 SOFT-BODIED FAÏENCE.

Report.—Commended for artistic quality in design and decoration, and for success in producing objects possessing much merit at low cost.

A. Montagnon, Nevers, France.

129 FAÏENCE IN OLD FRENCH STYLE.

Report.—Commended for skillful potting, design, and painting of ornament.

J. Aubry, Bellevue, France.

130 DECORATED FAÏENCE.

Report.—Commended for freedom and vigor of decorative drawing; correct reproduction of early styles of ornament.

Herrman Ostrand, Helsingborg, Sweden.

131 STONEWARE.

Report.—Commended for good quality of body, and serviceable in form.

Wendrich & Son, Copenhagen, Denmark.

132 TERRA-COTTA VASES, ETC.

Report.—Commended for elegance of forms and general good designs in small vases.

P. Ipsen's Widow, Copenhagen, Denmark.

133 TERRA-COTTA VASES, ETC.

Report.—Commended for an important exhibition, and for fine modeling and successful potting, and especially for excellent drawing of ornaments.

Höganäs Coal Mining Co., Höganäs, Sweden.

134 TERRA-COTTA STONEWARE, AND FIRE-BRICKS.

Report.—Commended for good design and moulding of terra-cotta; stoneware serviceable and judiciously ornamented. Fire-bricks of excellent quality.

F. Garcia Montalvan, Seville, Spain.

135 EARTHENWARE.

Report.—Earthenware with a coarse but bold and effective decoration,—extremely cheap.

Ott & Brewer, Trenton, N. J., U. S.

136 WHITE GRANITE WARES AND PARIAN FIGURES AND PLAQUES.

Report.—Commended for good quality of body and glaze of "granite" ware, figures in Parian modeled by Mr. Broome, new design of toilet wares, general attention to design.

Alois Klammerth, Znaim, Moravia, Austria.

137 STONEWARE AND DOMESTIC WARE.

Report.—Commended for good quality of stoneware, hard in body, and several designs good; also for very cheap domestic wares.

Telegraphic Supply Co., formerly of H. Schomburg, Berlin, Prussia.

138 TELEGRAPH WARES OF PORCELAIN.

Report.—Commended for excellent adaptation to purpose.

Miguel Nolla & Son, Meliana, Valencia, Spain.

139 TILES.

Report.—Commended for great variety of designs, many very good and effective.

Manuel de Soto y Tello, Seville, Spain.

140 TILES.

Report.—Commended as well fitted for brilliant mural decoration, variety of design, and effective use of excellent color.

Pickman & Co., Seville, Spain.

141 TILES.

Report.—Commended for good and effective color, and lustred glaze fairly used; excellent for decoration.

E. Muller & Co., Ivry, France.

142 TILES AND PERFORATED BRICKS.

Report.—Commended for good quality of body of tiles and bricks; ingenious arrangement for ceiling tiles.

Wilson Mitchell, Philadelphia, Pa., U. S.

143 COMPRESSED PAVING TILES OF VARIOUS COLORS.

Report.—The tiles are well moulded, are smooth on the surface, and possess sufficient strength and hardness to adapt them to paving areas, cellars, walks, halls of stores, and public buildings.

Villeroy & Boch, Mettlach, Germany.

144 TILES FOR ARCHITECTURAL USES.

Report.—Commended for good quality and quiet tones of color, suitable to certain classes of mural and other decoration.

Maw & Co., Broseley, Shropshire, England.

145 TILES.

Report.—Commended for high quality of embossed and glazed encaustic tiles, and for general excellence of exhibition.

Ravesteijn Bros., Westraven, Netherlands.

146 PAINTED TILES.

Report.—Commended for decoration successfully executed in style of the old Dutch tiles; color fair.

Minton, Hollins, & Co., Stoke-upon-Trent, England.

147 TILES.

Report.—Commended for high merit of encaustic and various mural tiles; for variety of designs and artistic work on panels.

C. G. L. Koolemans-Beynen, Willeskop, near Oudewater, Netherlands.

148 COMMON AND HOLLOW BRICKS, "DUTCH TRASS," AND ROOFING TILES.

Report.—It is an interesting and instructive display of materials in general use for building purposes in the Netherlands. The bricks and tiles, though not beautiful in form and color, are durable, and many of them are very hard and tough. The trass is of good quality, and well adapted to purposes of construction.

P. Krishtafovitch, Gorodishtche, Russia.

149 FIRE-BRICK.

Report.—Commended for good make and refractory character.

Mehmed, Constantinople, Turkey.

150 RED TERRA-COTTA.

Report.—Commended for decoration used with skill and effect.

Ismail Ousta, Jerusalem, Syria, Turkey.

151 ORNAMENTAL TERRA-COTTA.

Report.—Commended for patterns of good design.

P. Goedewaagen, Gouda, Holland.

152 TOBACCO PIPES.

Report.—Commended for excellent quality; accurately moulded and finished.

Newton & Co., Albany, N. Y., U. S.

153 FIRE-BRICK LININGS FOR STOVES, RANGES, AND HEATERS.

Report.—A large and varied display; good shapes, well moulded, and suited to the purposes.

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154 **Philip Neukumet, Philadelphia, Pa., and Perth Amboy, N. J., U. S.**

CLAY RETORTS FOR GAS WORKS, FIRE-BRICK FOR GAS WORKS, BLAST FURNACES, ETC.

Report.—A large exhibit of gas retorts, porcelain furnaces, fire-brick, blocks and tile; good shape, well burnt, and refractory.

Kier Bros., Salina, Pa., U. S.

155 FIRE-BRICK, FURNACE BRICK, ARCHES, AND KEYS.

Report.—A small exhibition of articles of good reputation and standard value.

Dover Fire-Brick Co., Canal Dover, Ohio, U. S.

156 FIRE-BRICK.

Report.—Common shaped fire-brick, good quality.

B. Kreischer & Son, New York City, N. Y., U. S.

157 CLAY RETORTS, MUFFLE OR ASSAY FURNACES.

Report.—Good shapes and well made.

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158 **Union Mining Co., Alleghany County, Md., U. S.**

FIRE-BRICK FOR BLAST FURNACES AND SIEMENS-MARTIN FURNACES.

Report.—The exhibit is large, and contains the various-sized articles used in the construction of blast furnaces and Siemens-Martin furnaces; well made and of excellent quality.

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159 **Robert Taylor & Co., Philadelphia, Pa., U. S.**

BLACK-LEAD CRUCIBLES AND LARGE RETORTS FOR DISTILLING ZINC FROM SILVER.

Report.—This exhibit contains all sizes of black-lead crucibles for smelting metals, and retorts for distilling zinc from silver. They are well made and of excellent quality.

McElroy & Co., Philadelphia, Pa., U. S.

160 CLAY TOBACCO PIPES.

Report.—Commended for good quality and for advance in manufacture.

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161 **Phœnix Manufacturing Co., Taunton, Mass., U. S.**

BLACK-LEAD CRUCIBLES FOR SMELTING STEEL, BRONZE, ETC., AND STILLS FOR ZINC.

Report.—A large exhibit, well made and of good quality.

Pablo Cucurney, Barcelona, Spain.

162 FIRE-CLAY ASSAY AND CUPEL FURNACES FOR COAL AND GAS.

Report.—Commended as good and cheap.

National Factory of Trubia, Trubia, Oviedo, Spain.

163 FIRE-BRICK.

Report.—Commended for refractory qualities.

J. Gambier, Widow, Givet, Ardennes, France.

164 TOBACCO PIPES.

Report.—Commended for pipes of good quality, some ornamented with busts skiilfully moulded.

Gerardo Sagarminaga, Madrid, Spain.

165 FIRE-CLAY CRUCIBLES.

Report.—Commended for good quality.

L. Fiolet, St. Omer, France.

166 TOBACCO PIPES.

Report.—Commended for good quality and moulding.

Molas & Co., Barcelona, Spain.

167 CLAY GAS RETORT.

Report.—Not remarkable for finish, but of good material.

Désiré Barth, Andennelle near Andenne, Belgium.

168 TOBACCO PIPES.

Report.—Commended for good quality and low price.

Anonymous Society of Seilles-lez-Andenne and Bouffioulx, Seilles-lez-Andenne, Belgium.

169 CLAY GAS RETORTS AND GAS FURNACES, FIRE-BRICKS AND SLABS.

Report.—Commended as well moulded and of good quality.

Dixon Crucible Co., Jersey City, N. J., U. S.

170 GRAPHITE CRUCIBLES.

Report.—Commended for refractory character, durability, and excellence of form; exhibited with a collection of graphite mined at Ticonderoga and collected from commercial and other sources, which is of scientific and practical interest.

J. P. Alexander, Akron, Ohio, U. S.

171 FIRE-BRICKS.

Report.—The bricks possess a high refractory power.

Davis & Chaddock, Boston, Mass., U. S.

172 FIRE-BRICK.

Report.—A small exhibit of common size fire-brick of good quality.

American Kaolin Co., Philadelphia, Pa., U. S.

173 FIRE-BRICKS.

Report.—Commended for common shapes, well made, and of good quality.

The Dominion of Canada Plumbago Co., Buckingham, Canada.

174 PLUMBAGO CRUCIBLES.

Report.—Commended as well made and durable.

175 **Harper & Moores, Stourbridge, England.**

FIRE-BRICK FOR BLAST FURNACES AND SMALL ASSAY FURNACES.

Report.—Commended as well shaped and of good quality.

Gundlach Bros., Grossalmerode, Hesse, Germany.

176 FIRE-BRICK AND BLACK-LEAD CRUCIBLES.

Report.—Commended for make, quality, and refractory character.

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177 **Wilhelm Gundlach & Son, Grossalmerode, Hesse, Germany.**

TRIANGULAR-SHAPED AND ROUND HESSIAN CRUCIBLES FOR MELTING BRONZE, SILVER, AND GOLD.

Report.—Commended for good quality and refractory character.

John Gundlach, Jr., Grossalmerode, Hesse, Germany.

178 LARGE AND SMALL HESSIAN CRUCIBLES FOR MELTING BRONZE.

Report.—Commended as well made and of good quality.

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179 **Stettin Fire-Brick Manufacturing Co., Stettin, Germany.**

INTERIOR GLAZED GAS RETORTS AND GAS FURNACE FIRE-BRICK FITTINGS.

Report.—Commended for uniform glaze and good quality.

Bulmer & Sheppard, Montreal, Canada.

180 FOUR COMMON BRICKS.

Report.—The bricks are of good quality and color, and are well fired.

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181 **Geo. King Harrison, Stourbridge, England.**

FIRE-BRICKS AND GLASS HOUSE POT CLAY; SOME UNBURNT BRICKS.

Report.—The bricks are highly refractory, and the clay sustains a high heat with very slight contraction.

Lee Bros., St. John, New Brunswick, Canada.

182 COMMON HARD BRICKS.

Report.—The bricks are of good quality, being very hard and strong, well moulded and fired, and of an agreeable dark red color.

Wood & Ivery, West Bromwich, Staffordshire, England.

183 BLUE BRICK AND TERRA-METALLIC WARE.

Report.—Commended for hard, solid body, well moulded and sharp.

Thomas Peake, Tunstall, England.

184 BLUE BRICK AND TERRA-METALLIC WARES.

Report.—Commended for compact texture; excellent for solidity.

Johnson & Co., Ditchling, Sussex, England.

185 ARCHITECTURAL TERRA-COTTA.

Report.—Commended for good selection of designs and good modeling.

Silva & Santos, Oporto, Portugal.

186 TERRA-COTTA FIGURES.

Report.—Commended as very clever in modeling and natural in expression.

Miguel Campolini, Oporto, Portugal.

187 TERRA-COTTA FIGURES.

Report.—Commended as cleverly modeled and expressive.

Baltimore Terra-Cotta Works (E. W. Rittenhouse & Bro.), Baltimore, Md., U. S.

188 TERRA-COTTA DRAIN AND SEWER PIPE.

Report.—The material is of good body, hard, compact, and strong.

João do Rio, Jr., Oporto, Portugal.

189 TERRA-COTTA STATUETTES.

Report.—Commended as good in design and successfully potted.

N. U. Walker, Wellsville, Ohio, U. S.

190 GLAZED SEWER PIPES.

Report.—Commended for good and hard body.

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191 **C. W. Boynton, Woodbridge, N. J., U. S.**

VITRIFIED DRAIN AND SEWER PIPE, PERFORATED VOUSSOIRS, PERFORATED AND SOLID SLABS.

Report.—All the goods have a good body, are well fired, strong, and durable, and exceptionally meritorious.

Vaiss, Martin, & Co., Constantinople, Turkey.

192 COMMON AND HOLLOW BRICKS.

Report.—The bricks are well burnt, hard and strong, and notably low in price.

Harvey & Adamson, Philadelphia, Pa., U. S.

193 TERRA-COTTA GLAZED DRAIN AND SEWER PIPES.

Report.—Commended for good quality and fitness for purpose.

Carson & Sons, Riverton, Warren County, Va., U. S.

194 ONE JAR OF UNSLAKED LUMP LIME.

Report.—The lime slakes well, is very white, and valuable for building purposes.

S. M. Hamilton, Baltimore, Md., U. S.

195 CUMBERLAND CEMENT.

Report.—The Cumberland cement is a quick-setting, natural hydraulic cement, and stands deservedly high among cements of that type.

Michael Ehret, Jr., Philadelphia, Pa., U. S.

196 GRANULATED SLAG ROOFING.

Report.—It is one of the best roofs of its class in imperviousness to water and in durability.

Otto Hiller, Berlin, Germany.

197 MASTIC ROOFING MATERIALS, AND MODEL OF MASTIC ROOF.

Report.—The coal-tar product appears to have been skillfully prepared, and the felt is of good quality and well saturated with the coal-tar mixture. The sample of finished roof-surface takes rank among the best of its kind.

Wampum Cement and Lime Co. (Limited), New Castle, Pa., U. S.

198 PORTLAND CEMENT, AND ARTIFICIAL STONE MADE FROM SAME.

Report.—The strength and hardness of this cement place it among Portland cements of good standard quality, and the specimens of artificial stone made from it are strong, dense, and well moulded. The ground cement is amply heavy, and of good color.

Louis Scharlach, Jr., Hamburg, Germany.

199 PREPARED ROOFING FELT.

Report.—The felt is firm in texture, and thoroughly saturated with a mastic of good quality.

Carl S. Haeussler, Hirschberg, Germany.

200 WOOD-CEMENT ROOFING.

Report.—It is an improved method of constructing a good roof covering at a moderate cost.

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201 **Cedar Hollow Lime Co., Philadelphia, Pa., U. S.**

LIME, MODEL OF LIMEKILN, AND MODEL OF HOUSE FOR STORAGE OF LIME AND OF CAR FOR TRANSPORTING IT.

Report.—The lime is of good quality; and the design for storage-house, and car for transporting lime, very creditable.

D. W. Denton, Philadelphia, Pa., U. S.

202 ARTIFICIAL SLATE ROOFING, APPLIED WARM IN SHEETS.

Report.—Commended for the ease with which it is prepared and applied, its power to withstand the effects of change of temperature, and its comparative durability.

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203 **The Coplay Cement Co., Allentown, Pa., U. S.**

SAYLOR'S PORTLAND CEMENT, COPLAY HYDRAULIC CEMENT, ANCHOR CEMENT, AND ARTIFICIAL STONE.

Report.—The strength and hardness of the Saylor Portland cement place it high among the Portland cements of good standard quality, and the artificial stone made with it is strong, dense, and well moulded. The cement is heavy and of good color. The Coplay and the Anchor cements are good, quick-setting, natural hydraulic cements, of average strength and hardness.

204 **The Fire-Proof Building Co. of New York, N. Y., U. S.**

FIRE-PROOF HOLLOW BLOCK OF TEIL LIME COMPOSITION FOR BUILDING PURPOSES.

Report.—The blocks are sufficiently fire-proof, possess sufficient strength, and offer sufficient resistance to water and frost to give them a high value for building purposes in constructions intended to prevent or resist conflagrations.

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205 **Charles Tremain, Manlius, Onondaga County, N. Y., U. S.**

HYDRAULIC CEMENT AND FLAGGING, BUILDING BLOCKS AND ORNAMENTS MADE FROM SAME.

Report.—The cement is quick-setting and good of its kind, and the flagging and building blocks are neatly moulded and durable.

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206 **Howe's Cave Association, Howe's Cave, New York, U. S.**

NATURAL HYDRAULIC CEMENT,—THREE BARRELS FROM DIFFERENT STRATA OF THE QUARRY.

Report.—One barrel of the cement is of good quality and sets quickly, and is suitable for submarine and subterranean constructions.

The Allen Cement Co., Siegfried's Bridge, Pa., U. S.

207 NATURAL HYDRAULIC CEMENT.

Report.—It is a good, quick-setting, natural hydraulic cement, of an agreeable color, and suitable for submarine and subterranean constructions.

Adam Weber, New York, N. Y., U. S.

208 FIRE-BRICKS, CLAY AND ENAMELED CLAY RETORTS.

Report.—Commended for smoothness of surface, strength, and uniformity of texture. The enameling of the retorts internally and externally is an important improvement, efficiently and successfully carried out.

Burns, Russell, & Co., Baltimore, Maryland, U. S.

209 HAND-PRESSED BRICK MASONRY.

Report.—The bricks have an excellent body, are well fired, true in form, and of beautiful dark-red color. The masonry shows skillful workmanship.

P. P. Quackenboss, Philadelphia, Pa., U. S.

210 FOUR LARGE ARTIFICIAL STONE VASES.

Report.—The vases are well moulded, the ornaments being sharp and distinct and the material hard and sufficiently strong.

Rowland & Sprogle, New York, N. Y., U. S.

211 ARTIFICIAL CARBONATED STONE.

Report.—The method of hardening the stone with carbonic acid is good, and the stone is compact, hard, and well moulded.

A. G. Day, Seymour, Conn., U. S.

212 VULCANIZED PAVING BLOCKS.

Report.—An improved method of treating a mixture of coal tar and bitumen for paving purposes.

Phœnix Stone Manufacturing Co., Philadelphia, Pa., U. S.

213 ARTIFICIAL STONE FLAGGING AND BUILDING BLOCKS.

Report.—The materials are compacted in iron moulds under a steam-hammer, and the flags and blocks exhibited are very hard, dense, and strong. They are also cheap, and are doubtless durable.

A. H. Lavers, London, England.

214 PORTLAND CEMENT.

Report.—The Portland cement is of good standard quality with respect to strength and hardness, and is finely ground and of good color.

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215 **Francis & Co., Cliffe Creek, Rochester, England.**

PORTLAND AND PARIAN CEMENTS, AND ARTICLES MOULDED FROM SAME.

Report.—The Portland cement is of good average quality, and the Parian cement is of superior quality. The articles moulded from the cements are strong and neatly formed, with sharp angles and edges, especially the pieces of mouldings in Parian cement.

Wouldham Cement Co., Wouldham-on-Medway, England.

216 PORTLAND CEMENT.

Report.—The strength and hardness of the Wouldham cement place it high among Portland cements of good standard quality. The cement is heavy and of good color, and the mortar made from it is hard, strong, and dense.

Hollick & Co., Greenwich, England.

217 PORTLAND CEMENT.

Report.—The Portland cement is of excellent quality, is finely ground, and produces a mortar of great strength, hardness, and density.

Wm. McKay, Ottawa, Ontario, Canada.

218 HYDRAULIC CEMENT (A PATENTED ARTICLE).

Report.—McKay's patent cement is of fair average quality as compared with the good grades of Portland cement, but possesses three times the strength and hardness of ordinary quick-setting natural hydraulic cements.

P. Gauvreau & Co., Quebec, Canada.

219 HYDRAULIC CEMENT AND ARTIFICIAL STONE.

Report.—The cement is quick-setting and excellent of its kind, and the specimens of artificial stone are fairly moulded, and of sufficient strength and hardness for the purposes for which they are severally intended.

Toepffer, Grawitz, & Co., Portland Cement Factory "Stern," Stettin, Germany.

220 PORTLAND CEMENT.

Report.—The Portland cement is of excellent quality, is finely ground, and produces a superior mortar of great strength, hardness, and density. No Portland cement superior to it is exhibited.

Albert Manufacturing Co., Hillsborough, New Brunswick, Canada.

221 RAW AND CALCINED GYPSUM.

Report.—The plaster is of excellent quality, is pure white, and is very valuable for decorative purposes, especially when artistic finish is desired.

C. Schmidt, Riga, Russia.

222 ROMAN AND PORTLAND CEMENT.

Report.—The Roman cement is of good quality, being quite equal in strength and hardness to the average quick-setting natural cements.

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223 **Lonquety & Co., Boulogne-sur-Mer, France.**

PORTLAND CEMENT, AND CEMENT-CONCRETE FLAGGING, AND CEMENT TANK.

Report.—The cement is of a good quality, and the articles made with it are well moulded, hard, dense, and compact.

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224 **L. & E. Pavin de Lafarge, Viviers, near Teil, France.**

PORTLAND CEMENT, HYDRAULIC LIME, AND CEMENT TILES AND BALUSTRADES.

Report.—The cement is of a good quality, and the tiles and balustrades are well moulded and strong. The lime is of excellent quality for building purposes wherever the hydraulic property is desirable. It is able to resist the solvent action of sea-water, and is characterized by a general fitness for subterranean and submarine construction in localities where a quick-setting mortar is not required.

Soullier & Brunot, Teil, France.

225 TEIL HYDRAULIC LIME.

Report.—Commended for its excellent quality for building purposes wherever the hydraulic property is desirable, its power of resisting the solvent action of sea-water, and its general fitness for the construction of subterranean and submarine masonry in localities where a quick-setting mortar is not required.

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226 **James T. Allen, Philadelphia, Pa., U. S.**

SCAGLIOLA AND MAREZZO ARTIFICIAL MARBLE COLUMNS, PEDESTALS, PILASTERS, MANTELS, WAINSCOTING, ETC.

Report.—Commended for firmness of texture, accuracy of imitation in colors and polish, and great variety in form.

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227 **John Ambruster, Camden, N. J., U. S.**

A SECTION OF MASONRY, LAID WITH HAND-PRESSED BRICK, WITH A FANCY BOND.

Report.—Commended for ingenious and skillful workmanship and pleasing results, due to the peculiar bond employed. The bricks used are of a superior quality and finish.

George Richardson, Milwaukee, Wis., U. S.

228 CARBONIZED ARTIFICIAL STONE SEWER PIPE, AND PIPE MOULD.

Report.—Commended for the simplicity and strength of the mould, and the increased strength which it confers on the pipe, due to the longitudinal bed-piece formed in the mould; and for increased hardness of the artificial stone in the early stages of introduction, produced by the carbonization.

229 **Jeronimo Boada, Mataro, near Barcelona, Spain.**

ARTIFICIAL STONE BALUSTRADES, SLABS, AND SMALL ARCHITECTURAL ORNAMENTS.

Report.—The articles are fairly well moulded, and hard and strong. The forms are good.

R. Escudero, Santiago, Chili.

230 ARTIFICIAL STONE, IN GRINDSTONE, FLAGGING, AND BALUSTERS.

Report.—They are neatly and sharply moulded, possess sufficient strength and hardness, and the balusters are well proportioned and artistic.

Neufchâtel Asphalt Co. (Limited), Travers, Canton Neufchâtel, Switzerland.

231 COMPRESSED ASPHALT ROCK.

Report.—It is a material possessing great excellence for pavements, and for covering articles and walls to render them water-tight.

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232 **H. F. Onderwater, Dordrecht, Netherlands.**

ASPHALT BLOCKS FOR PAVING STABLES, CELLARS, SHOPS, AREAS, ETC.

Report.—They are well and compactly moulded, hard, tough, and of moderate price.

Missisquoi Lime Co., Boston, Mass., U. S.

233 ONE JAR OF LUMP OR QUICK LIME.

Report.—The lime is exceptionally pure, and is valuable for building and other purposes.

José Gabriel Cadiz, Santiago, Chili.

234 ARTIFICIAL MARBLE MANTEL, PILASTERS, AND CEMENT TILES.

Report.—They are well moulded, are hard and strong, with sharp edges and angles, and good forms.

Scanian Cement Co. (Limited), Lomma, Malmö, Sweden.

235 PORTLAND CEMENT.

Report.—It is a Portland cement of good standard quality.

Z. Yeiraku, Kioto, Japan.

236 PORCELAIN DECORATED WITH SPECIAL COLOR.

Report.—Commended for excellence of red color, which, combined with gold decoration, is very effective as used by this manufacturer.

S. Haruna, Kaga, Japan.

237 DECORATIVE PORCELAIN.

Report.—Commended for excellent colored ground, and minute and delicate decoration.

K. Utsumi, Kaga, Japan.

238 DECORATIVE PORCELAIN.

Report.—Commended for characteristic decoration, rich and effective; good painting.

S. Fukami, Arita, Japan.

239 PORCELAIN.

Report.—Commended for delicacy of porcelain, good decoration of elegant design, and careful painting.

K. Tsuji, Arita, Japan.

240 PORCELAIN.

Report.—Commended for excellent potting, difficulties of manufacture overcome, forms good, decoration of native character, delicate and effective.

Y. Fukagawa, Arita, Japan.

241 PORCELAIN VASES.

Report.—The porcelain vases are some of them very remarkable as pieces of potting on a most unusual scale. The decoration also is splendid and effective.

Royal Prussian Porcelain Manufactory, Berlin, Prussia.

242 PORCELAIN AND CHEMICAL WARES.

Report.—A large and important exhibition of decorative and other porcelain, of a hard, even, and compact body, and hard glaze; very elaborately decorated. Chemical ware of a very high degree of excellence.

W. Brownfield & Son, Staffordshire, England.

243 PORCELAIN AND EARTHENWARE.

Report.—Commended for a variety of useful and decorative porcelains of high character and merit, as well as for good and serviceable earthenware.

Vista Alegre Porcelain Manufactory, Vista Alegre, Aveiro, Portugal.

244 PORCELAIN.

Report.—Commended for very compact vitreous body, glaze remarkably incorporated with the body.

T. C. Brown-Westhead, Moore, & Co., Staffordshire Potteries, England.

245 PORCELAINS AND EARTHENWARE.

Report.—Commended for general good quality and integrity of the wares, and for excellent useful application to common uses.

Charles Field-Haviland & Co., Paris, France.

246 HARD PORCELAIN.

Report.—Texture of the body very good and homogeneous; forms neat and useful; decorations fitting; highly commended also for suitability, in good quality combined with cheapness, for purposes of commerce.

Thomas C. Smith & Sons, Green Point, N. Y., U. S.

247 WHITE PORCELAIN WARES.

Report.—Commended for remarkable hardness of body and glaze, and clearness of texture.

248 **F. Goyard, Paris, France.**

FIRE-CLAY ASSAY FURNACE FOR COAL AND GAS AND GAS CUPEL FURNACE.

Report.—Commended as well adapted for the purposes, and cheap.

Haviland & Co., Limoges, France.

249 HARD PORCELAIN.

Report.—Commended for porcelain of high quality, also for the introduction of technical processes, in some of which success has been attained.

P. Detemmermann, Paris, France.

250 PORCELAIN FLOWERS.

Report.—Commended as skillfully designed and modeled, and the blossoms naturally colored.

F. Woodcock, Paris, France.

251 PORCELAIN FLOWERS.

Report.—Commended as very skillfully modeled, and the blossoms well colored.

Ho Kan Chin, Shanghai, China.

252 PORCELAIN.

Report.—A valuable and instructive collection of ancient porcelain of many factories.

Hu Kwang Yung, Hong-Chow, China.

253 PORCELAIN AND POTTERY.

Report.—An important collection of ancient and modern porcelain, containing some pieces of very fine quality; also flower-pots of fine brown ware.

Count Von Thun, Klosterle, Bohemia, Austria.

254 PORCELAIN.

Report.—Commended for excellent quality of porcelain, compact, vitreous, and hard body; tea wares especially good in quality.

Tack Loong, Canton, China.

255 PORCELAIN.

Report.—Commended for good quality and fair decorative effect.

Alezander Casarir & Co., City of Mexico, Mexico.

256 PORCELAIN POTTERY.

Report.—Commended for very hard body of porcelain, creditable essay in porcelain painting, and in employing designs of native character in the decoration of pottery.

R. Nakashima, Kagoshima, Japan.

257 EARTHENWARE OF DECORATIVE CHARACTER.

Report.—Commended for excellent potting, decoration, and general high character of his exhibition.

Benshi, Tokio, Japan.

258 TERRA-COTTA FIGURES.

Report.—Commended for great force of expression and singular skill in conveying the meaning of the groups of figures.

Brunt, Bloor, Martin, & Co., East Liverpool, Ohio, U. S.

259 WHITE GRANITE WARES.

Report.—Commended for good quality of body and glaze, also for excellent decoration derived from natural forms of grasses.

Shitomi Shoei, Yokka-ichi, Province of Ise, Japan.

260 DECORATIVE EARTHENWARE CALLED "BANKO WARE."

Report.—Commended for skillful modeling of Banko ware; good "marbled" ware, showing dexterous potting.

Wage Kitei, Kiyoto, Japan.

261 EARTHENWARE OF DECORATIVE CHARACTER.

Report.—Forms characteristic, decoration fair.

Jose Alves da Cunha, Caldas da Rainha, Portugal.

262 EARTHENWARE FIGURES AND ANIMALS.

Report.—Commended as well modeled, humorous, and clever.

Hugo Lonitz, Neuhaldensleben, Germany.

263 TERRA-COTTA ANIMALS.

Report.—Commended for good modeling and imitations of natural forms.

Andrea Boni, Milan, Italy.

264 TERRA-COTTA STATUES AND STATUETTES.

Report.—Commended for spirit in design, fair skill in modeling, and cheapness of production.

St. John's Stone Chinaware Co., Quebec, Canada.

265 WHITE GRANITE WARES.

Report.—Commended for fair quality of body and glaze, good quality of color in blue decoration.

J. Stiff & Sons, Lambeth, England.

266 STONEWARE.

Report.—Commended for sound and hard body, and good glaze; excellent potting.

J. & C. Price & Brothers, Bristol, England.

267 STONEWARE.

Report.—Commended for dense and strong body; forms suitable to purposes.

W. & J. A. Bailey, Alloa, Scotland.

268 ROCKINGHAM AND TORTOISE-SHELL WARES.

Report.—Good serviceable wares of rich and effective colors.

The Watcombe Terra-Cotta Co., Watcombe, South Devon, England.

269 RED TERRA-COTTA.

Report.—Commended for successful production of decorative objects at very low prices for commercial and popular purposes.

Bates, Walker, & Co., Burslem, England.

270 EARTHENWARE.

Report.—A large collection of staple and useful articles, well designed for their purposes, and very cheap.

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271 **A. Hall & Sons, Perth Amboy, N. J., U. S.**

BROWN AND YELLOW EARTHENWARE, WHITE AND BLACK BRICKS, AND FIRE-BRICKS.

Report.—Earthenware of hard compact body with rich colored glaze. White brick for building purposes that will not discolor by turning green or yellow. Good quality of fire-brick.

Makudzu Kozan, Ota, near Yokohama, Japan.

272 DECORATIVE EARTHENWARE.

Report.—Commended for great ingenuity and skill in potting; success in difficult manufacture accomplished in a short time.

John Edwards, Fenton, Staffordshire, England.

273 WHITE EARTHENWARE.

Report.—Commended for general good quality of wares and for good potting and fitting.

J. E. Jeffords & Co., Philadelphia, Pa., U. S.

274 ROCKINGHAM AND YELLOW EARTHENWARES.

Report.—Commended for good quality.

João da Roza Marques, Extremoz, Portugal.

275 POTTERY.

Report.—Commended for good and elegant forms and ingenious decoration, also for remarkable cheapness.

Casimir Cybulski, Zmelov, Russia.

276 STONE TEA WARES, POTS, JUGS, AND JARS.

Report.—Commended for good quality and forms, and for low prices.

Leopold Bonafede, St. Petersburg, Russia.

277 ENAMELED TERRA-COTTA.

Report.—Decoration characteristic and successful.

Ali Agha, Roostchook, Turkey.

278 DECORATED EARTHENWARE.

Report.—Commended for black earthenware successfully decorated with ornaments in white metal.

Eugène Blot, Boulogne-sur-Mer, France.

279 ORIGINAL TERRA-COTTA FIGURES AND GROUPS.

Report.—Commended for excellence of design and modeling, evincing artistic skill of a high order.

Mercer Pottery Co., Trenton, N. J., U. S.

280 WHITE GRANITE TABLE WARE AND GILDED DECORATIONS.

Report.—Commended for good quality of body and glaze; successful gilding decoration, though somewhat lavishly employed.

Galloway & Graff, Philadelphia, Pa., U. S.

281 ARTISTIC TERRA-COTTA.

Report.—Commended for designs fairly artistic and successfully carried out.

S. C. Rose, Kiu-Kiang, China.

282 PORCELAIN.

Report.—A good collection of decorative porcelain; some of the designs being produced from the exhibitor's suggestions.

Merkelbach & Wick, Grenzhausen, Germany.

283 STONEWARE.

Report.—Commended for successful reproduction of the styles of the sixteenth and seventeenth centuries in a good hard stoneware.

Reinhold Hanke, Höhr, near Coblentz, Germany.

284 STONEWARE.

Report.—Commended for cheapness of stonewares in early styles.

F. P. Albert, New York, N. Y., U. S.

285 COMPOSITION SEWER PIPES AND SEWER INVERTS.

Report.—The articles are well moulded; the material is very hard, tough, and compact, possesses a high degree of strength, and is believed to be durable. Its cost is comparatively low.

William L. Gregg, Philadelphia, Pa., U. S.

286 GREGG'S TRIPLE PRESSURE BRICK MACHINE.

Report.—The brick machine possesses great strength, works rapidly in moist clay, and delivers well-compacted bricks of good form and edges, and is well arranged for repressing bricks

J. W. Stockwell, Portland, Maine, U. S.

287 CEMENT-PIPE MOULD OPERATED BY POWER.

Report.—Commended for the simplicity of the mould, the strength of its parts, and the rapidity with which it can be operated.

The Brick Enameling Co., Philadelphia, Pa., U. S.

288 ENAMELED BRICKS, IN A VARIETY OF COLORS.

Report.—Commended for the excellence and beauty of the porcelain enameling, its superior hardness, and the great tenacity with which it is united to the bricks. It resists a steel point, shows no signs of crazing, and is doubtless durable. It is impervious to moisture and resists the effects of fire.

Ad. Hache & Pepin-Lehalleur Bros., Paris, France.

289 HARD PORCELAIN.

Report.—An important exhibition, showing originality of character in designs, good decoration, great skill and knowledge of potting in producing a porcelain of very delicate texture.

The Union Stone Co., Boston, Mass., U. S.

290 ARTIFICIAL SOAPSTONE REGISTER BORDERS AND STOVEPIPE INSULATORS.

Report.—The articles are well moulded, with sharp angles and corners, are fully equal in strength, hardness, and durability to those cut from the natural soapstone, and very closely resemble it in texture and color.

Henry Doulton & Co., Lambeth, London, England.

291 TERRA-COTTA AND DECORATIVE "FAÏENCE" AND STONEWARE.

Report.—Artistic terra-cotta for decorative purposes; richly colored ware called "Lambeth faïence;" improved sanitary stonewares and sewer-pipes of special construction.

Doulton & Watts, Lambeth, London, England.

292 STONEWARE, ARTISTIC "DOULTON" WARES.

Report.—Originators of a highly decorative stoneware for various artistic purposes; also excellent stoneware of large size for chemical purposes. A remarkable and instructive exhibition.

Trubia Government Works, Spain.

293 FIRE-BRICKS AND TELEGRAPHIC WARE.

Report.—Commended for good quality and adaptation to purpose.

T. Castellani, Rome, Italy.

294 MODERN "MAJOLICA" VASES.

Report.—Commended for great accuracy in reproduction of the decorated work of the fifteenth and sixteenth centuries.

Imperial Customs, Shanghai, China.

295 PORCELAIN.

Report.—A large collection of decorative objects of good quality and showing some good colors.

J. W. Berlin, Fuerth, near Nuremberg, Germany.

296 BLOWN HALF-WHITE GLASS MIRRORS, POLISHED AND SILVERED.

Report.—Commended for cheapness.

A. Bougard, Manage, Belgium.

297 GLASS TABLE WARES.

Report.—Commended for very low prices.

Christiania Glass Magazine (Harald Berg), Christiania, Norway.

298 GLASS TABLE WARES.

Report.—Commended for low prices.

M. Marunaka, Kanazawa, Kaga, Japan.

299 EXHIBITION OF DECORATIVE PORCELAIN.

Report.—A very instructive and important exhibition of decorative porcelain of the Province of Kaga, offering valuable suggestions to manufacturers in this country.

SIGNING JUDGES OF GROUP II.

The numbers annexed to the names of the Judges indicate the reports written by them respectively.

R. H. SODEN SMITH, 1, 5, 24, 121, 122, 123, 129, 130, 131, 132, 133, 144, 147, 150, 152, 187, 240, 250, 254, 258, 266, 277, 282.

HECTOR TYNDALE, 29, 31, 33, 34, 35, 37, 39, 40, 42, 44, 46, 48, 49, 51, 55, 56, 58, 59, 61, 62, 65, 71, 72, 73, 75, 78, 79, 81, 85, 89, 93, 97, 100, 104, 106, 108, 111, 112, 120, 125, 126, 127, 128, 137, 138, 160, 164, 185, 186, 189, 190, 239, 246, 253, 255, 257, 265, 269, 274, 276, 292, 294, 296, 297, 298.

Q. A. GILLMORE, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 21, 28, 67, 143, 148, 171, 180, 181, 182, 188, 191, 192, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 285, 286, 287, 288, 290.

G. SEELHORST, 30, 32, 36, 38, 41, 43, 45, 47, 50, 52, 53, 57, 60, 63, 64, 66, 68, 69, 70, 74, 76, 77, 80, 82, 83, 84, 86, 87, 90, 91, 92, 94, 95, 96, 98, 99, 101, 102, 103, 105, 107, 109, 110.

A. E. NORDENSKIOLD, 2, 117, 134, 139, 141, 168, 183, 193, 243, 247, 251, 268, 275, 280, 284, 289.

E. T. COX, 18, 20, 25, 26, 27, 149, 153, 154, 155, 156, 157, 158, 159, 161, 162, 163, 165, 167, 169, 172, 173, 174, 175, 176, 177, 178, 179, 248, 271.

ARTHUR BECKWITH, 3, 4, 23, 88, 115, 135, 136, 142, 145, 146, 236, 237, 241, 242 245, 249, 259, 273, 278, 279, 281, 291, 295.

C. DE BUSSY, 22, 54, 114, 124, 140, 151, 166, 184, 244, 256, 260, 261, 262, 263, 264, 267, 270, 283, 293, 299.

HENRY WURTZ, 170, 208.

K. NOTOMI, 113, 116, 118, 119, 238, 252, 272.

SUPPLEMENT TO GROUP II.

REPORTS

OF

JUDGES ON APPEALS.

JUDGES.

JOHN FRITZ, Bethlehem, Pa.
EDWARD CONLEY, Cincinnati, Ohio.
CHARLES STAPLES, JR., Portland, Me.
BENJ. F. BRITTON, New York City.
H. H. SMITH, Philadelphia, Pa.
COLEMAN SELLERS, Philadelphia, Pa.
JAMES L. CLAGHORN, Philadelphia, Pa.
HENRY K. OLIVER, Salem, Mass.
M. WILKINS, Harrisburg, Oregon.
S. F. BAIRD, Washington, D. C.

Anonymous Society for Glass Manufacture of Charleroi, Lodelinsart, near Charleroi, Belgium.

1 GLASS.

Report.—For good quality of glass and evenness.

Marinha Grande Royal Glass Manufactory, Marinha Grande, Portugal.

2 GLASSWARE.

Report.—Commended for a very good display of useful glassware, from the commonest pressed glass goods to a good quality of cut glass of good quality of material and design, at very moderate prices.

Cabo Mondego Mining and Industrial Co., Lisbon, Portugal.

3 GLASS SHADES AND LARGE GLASS CYLINDERS.

Report.—A good display of glass; quality and workmanship very good.

Albiani Franco Tomei, Pietra-Santa, Lucca, Italy.

4 SAMPLES OF COMPOSITION PAVEMENTS.

Report.—Commended for strength and good workmanship. This is represented by good samples of cement tiles for pavements.

Edward Brooke & Sons, Field Lorne Fire-Clay Works, Huddersfield, Yorkshire, England.

5 SANITARY TUBES; FIRE BRICKS AND CLAY FOR FURNACES.

Report.—Commended for good material and workmanship.

James Carr, New York, N. Y., U. S.

6 PARIAN, MAJOLICA, AND C.C. WARE.

Report.—The parian is of a hard, well-vitrified body, brilliant, and of fine texture. The majolica is well fired, and coated with an excellent glaze of great hardness and transparency. The etchings under the glaze (designed by Mr. W. H. Edge) are commended for technical merit, and as a progress in this department of American pottery. The C.C. ware is commended for its hard and durable glaze.

G. D. Guthrie, Epsom, Sandhurst, Victoria, Australia.

7 STONEWARE.

Report.—Commended for good workmanship and excellent material.

Patent Selenitic Cement Co. (Limited), London, England.

8 SELENITIC MORTAR AND CONCRETE.

Report.—The specimens are hard and strong, and the material is evidently well suited for stone or brick masonry, for stucco work, and for concrete, being nearly as strong as Portland cement mixtures containing the same proportion of sand, while it costs considerably less.

Wile, Seidel, & Co., Philadelphia, Pa., U. S.

9 BLACK-LEAD CRUCIBLES AND STOVE POLISH.

Report.—Crucibles of good shape and workmanship. Stove polish, a creditable display of good quality.

P. J. McElroy, East Cambridge, Mass., U. S.

10 GLASS AND FAMILY SYRINGES, FEEDING AND DRINKING TUBES, AND NIPPLE SHIELDS.

Report.—A very good exhibit of many forms of syringes and glass work of similar character; glass tubing of good quality; workmanship superior.

C. W. Sanger & Co., Philadelphia, Pa., U. S.

11 PRESSED BRICKS.

Report.—Commended for good shape, color, and quality of material.

Simons & Co., Au Cateau, Grand Duchy of Luxemburg.

12 MOSAIC TILES.

Report.—Commended for good quality of material and excellent workmanship; a very superior tile, well adapted for the purpose intended.

SIGNING JUDGES OF SUPPLEMENT TO GROUP II.

The figures annexed to the names of the Judges indicate the reports written by them respectively.

COLEMAN SELLERS, 1, 2, 3, 4, 5, 7, 9, 10, 11, 12.
ARTHUR BECKWITH, 6.
Q. A. GILLMORE, 8.