THE CERAMIC INDUSTRIES
OF PENNSYLVANIA

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Preface

Pennsylvania is the greatest mineral industrial commonwealth in the world. No single state or country can display such a firm grip on resources and such a valuable use of mineral products. Her mineral industries include coal, iron, and non-metallic mining, quarrying, ceramics, oil and gas production, fuel technology, and metallurgy; her mines and products derived from minerals account for about two thirds of the entire productive wealth of the State.

As a component part of a state institution, the School of Mineral Industries of The Pennsylvania State College considers a portion of its normal function to be the collection and dissemination of relevant facts concerning the economic and scientific problems of the mineral industries, and the relationship of higher technical education to the solution of those problems.

The School of Mineral Industries was established in 1891 by an appropriation act of the State Legislature. It is one of the oldest and largest schools of its kind in the United States and is recognized as a necessary part of the mining and the mineral industries of Pennsylvania. The program of the School embraces, first, fundamental education and extension courses that fit the requirements of the industries; and second, applied research and investigation that will conserve and better utilize our natural mineral resources and help make for greater safety and efficiency in the industries.

The new Mineral Industries Building will permit a healthy expansion in all of the departments of the School, including extension and research. With the advisory board program in operation the School is closely linked with its related industries and is prepared to carry out a comprehensive program of service to the people of the Commonwealth.

The Department of Ceramics is the only department in Pennsylvania giving college instruction in Ceramics. The facilities of the Department in the new building will be equal to those found anywhere. It is planned to expand the work of the Department to include every phase of ceramic science, engineering, and art, and to make every effort possible to serve the ceramic industries of Pennsylvania.

Edward Steidle, Dean
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ILLUSTRATIONS

Illustrations for this bulletin were obtained from the following companies:

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Harrop Ceramic Service Company, Columbus, Ohio.
The Owens Bottle Machine Company, Toledo, Ohio.
Pennsylvania-Dixie Cement Corporation, New York City.
EXTENSIVE USE OF CERAMIC PRODUCTS IN THE HOME

1. Enameled steel kitchen range
2. China dishes
3. Glass doors in cabinet
4. Enameled cast iron kitchen sink
5. Faience tile
6. Wall tile
7. Floor tile
THE CERAMIC INDUSTRIES OF PENNSYLVANIA

CHAPTER I

By JOSEPH B. SHAW

PURPOSE OF THIS REPORT

This publication has been developed in response to a long-felt need for a source where information could be obtained on ceramic producers and ceramic products of the Commonwealth of Pennsylvania. State and Federal departments have for years published lists of producers, giving location of industries and data relative to employees and value of products. These publications are always available as a source from which statistical data may be obtained. However, the system used in subdividing the industries into various groups is such that some of the ceramic industries are listed with other industries and lists of manufacturers are not published by any of these agencies in a form readily usable.

No attempt has ever been made to compile a list of the producers of ceramic products or to tabulate complete data on the quantity and value of ceramic products of the State. Part lists, relative to separate phases of the industry, have been made and very useful data is available in such lists. Thomas C. Hopkins, Assistant Professor of Economic Geology in The Pennsylvania State College, published three bulletins as Appendices to the Annual Report of The Pennsylvania State College for 1897. These three bulletins were entitled I, Clays of Western Pennsylvania (in Part); II, Clays of Southeastern Pennsylvania (in Part); III, Clays of the Great Valley and South Mountain Area. A chapter in Part I of this work on The Clay Industries of Allegheny County was contributed by W. L. Affelder, of Pittsburgh.

This work of Hopkins is the most complete treatise on the clays of the State ever prepared and, while the processes and equipment he described are out of date, the work was a classic in its time and served as a basis for the development of the clay industries. Further reference on clays will be found in the Bibliography under Raw Materials.

While the clays and clay industries form a substantial portion of the ceramic industries, the term is now universally construed as covering a much larger field. There is a great lack of understanding as to just what constitutes "ceramics" and one of the chief functions of this publication is to give a clear and concise classification of ceramic industries; to show how these industries are related and why they form a separate group of industries which are properly listed under one heading.

Funds for making this survey were made available to the Department of Ceramics by special appropriation in June, 1929. Work was started October 1, 1929. It would be obviously impossible to visit all plants for the purpose of obtaining information, but many have been visited and
practically all manufacturers have cooperated fully in obtaining desired information. The aim has been to obtain authentic information directly from the producers. Further information and data have been obtained from every available source.

The discussion in reference to each phase of the industry has been kept as brief as possible while at the same time giving sufficient information to show the distinguishing characteristics in each branch of Ceramics. It was not thought desirable to attempt to make detailed description of equipment and processes, such information being readily obtainable from textbooks and trade journals.

While space does not permit publishing a list of all sources from which information and assistance in compiling the data have been obtained, grateful acknowledgement is here given to all who have assisted in any way. Special mention should be made of the Bureau of Statistics, Department of Internal Affairs, Harrisburg, Pa., American Ceramic Society, American Refractories Institute, The Ceramic Age, National Glass Budget, United States Department of Commerce, Philadelphia Quarter Master Department of the United States War Department, Ceramic Products Cyclopedia, and Factory Design and Equipment by T. W. Garve. George J. Bair, Instructor in Ceramics, read the original copy and furnished a portion of the text. Myril C. Shaw assisted in preparing the bibliography. Due recognition is given to others throughout the publication.

In compiling the data, every ceramic producer in the State received at least one questionnaire; many of them received three. A total of 3000 questionnaires were mailed. In addition, several hundred personal letters were sent.

The painstaking and efficient work of Mrs. Helen C. Search in compiling data and of Miss Helen M. Forgeus in preparing the manuscript have made it possible to complete the work within the allotted time and with the funds available.
CHAPTER II

CERAMIC INDUSTRIES

In spite of the fact that ceramic products are and have been for centuries among the commonest articles of every day use, there is still a universal lack of understanding of the meaning of this term. Not only is the significance of the word not recognized by the general public but there is no unanimity of understanding on the part of those engaged in the ceramic industries as to what industries are covered by the term. It is generally understood by those who are familiar with the word that it refers to pottery. Any one using it in reference to other products or industries is under the necessity of explaining the connection. It is necessary therefore for the benefit of those who may not be directly interested in ceramics to show the relation between these industries which justifies grouping them together.

The Volume Library gives a modern definition of Ceramics as follows, “In the broadest sense, the term Ceramics includes the whole field of compounds and mixtures of which the foundation is silica and to which solidity and permanence are given by the action of fire, or briefly, the field of igneous silicates. In this term, therefore, are included not only pottery and porcelain but bricks, tiles, terra cotta, stoneware, glass, the hydraulic cements, and enamels for steel ware and for use in jewelry. The principle of composition and the technical treatment of these are similar in character though differing in detail.”

This definition is in close harmony with what ceramic science has recognized as the field of ceramics. The American Ceramic Society describes its function on the cover of the Monthly Journal as being “Devoted to the Arts and Sciences Related to the Silicate Industries.” The Transactions, Journals and Abstracts of the American Ceramic Society, published regularly during the last thirty years, furnish the most complete reference library on Ceramic Technology available. Throughout these publications will be found many articles on various phases of the ceramic industries. All industries listed here as ceramic industries are extensively dealt with in these publications.

From the standpoint of raw materials used, processes of production, chemical and physical properties of products and utility, there is no more difficulty in recognizing the industries properly belonging in the ceramic field than in classifying metallurgical or automobile industries. These are the factors on which each of the industries in the following classification are considered as properly belonging to ceramics. The potter may be surprised to find himself classed with the manufacturer of refractories, and the brick maker will fail to see why he is grouped with the cement manufacturer. The explanation is extremely simple if each considers his raw material and manufacturing processes. Clays, limestone and silica are the essential constituents. All products are produced by conversion of the natural or synthetic mixture to artificial silicates by application of high temperature, using similar equipment in all cases. The products, while competitive in some cases, are essentially similar.
The outstanding position of the Commonwealth of Pennsylvania in the ceramic world is revealed by the many different kinds of raw material used in production of ceramic products, which are produced within the border of the State, and by the fact developed in this survey that nearly every type of ceramic product is produced within her borders. The following classification gives the raw materials, industries and products of the State as of 1928.

CERAMIC INDUSTRIES

RAW MATERIALS
Clays
Ganister
Glass Sand
Feldspar
Limestone
Dolomite
Iron Ore
Coal
Oil
Gas

HEAVY CLAY PRODUCTS
Common Brick
Face Brick
Paving Brick
Hollow Tile
Roofing Tile
Drain Tile
Sewer Pipe
Wall Coping
Conduits
Stoneware
Flower Pots

CEMENT
Portland Cement
Oxyclochloride Cement
Plaster
Gypsum

LIME
Burnt Lime
Agricultural
Chemical
Building
Hydrated Lime
Pulverized Limestone
Dolomite Lime

GALSS
Blown
Bottle
Window
Light Bulbs
Chemical Glass
Art Glass

REFRACTORIES
Fire Clay Brick
Silica Brick
Magnesite
Dolomite
Chrome
Carborundum Refractories
High Temperature Cements
Abrasives and Grinding Wheels
Graphite Refractories
Flue Linings
High Alumina Refractories
Special Refractories

WHITE WARE
Hotel China
Electrical Porcelain
Vitreous Sanitary Ware
Floor Tile
Wall Tile
Refractory Porcelain

ENAMELS
Steel
Signs
Kitchen Utensils
Reflectors
Refrigerators
Specialties

CAST IRON
Sanitary Ware
Stove Parts
Specialties

TERRA COTTA
Architectural Terra Cotta
Art Tile
Floor Tile
Garden Pottery
CHAPTER III

MANUFACTURING PROCESSES

It is outside the province of this work to enter into a detailed discussion of equipment and processes used in the manufacture of ceramic products. Procedure is outlined in sufficient detail to show the general character of processes used; those interested in obtaining technical details with reference to processes, materials and products are referred to the bibliography, page 200, and the references cited.

The necessary steps in the manufacture of those ceramic products commonly referred to as clay products may be outlined as follows:

1. Winning Raw Materials
2. Reduction of Raw Material
3. Sizing
4. Proportioning and Mixing
5. Tempering
6. Shaping
7. Drying
8. Firing

These operations generally take place in the sequence given. In the Cement, Lime, Glass and Enameling industries the sequence and character of processes differ. They are shown later.

WINNING RAW MATERIALS

Surface Clays

Surface clays are quarried by hand shoveling, power shovels, drag lines, scoops, or hydraulic methods. When labor is cheap the clay is often shoveled into carts or cars by hand. When doing so the large pebbles and stones are sorted out and a better selection of clay is thus obtained. In most cases this method is too expensive and power equipment is employed. Where a large water supply is available the clays are sometimes obtained by washing them into a settling pond where the water is allowed to evaporate and the clay then taken for use. This method not only wins the clay but washes out the stones, pebbles and sand. It also, however, is too expensive for general use because the clay must be dried before it can be used.

Shales

Shales are usually obtained by means of a power shovel. If the shale is too hard to be dug with the shovel it is first loosened with charges of dynamite. Shale planers have come into greater prominence recently and many face brick plants are using them to obtain their raw material. They give a more uniform mixture of the shale than can be obtained by steam shovel but, on the other hand, do not provide a possibility of elimination of pockets or strata which may be objectionable. Beds of shale are often covered with a few feet of overburden which is harmful and is generally removed.
FIRE CLAYS

Fire clays which are associated with the coals are won by mining, either direct entry method, using room and pillar; or shaft entry, using room and pillar; or in some cases stoping when the bed is sloping steeply. The first method is most common. The clay is usually dug and loaded by hand. Power loading machinery is employed in some cases, explosives being used to loosen the clay. Refractory clays in Central Pennsylvania, described by E. S. Moore\(^1\) as occurring in Upper Cambrian sandstone, sometimes referred to as kaolin, are quarried in open pit quarries by means of steam shovels or by bucket or drag line operations. Similar deposits occurring in Eastern Pennsylvania in the vicinity of Saylorsburg underlying the Oriskany sandstone are mined by vertical shaft and room and pillar methods.

FELDSPARS

Feldspar, occurring invariably in local dikes and pockets, is obtained by removing the surface and blasting out the rock. It is hand sorted, such impurities as quartz and iron bearing materials being avoided in blasting in so far as is possible, and sorted out by hand when unavoidably encountered.

GANISTER

Two types of quarrying processes are used in obtaining quartzite: first, quarrying or stripping the loose broken talus floe rock which forms sheets or piles along mountain flanks, and second, quarrying the solid or ledge rock. In stripping the floes, which in some cases are a mile or more in length, several hundred feet wide, and from two to thirty-five feet thick, the operation is comparatively simple. A plane is constructed running along the mountain face to the floe and the tracks are laid from the plane along the mountain so that the broken rock may be worked in benches.

The rock is broken with sledges and loaded into cars by hand. Considerable care must be exercised in sorting the rock especially where it is not running uniform. In stripping a talus practically no blasting is necessary. Mud-capping is often used when the boulders are too large to be broken with a sledge. Where there are many large and tough blocks some of these may be drilled by hand or with a jackhammer or air drill and the charge placed in the hole.

In quarrying the ledge or solid rock, an excavation is made either by blasting out the quartzite or by prying it out with bars. When the quartzite is covered with a few feet of overburden it is removed either by hand, scrapers or power shovels. The loading is done entirely by hand as automatic loading machinery can not sort the materials.

The cost of quarrying is much less for the floe rock than for the ledge rock. Also, it is generally admitted that the floe rock is of better quality than the solid formation from which it has been broken by weathering processes, because it has been more thoroughly leached of its soluble salts, such as those of calcium, iron, magnesia, and the alkalis.

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Glass Sand

The quartzite used for production of glass sand is quarried in the same manner as that used for production of silica brick. The glass sand is produced by grinding stone to size suitable for the glass industry. The quartzites used for production of glass sand occur in the same general locality as those used in the production of silica brick, but in a

DRY PAN

1. Mullers
2. Revolving pan
different geological formation, the ganister for silica brick being the Tuscarora sandstone while the glass sand comes from the Oriskany sandstone. The two formations are about 6000 feet apart geologically. The glass sand requires material analyzing 99% silica or more. The producers of glass sand locate those deposits which have chemical properties meeting their requirements and quarry them by the same methods as the silica brick manufacturers, using greater care in sorting
and taking every precaution to prevent contamination of the product with iron or other undesirable compounds.

**Flint**

Flint, as used in the ceramic industries, is as a matter of fact finely ground quartz. There is no true flint produced in Pennsylvania, nor in fact in the United States, for the production of white ware. The product which is sold as flint, however, is quarried from the quartzites previously referred to as being the source of glass sand. The methods of quarrying are the same as for glass sand. The material is ground to a fine powder, a large percentage passing a 200 mesh screen.

**Reduction of Raw Material**

The type of machine used for reduction of raw materials depends upon the character of the material and the amount of reduction required. Surface clays are sometimes tempered and molded into shape without grinding. Usually, however, some crushing and grinding is required. For reduction of large sizes of clays and shales, limestone and ganister, machines commonly used are jaw crushers, gyratory crushers, and rolls. For finer grinding of clays and shales the dry pan is the most commonly used machine. Hammer mills, though used, are less common. For still finer grinding or pulverizing of ceramic raw materials tube mills, ball mills, and Hardinge mills (a conical ball mill) are used.

**Sizing**

Two methods of classifying fine materials are in general use:—(1) Screening, (2) Air separation.

The “grizzly” is a crude form of screen used for elimination of oversized pieces. The bottom plate in a dry pan is of this type. The gravity type screen is generally set at an angle, stationary and sometimes brushes moving over the surface facilitate the screening operation. Rotary screens are used in limestone and enameling industries but are not well adapted to screening clays. Vibratory screens, operated mechanically or by electricity, are commonly used.

**Proportioning and Mixing**

In those industries classified as heavy clay industries the raw materials are generally used as they come from the deposits, no blending or variation being attempted except by rejecting undesirable materials at the quarry. In making common brick sometimes the clay is too plastic, as a result of which it is difficult to mold and shrinks and cracks excessively. To remedy this defect sand may be added. Such additions are made before grinding or tempering.

In some industries, such as refractories, two or more clays are blended in varying proportions, giving products of varying properties. Frequently these clays are blended by volume, using wheelbarrows or cars divided into pockets of appropriate size by partitions. The operation of proportioning is sometimes carried out before grinding. In this case the mixing and grinding are performed in the same machine. In other cases the clays are first ground and stored in separate bins. The
proper proportions of the ground materials are fed onto a table by automatic feed as in the cement industry or they may be weighed and blended in a mixing device, such as a pug mill or tube mill. If thorough blending is essential it is always advisable to mix the materials in the dry condition unless the product is to be mixed in the form of a slurry or liquid.

In the glass and enameling industries and in the production of glazes, the raw materials are accurately weighed and the batch thoroughly mixed in a revolving cylinder, or device similar to a concrete batch mixer.

In the white ware and porcelain industries the non-plastic materials, feldspar and flint, are sometimes weighed separately and mixed by grinding in a ball mill for several hours; the clays are then added with sufficient water to give a thin liquid and mixing continued by further grinding. In other cases the batch materials are weighed and mixed in a blunger, sufficient water being present to give a creamy consistency.

In the cement industry great care is necessary in maintaining exact proportions of the raw materials and in securing intimate mixing. Where the dry process, which is the most common one, is used for the production of Portland cement, automatic feeding devices deliver the proper proportions to a preliminary pulverizer or directly to tube mills where the mixing and grinding are completed.

**Water in Clay**

Water is added to clay by various processes. The common method where a pug mill is used is to permit a small stream of water to flow continuously into the upper end of the pug mill. The rate of flow is regulated by the man who is constantly in attendance. In recent years the poidometer combined with a liquidometer has come into general use. This device feeds clay and water at a uniform rate. It is theoretically accurate but results are not entirely satisfactory because the quantity of water in the clay as it comes to the poidometer varies. It is claimed that a man must be in constant attendance at the pug mill to correct the variation, and because of this fact the poidometer is not universally used.

In batch mixing in the wet pan, the water is run in from a pipe, the quantity being determined for each batch by the operator who judges from the feel of the clay whether more clay or more water is necessary to give a batch of proper consistency.

Water for slaking lime is added in various ways. In some processes all water necessary is added prior to screening. In others a portion of the lime may be mixed with an excess of water and then the remainder of the lime is added.

**Tempering**

Tempering is the term used to describe the process of developing the body to the proper consistency so that the desired article may be molded. In clay industries tempering is the pugging or wet mixing whereby the inherent plasticity of the clay is developed; when the clay-water mixture is worked by hand the process is called “kneading.”
WET PAN

1. Muller
2. Revolving pan
3. Unloading arm
When it is carried out by tramping with the feet (such as is still done in countries where mechanical equipment has not been extensively developed) it is called "tramping." The most common mechanical device for this purpose is the pug mill. This process is called "pugging." A still more thorough mechanical method is to grind in the wet pan. In some
MOLDING ELECTRICAL INSULATORS

1. Plaster mold
2. Steel press
3. Plastic porcelain body
cases the pug mill treatment is followed by storing the well mixed plastic material in "aging" cellars, where bacterial action results in development of the ultimate toughness and strength of the clay. In the terra cotta industry the mixture of clay and grog is allowed to stand for days in a "soaking pit" where the water becomes uniformly distributed through the material, and toughness and strength are developed. The soaking pit differs from the aging cellar in that bacterial action is better facilitated in the latter.

Tempering of glazes and enamels is the process of developing in the slip the proper creamy consistency and physical property of "shortness" or resistance to flowing, so that when it is applied to the surface of clay or metal it will stand on vertical surfaces. An enamel not properly tempered for dipping or spraying will flow from vertical surfaces leaving bare or thin spots at the top and thick spots near the bottom. The tempering of glazes and enamels is accomplished by adding small quantities of tempering agents, such as acetic acid, magnesium sulphate, or borax. These agents react with the colloid content of the mixture producing flocculation. The clay, the most efficient of which are ball clays or plastic fire clays, is the principal constituent of the glaze or enamel entering into the reaction. It is practically impossible to hold glazes or enamels in suspension in water without clay.

SHAPING

The process of giving form or shape to the product is variously referred to as molding, forming, or shaping. The process used in shaping ceramic ware depends upon several factors, such as character of the raw materials and the properties and uses of the product. Objects identical in shape and size are made by as many as half a dozen different processes. To those engaged in ceramic industries the name of the shaping process implies the sequence of manufacturing operations, type of clay or body mixture, and character of the product. A stiff-mud brick plant implies a shale quarried by steam shovel or shale planer, dry pan, pug mill, auger machine, etc.

The primitive method of shaping was of course hand molding. Indian pottery was built up entirely by hand. Some art ware is now made in this way. Several other processes are referred to as hand molding although a wheel or mold assists in the operation.

Throwing is the process of molding articles round in cross-section but varying in design and size. In the process the artist places his ball of clay on a revolving disc and shapes a vase or other article; as it rotates under the pressure of his hands, he imparts individuality to each piece. Each article made by this process is an expression of the artist who molds it and can not be exactly reproduced.

Jollying is the process of shaping by pressing the article by means of a profile pressing the soft clay body against a mold while rotating.

Jiggering is employed for round or oval articles by rotating the clay under a profile while the opposite side or inside of the article takes the form of a plaster or other porous mold. Jollying and jiggering are identical in principle and result, one side of the article taking its form from the mold while the other is shaped by the templet or profile.
Hand Molding is employed in shaping terra cotta. The article specified by the architect is modeled in clay on a large easel as it is to appear in the building. A plaster of Paris mold is then cast over the model and the terra cotta body is pressed by hand into the plaster molds. As many pieces as are required of one design may be made from a single mold, each piece being turned out of the mold as soon as it has "set" sufficiently to hold its form.

Glass melting pots are built up by hand. Plastic fire clay mixtures are used and a period of several weeks may elapse during the building of a single pot, only a few inches being built each day. During the building period the article is kept covered with wet cloth.

In all hand molding processes the clay or body is in a "soft-mud" consistency. All shaping processes in making ceramic articles in which clay is the important constituent may be conveniently divided into four classes, namely, "soft-mud," "stiff-mud," "dry-press," and "liquid casting."

Soft-Mud

The soft-mud process, in addition to cases mentioned previously, finds its most extensive application in the production of common building brick and, to a lesser extent, fire brick. In this process the body contains sufficient water to make it soft and yielding to moderate pressure so that when forcibly thrown into a mold it will spread and fill all crevices and corners. It is, however, a solid mud and not liquid which will flow. While common brick were formerly all made by hand molding soft mud in wooden molds, they are now almost universally made by use of soft mud in wood molds but in machines. A single machine may have a capacity of 120,000 brick per day.
STIFF-MUD

As the term implies, in the stiff-mud process the clay body contains sufficient water to make a body of the consistency of putty, somewhat less pliable than the soft-mud consistency and yet sufficiently yielding to flow under pressure and to give a solid continuous stream of clay flowing through an orifice or die under pressure applied by an auger machine or piston. The typical product made by the stiff-mud process is face brick. Raw materials employed are more commonly shales, which have been reduced to the stiff-mud consistency by the various treatments heretofore mentioned. A column of clay emerges from the brick machine or sewer pipe die in the form of a rather dense compressed body. This column is cut into the desired lengths by passing a wire through it, making the individual brick or tile as desired. Cutting tables having 12 to 14 wires cut off an equal number of brick with a single stroke.

Clay of the stiff-mud consistency is used in the production of roofing tile. In this case a palate forms one side of the tile, and the mass of the stiff clay, being spread over the die, is subjected to pressure from a mechanically operating press, the face of the piston carrying the form desired to give the shape to the opposite side of the tile.

DRY-PRESS

The dry-press process employs a raw material which has been finely pulverized and which contains a small amount of water. This process is conveniently divided into two parts, one known as dust pressing, the other as semi-dry pressing. In the dust pressing the water content may be as low as 4% whereas in the semi-dry press the material may contain 10% or 12% water. In this case the water content is sufficient to cause the body to hold together when firmly pressed in the hand. Dust pressing is more commonly employed for porcelain and white ware articles, whereas the semi-dry press is employed for production of face brick and fire brick. The dust is placed in a steel mold and pressure applied by a piston carrying a face which fits into the mold neatly. Under very high pressure the article is condensed into a solid article capable of carrying considerable pressure and withstanding the handling necessary in the subsequent process of placing the article in the kiln ready for burning.

LIQUID CASTING

In the casting process the body is suspended in water. The material when ready for casting has the consistency of cream or in some cases it may flow like thick molasses. This process is carried out under two different methods, one known as hollow casting and the other as solid casting. In hollow casting the slip, as the casting liquid is called, is poured into a plaster of Paris mold, the inside of which has the shape of the outside of the article to be made. The mold is filled with slip. The porous plaster draws water from the slip immediately and rapidly. This results in a layer of the clay body being formed on the surface of the mold. In a period of a few minutes a layer \(\frac{1}{8}\) or \(\frac{3}{4}\) of an inch thick will be built up depending upon the rapidity with which the mold draws the water out and the thickness of the slip itself. As soon as the thickness of this
layer of clay is sufficient, as determined by the operator, the mold is turned upside down and the excess slip poured out, leaving the desired article clinging to the walls of the mold. A brief drying period loosens the clay from the plaster mold by slight shrinkage, and the mold, which is generally in two or more parts, is removed leaving the article sufficiently rigid to stand and permit trimming and further treatment.

In the solid casting process the slip is of a consistency more like molasses, this being the result of a tempering process in which the colloid of the clay is deflocculated by addition of sodium carbonate or sodium silicate. This procedure is necessary because, whereas in the hollow casting process a slight shrinkage is desirable when freeing the article from the mold, in the solid casting process the shrinkage must be held at a minimum to prevent breaking or cracking of the article. This minimum shrinkage is obtained by deflocculation of the colloid whereby a liquid slip is obtained with the minimum water content of the body.

In this solid casting process, plaster molds are used as before but the essential difference aside from difference in consistency of the casting slip is that there is a core or center mold as well as an outside mold. The center mold is of plaster and draws the water from the body in the same way as the outside mold. The slip is poured into the space between the two molds until full; no slip is poured out as in the case of hollow casting. The mold is allowed to stand until the clay body has solidified by virtue of water being drawn into the mold, after which the molds are taken apart and the finished article has sufficient rigidity to stand the necessary handling.

**Shaping Glass**

The discussion on shaping thus far has dealt with products which derive their shape before firing or burning. In shaping articles from glass, a series of processes parallel in principle to those employed in shaping articles from clay is used. However, instead of molding the glass article from raw materials, these constituents are melted to a homogeneous liquid state. After the melting has been finished and the process of planing, resulting in freeing the glass mass from gas bubbles, is complete, the clear liquid glass is converted into articles of the desired shape by a series of processes which can be conveniently divided into blowing, pressing, casting, and continuous drawing. The blowing process of molding glass articles is similar in principle to jiggering described under molding of pottery articles. The hot viscous glass is collected on the end of a hollow iron pipe and after the preliminary shaping by the glass blower the ball of glass, into which the operator has forced a hollow center, is placed in an iron mold and by pressure from the lungs of the operator the liquid is forced out against the wall of the mold which imparts the desired shape to the article. This same series of operations is carried out in all of the glass bottle machines which do mechanically the operation that in former days was done entirely by the glass blower. The pressing of glass articles involves the same principles as the dry pressing of any kind of clay product. The hot viscous glass is placed in a steel mold and the plunger exerts pressure causing it to flow and fill all of the corners and crevices of the mold. The casting process as
applied to glass is limited to the simple operation of pouring a pot of molten glass on a steel table. The glass spreads, partly by virtue of its own tendency to flow, and is further forced to spread by running a heavy iron roller over it. The roll runs on guides which determine the thickness of the plate of glass to be made. This is as yet the most extensively used process of producing plate glass. The continuous drawing process, which promises to revolutionize the glass industry in the coming years, is applied to the production of glass tubing, window glass and plate glass. Numerous patents have been granted on processes whose objects are to produce a continuous stream of molten glass flowing from a glass tank and giving the shape and thickness to the glass stream necessary to produce the desired article. The production of window glass by this process has already reached a high degree of success. The production of plate glass, which is a much more refined product, has introduced difficulties which have not as yet been altogether overcome, the principle of these difficulties being the tendency to produce strains, reams and similar defects. The drawing of plate glass, which is thicker than window glass, magnifies the difficulties greatly. However, some success has been obtained and there are in operation a few plants producing plate glass by this continuous drawing process.

DRYING

The process of drying ceramic products consists of the elimination of mechanical water which is present in the product after shaping. It is apparent from a discussion of methods of shaping those ceramic products which contain a considerable proportion of clay or shale that the quantity of water present in the shaped article varies within very wide limits. In the casting process there may be as much as 60% or 70% of water in the body when the process of shaping starts, whereas in the dust pressing process the quantity of water may be as low as 4%. Variations between these two extremes are found in different branches of the industry. This water, however, must be eliminated by some process of drying before the product can pass on to the firing period of manufacture.

The drying of these ceramic products is a very different problem from the drying of clothes, for instance. The difficulties encountered in the drying of ceramic products are similar in character to those met with in the drying of lumber, but in most cases decidedly more pronounced and more serious because of the low mechanical strength of the body as compared with lumber. Those who have observed the drying of green lumber know, for instance, that if a green board be laid in the sun and left to dry in that position, in a very few days the ends will begin to turn up and the board will assume a curved shape. If the board be now turned over and the other side exposed to the sun, it will straighten out and, if left long enough, the curve will turn in the opposite direction from that previously assumed. This bending or distortion of the board is the result of the physical forces brought into play by the process of evaporation of water from one side of the board. Examination of the surface of this board will in many cases reveal cracks opening in the surface. These are further results of the uncontrolled elimination of water. Drying of lumber by that process is of course objectionable
THE DRYING FLOOR IN A REFRCTORIES PLANT, SPECIAL SHAPES DRYING IN THE FOREGROUND
and ruinous to the lumber. This is the reason that in the lumber industry we have drying kilns which are capable of accurate control and from which dry unwarped lumber of sound quality can be obtained. This discussion on the drying of lumber is for the purpose of enabling the reader to visualize the difficulties encountered by the ceramic manufacturer in the drying of his ware.

In the manufacture of common brick by the soft-mud process the shaped brick consists of perhaps 70% solid clay and 30% water. This water must be removed from the brick by a process of evaporation. All the evaporation takes place at the surface during the early stages of drying. As the surface dries the process of capillary attraction results in a continuous flow of water from the interior of the brick through the capillaries to the surface thereby resulting in a gradual decrease in the volume of water present in the interior as well as at the surface. This decrease in volume of water shows up as a shrinkage in the size of the whole brick. Because of this shrinkage which accompanies the elimination of the first quota of mechanical water, this water which is eliminated during the shrinking of the clay has been called shrinkage water. After drying has proceeded to a point where perhaps the 30% original mechanical water has been reduced to 20% the quantity is no longer sufficient to maintain all of the pores of the clay full of water. This results in a break in the continuity of flow from the interior to the surface and instead of the clay continuing to shrink in approximately the same proportion as the water which leaves, voids are left in the body. The process of drying from now on must be completed without the assistance of the capillary flow of water to the surface, and the water which is left in the interior of the brick must be carried to the surface by some other process. The water which is eliminated during this second stage of drying and which results in leaving pores or voids in the body has been termed pore water. This pore water is eliminated by the process of air actually entering the pores and gathering up or absorbing such a quantity of water as it can carry and passing back out into the atmosphere surrounding the brick.

This discussion has been applied to a brick. The same principles govern the drying of any ceramic article. During the early history of the industry the drying was carried out in open yards, the manufactured product being set on the ground and left in the sun to dry. This drying process resulted in warpage in precisely the same manner as was pointed out in the discussion on lumber. Drying floors came into use relatively early in the history of common brick manufacture, these floors being heated by means of underground flues and protected from the weather by a roof. The drying floor hastened the rate of evaporation and when the brick were turned on the floor for drying it was possible to maintain their shape with reasonable accuracy. This method is rather extensively used at the present time in the production of fire brick and special shapes, the floors being heated by steam coils or underground flues carrying waste heat from plant operations. However, in the fire brick industry these brick are dried only partially after which they are repressed in a steel die which gives them accurate size and true shape. The distortion resulting from unequal rate of drying on the drying floor is largely eliminated by a re-shaping of the half-dried article. In some manufacturing
operations such a re-shaping is not possible, for instance, in the production of sewer pipe or hollow tile or glass pots. These articles derive their final shape in the shaping process described above and while they contain large percentages of water they are also of such shape and size that the evaporation of the water inevitably presents strong tendencies to distort the article. Because of these tendencies the drying of these and similar products introduces the most serious problem encountered in their manufacture and one of the greatest items of cost in the production of these products is the item of drying.

The drying of all kinds of ceramic products in recent years has been reduced to an exact science. Just as the humidity system of drying lumber has become universally adopted, so also has the humidity system of drying ceramic products become standard in all phases of the industry where the size and shape of the article lend themselves to handling in humidity driers. In all other phases of the industry such as production of sewer pipe, glass pots and other articles which are too massive and bulky to admit of efficient handling in humidity driers, the principle of humidity control is recognized and ways and means are provided for its utilization. The drying of all ceramic products can be said to be carried out under a system of scientific humidity control in so far as the character of the product and other manufacturing facilities render it possible to do so.

The most extensively used type of drier in the ceramic industries is the tunnel drier. In its use the product to be dried is placed on cars and run in a continuous train through an enclosed tunnel. The process of drying is carried out by positive means of forcing large volumes of air through the tunnel and controlling the relative humidity of this air as it enters and leaves. The tunnels are generally heated by some means, a great variety of methods being available. The path of the air which is forced to come in contact with the drying ware is controlled as is also the amount of moisture which the air carries at any point in the tunnel. Occasionally steam may be injected into the tunnel for the purpose of increasing the moisture content of the air. This would seem rather strange procedure but it is just such definite control as this implies that is necessary in order to insure drying of all parts of an intricately shaped product at the same rate and thereby avoiding warpage or cracking in the drying process. Humidity driers of various designs are adapted to the production of pottery and other types of products. In certain cases, as in the manufacture of dry-press and dust pressed ware, no serious drying problem is encountered. These products are set in the kiln ready for burning without passing through any definite drying operation.

The only ceramic products which must be dried and which do not carry such large percentages of clay as to introduce a serious drying problem are enameled products. In the wet process of enameling cast iron and steel, a drying operation is necessary. The only requirements here are that the water be eliminated without violent boiling and that during the drying process the surface be protected from injurious dust particles which might be floating in the air. In this industry it is simply a question of rapid evaporation while protecting the product from dust.
FIRING

The firing or burning of ceramic products is not only the last step, generally, in their manufacture but it is the process among all those through which the product passes that is common to all ceramic products and that imparts to all of them their characteristic properties. Ceramic products are fired or burned but never baked. Distinction should be made here between the high temperature firing process to which vitreous enamels are subjected and the very moderate temperature of baking which organic paints or enamels undergo. The baking of an enamel, which has as its base an organic material such as linseed oil, involves simply the process of hardening by a partial distillation of the organic compound. Carbon is invariably left as one of the principal constituents of these organic enamels. Most of them if subjected to a moderate flame, will burn. Such products should not be confused with ceramic products which have been subjected to high temperatures in all cases and in which no carbon could remain if oxygen were present for burning. The baking process is applicable to these low temperature paints, but in referring to the heat treatment to which ceramic products are subjected the term "baking" is never used. In the burning process ceramic products are subjected to such heat treatment as will bring about chemical and physical changes necessary to develop the particular silicate desired. The firing process differs greatly in various branches of the ceramic industry as to the type of equipment and the stage in the manufacturing process where it takes place. It is, however, in all of the ceramic industries the only process where ultimate chemical and physical properties of the product are developed. In those branches of ceramics where clays and shales are the principal raw materials used, the firing process has for its object simply the development of a well vitrified article which has been previously shaped and dried. In the glass industry, the firing process has for its object the production of a homogeneous liquid which is subsequently shaped. In the enameling industry, two processes of firing are essential. In the first process, the raw materials are fired for the purpose of producing a homogeneous glass. This glass, after being subjected to grinding and mixing with other materials, is again fired after being applied to the surface of the metal. In this final firing process the enamel attains its ultimate chemical and physical properties and in the last analysis has all of the properties of glass. In the cement industry, the object of the firing process is to bring about certain definite chemical reactions which result in the production of a clinker; this clinker when properly ground possesses all of the desired characteristics of the finished article. In the lime industry, the firing has for its object the bringing about of a simple chemical disintegration leaving as the finished product a simple chemical compound.

As pointed out above, the production of any ceramic product involves the development of some product having predetermined chemical and physical properties. The character of the equipment and the methods used in bringing about this result by application of heat to the raw material are greatly varied. In practically every process the application of heat involves the use of some piece of equipment commonly termed a kiln or furnace. These kilns are conveniently designed compartments or chambers so arranged as to facilitate the application of heat to the
product while it is supported in any appropriate manner within the chamber. The design of kilns and furnaces is so varied that no effort can be made here to describe them all. They are variously referred to in the ceramic industry as scove, round down draft, rectangular down draft, pottery, chambered continuous, rotary, and ear tunnel kilns.

Perhaps the simplest of all ceramic kilns is the lime kiln, in which the limestone and fuel are mixed in intermediate layers. In this process the raw material, from which the finished product is to be derived, is mixed with the fuel, either wood or coal, which furnishes the heat necessary to bring about the chemical reaction which results in the ultimate product, lime. This was the primitive method and one which is still followed to a considerable extent in rural communities at the present time. The burning of lime, which is the simplest of our ceramic processes, has been refined and there are in use rotary kilns, which are perhaps the most up-to-date type of equipment for burning lime and Portland cement. Intermediate steps between this primitive method and the rotary kiln are in use at various localities.

A primitive method of burning brick was the scove kiln, which consists of piling the brick in a convenient fashion so as to facilitate the passage of products of combustion through the pile of brick. The fire-boxes, in which the fuel is to be burned, are constructed in the process of piling the brick and when the kiln is thus set fuel is burned in these fire-boxes. Natural draft carries the products of combustion from the firebox up through the spaces left for that purpose between the brick, resulting in the heat being carried to all portions of the kiln. A period of many days is necessary to carry the temperature to all of the brick and thus finish the burning. This process, which is referred to as primitive and which was in wide general use all over this State in the early history of brick manufacture, is still used for the production of common brick but the localities where it is in use are very limited in number at the present time. As in the case of lime, so with common brick; while brick are still burned in scove kilns, which are of primitive type, we find them also being burned in kilns of recent design representing the accumulated experience of ceramic manufacturers throughout the past and having incorporated in them the principles of design which have been the outgrowth of ceramic science to date. In the production of some types of ceramic products it is essential that the flame from the fuel be not permitted to come in contact with the product during the firing process. In such cases “muffle” kilns are used. These kilns are so constructed that the ware to be burned can be placed in them and when sealed there the products of combustion pass around the ware but do not come in contact with it, the heat being conducted through the walls of the muffle to the ware within. Recent developments have led to the application of electricity for burning processes. In this case the heat is generated by electric current and no injurious flame or products of combustion are present during the burning process. We thus find art tile and enameled products being rather extensively burned by electric heat at the present time. This is possible in those industries where the mass of product is not great and the temperature relatively low. Electrical energy is at present too expensive to use for the production of massive ceramic products, such as brick and terra cotta. The most recent development in kiln design has been in the direction of the car tunnel kiln.
This, as the name implies, is a properly constructed tunnel arranged for efficient distribution of heat and provision made for cars to run through the tunnel carrying the product to be fired. Hundreds of these kilns are now in operation in this country. Indications are that their popularity will continue to grow and that they will in large measure replace the periodic kilns which have throughout the past been the type of kiln used for burning. One of the greatest disadvantages of the tunnel kiln is its fixed capacity. When one builds a tunnel kiln he definitely fixes the rate at which he must operate all parts of his plant if he is to obtain the maximum efficiency and to derive all of the profits obtainable from the kiln, and he obligates himself to operate the kiln at approximately 100% capacity from the time it is started until necessary to close down for repair. Closing down one of these kilns is a very expensive operation not only because of the large amount of fuel required to bring it back up to operating temperature but still more because the cooling and heating of the kiln results in serious breakage of the refractory parts of it. It is therefore almost absolutely essential that the kiln operate continuously after once starting. This lack of flexibility in the capacity of the plant is objected to in many industries because of the seasonal character of the market for their product. This objection, while it is recognized as existing, is nevertheless being disregarded and tunnel kilns are being built in all parts of the country for the burning of all kinds of ceramic products. Their great advantages are in economical operation as regards fuel and labor, and in the uniform quality of the product which it is possible to obtain from them. The most satisfactory type of kiln other than the car tunnel kiln is the chambered continuous kiln, which has been recognized for many years as the most economical kiln as regards fuel available for the burning of most ceramic products. In this kiln the ware must be set in individual chambers which follow one another in a continuous ring around the kiln. The first cost of building one of these continuous kilns is very great, which is one of the chief arguments against them.

In the burning of enameled products the burning device is more frequently referred to as a furnace. The designs of these do not vary so widely as the designs of kilns for clay products. In most cases enameled products are burned in muffle furnaces which are heated to the desired temperature by many different kinds of fuel. The metal with the enamel applied ready for burning is placed in the muffle which has been previously raised to the desired temperature and the burning process requires only a few minutes at the most. The fired product is taken out of the muffle, generally without cooling gradually, and new material is immediately placed in the muffle without any provision for slow heating up.

The term furnace is applied more frequently to the equipment used for melting glass. The design of these furnaces is greatly varied but in general they fall under two classes—what are known as pot furnaces in one case and continuous glass tanks in the other. The pot furnace is simply a chamber suitably designed so that a desired number of glass pots can be set around the outside with openings through the wall to facilitate getting at the glass in the pot and charging raw materials into it for melting. In cases where the glass is to be worked out of the pot,
a small opening through the wall permitting the operator to gather the
glass from the pot is the only entrance desired. In the case where the
glass is to be cast, as in the production of plate glass, a large door, which
will permit the pot to be placed and withdrawn conveniently, is necessary.
In the case of the continuous glass tank the heating chamber proper
consists of a large tank constructed of refractory materials. These tanks
range in size from 10 to 16 feet wide, in length from 12 to 20 feet, and in
depth from 2½ to 4 feet. The continuous tank furnace is analogous in prin-
ciple to the ear tunnel kiln on the one hand and the rotary lime kiln
on the other. It admits of a continuous operation, in which raw materials,
having been previously mixed, are fed in at one end of the tank; the
melting takes place in the melting chamber, and the molten material
flows in a continuous stream through the melting and refining chamber
and is worked out at the opposite end of the furnace. The rate of flow
is determined by the rate at which the glass is worked out and this in
turn determines the rate at which the raw materials are fed into the
tank.

The tendency in recent years in all of these heating devices has been
toward continuous processes. The cost of labor and fuel has more and
more become an influential factor in modifying the character of burning
processes. This has led to the development of processes which would
result in decrease in the quantity of labor and fuel required to produce
a given product. At the same time, the quality of many ceramic prod-
ucts has been improved in some respects by the adoption of continuous
processes. On the other hand, in some cases the continuous process
results in an inferior product and in such cases, where a particular
quality of the product is a determining factor in the prosperity of the
industry, these continuous processes are not meeting with such uni-
versal success and are being less slowly adopted.

Fuel used in the ceramic industries is practically everything avail-
able for fuel—coal, both anthracite and bituminous; coke, less common;
fuel oil; natural and producer gas; and electricity. Cost is in general
the determining factor in deciding the fuel used; there are some cases,
however, where the character of the chemical reactions involved dictate
the use of certain types of fuel. The production of flashed face brick,
for instance, requires the use of a fuel which will produce strong reducing
conditions. This implies coal, oil or gas, electricity being not available
for this purpose. In the glass industry solid fuels are no longer used
for direct production of heat. They are, however, sometimes used in a
gas producer, the ultimate fuel being gas, either producer or natural.

In the production of Portland cement the rotary kiln, which is
simply a tube lined with refractory material, is almost universally used.
This kiln rotates slowly and is inclined at a very slight angle. The raw
material fed in at the upper end gradually works toward the lower end
where it drops out a finished product. Fuel is blown in at the lower end
where it burns and, passing up through the kiln meeting the raw material
coming down in the opposite direction, it passes out into the stack at the
upper end of the kiln. The hottest end of this kiln is at the lower end
and the temperature there must be sufficient to complete the chemical
reaction desired. The material passing down through the kiln gradually increases in temperature until it reaches the hottest zone near the lower end.

As was mentioned before, the object of firing all ceramic products is to produce chemical and physical reactions which will result in the desired product. The character of these chemical reactions depends of course upon the raw materials used and upon the combinations of raw materials mixed for a given product. While heat is the essential thing desired to bring about these reactions, it is inevitable that they will be greatly influenced by the products of combustion from the fuel used.

While the majority of ceramic products are fired only once, in many cases they are fired twice and sometimes a great number of times. The ultimate product in many cases has a glaze on the surface which is fired subsequently to the firing of the body of the article itself. Over this glaze are in other cases applied decorations, the burning of which requires sometimes several different fires. Even in the manufacture of enameled products the ware is subjected to two or three firings and sometimes, as in the case of enameled signs, as many as ten firings take place.
CHAPTER IV

CERAMIC INDUSTRIES IN PENNSYLVANIA

In this chapter the aim has been to set forth briefly the character of ceramic products manufactured in the State and to give a general outline of the raw materials and processes used in the production of each type. A studied effort has been made to avoid scientific terms and technical details, the desire being to present all information in such form as to enable any one, whether scientist or laborer, to understand it.

RAW MATERIALS

Clays

The Commonwealth of Pennsylvania is bountifully supplied with a great variety of clays and shales suitable for the production of many kinds of ceramic products. Surface clays, which were used in the early days of the ceramic industry for the production of common brick and crude pottery, are available in all sections of the State. The most valuable clays in the State are the fire clays in the Carboniferous area extending from the central part to the western border and from the northern to the southern border. These clays, commonly termed coal measure clays, form the basis of the refractories industry of the State and are the source from which most of the clay produced and sold is derived. Also associated with these coal measure fire clays are the Carboniferous shales which are almost unlimited in extent and are capable of producing the better qualities of heavy clay products.

Another group of refractory clays, described by E. S. Moore and F. B. Peck in United States Geological Survey, Bulletin 708, occur in Huntingdon, Blair and Centre Counties in the vicinity of Huntingdon, Hollidaysburg, and Warriors Mark. These clays are described as being the weathered product of Gatesburg sandstone and the Oriskany sandstone. They are white to gray in color and generally quite refractory. Clays from these deposits are being extensively used in metallurgical industries, their principal point of merit being that they can be won by quarrying and therefore are cheap as compared with the Carboniferous clays which must be mined. These deposits, however, are spotty, occurring in pockets of limited extent. Since they are not all highly refractory, materials from the same deposit varying in refractoriness, it is necessary to test these materials carefully when purchasing them.

The kaolin industry in Pennsylvania has decreased in recent years. Only one company reported producing in 1928, their production being 60 tons per day. These white clays described by Moore and Peck coming from the Gatesburg and Oriskany formations are sometimes called kaolin. It is not proper, however, to so refer to them, the term kaolin being now limited in its industrial application to those clays which are capable of producing china and porcelain bodies. Such clays are generally washed and upon burning produce a white body. Many of these Central Pennsylvania clays when burned produce a very light gray but so far as the deposits have thus far been tested none of them have yielded a clay which burns to a sufficiently white color to justify being termed kaolin.

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The eastern section of Pennsylvania heretofore has been assumed to be less bountifully supplied with good shales and clays than the western section. However, recent investigations made by the writer have revealed workable deposits of clay in the vicinity of the Blue Ridge range along the Lehigh and New England Railroad and furthermore there are indications that the anthracite district has within it rather extensive deposits of good quality shales.

Geologists recognize the fact that the coal in the anthracite region is geologically the same as that in the bituminous region, but it has had a different history which has changed its character. That being the case, the shales in the anthracite region probably had the same origin as the shales in the bituminous region. They also have had a different history and this more extensive metamorphism has converted some of them to slates. Because of their dense character as they occur, it has been assumed that all of the shales in the anthracite region were slates and they are so named. An examination of a considerable number of these so-called slates revealed the fact that certain of the strata upon proper treatment developed quite surprising plasticity and workability and the burning properties were not unlike some of the shales occurring in the bituminous region. This preliminary investigation would indicate that there may be available in the anthracite region shales suitable for the production of face brick and sewer pipe similar to those which are so satisfactorily used in the bituminous region.

A rather unusual type of clay has been discovered in recent years in the vicinity of Aspers, Adams County. This clay, upon burning, produces a dead black product. It is so unusual in this respect that it is being extensively sold by producers of chemicals for use in many branches of the ceramic industries. Black clays are very common in nature but the black color almost invariably disappears upon firing. In fact a clay which is black in the deposit may burn to a very satisfactory light buff or cream color, the black color of the raw clay being due to carbon which burns out.

**Ganister**

Ganister is a highly refractory siliceous sedimentary rock used in the production of refractory brick. The term was first employed to describe the close-grained dark colored sandstone found in the Carboniferous composition near Sheffield, England, and composed approximately of 83% quartz, 13% clay and 4% moisture. It is now applied to any similar rock consisting chiefly of quartz but containing sufficient clay material to act as bond and not enough fluxing ingredients to lower its refractoriness. Ganister which is used in Pennsylvania for the production of silica brick contains 96% to 98% silica and is obtained chiefly from two formations—the Tuscarora quartzite and Chickies quartzite, more than 90% of the total coming from the former.

The quantity of ganister in the Tuscarora formation is almost unlimited, extending as it does from the north central section of the State to the southern border in a series of mountain ranges. However, while this entire body of rock is similar in its character, being composed almost entirely of silica, there is in fact a limited number of places within a reasonable range of railroad facilities in these mountains where quartzite
of a proper degree of chemical purity and having the proper physical characteristics for the production of silica brick can be obtained.

The production of ganister in Pennsylvania is confined largely to the manufacturers of refractories but there are a few producers who quarry the material and sell in the open market to metallurgical industries.

GLASS SAND

Glass sand is produced in Pennsylvania principally from the Oriskany sandstone, a little being also produced from the Pottsville sandstone. For the purpose of glass manufacture it is necessary that the sand be as nearly as possible 100% quartz. First quality glass sand must contain 99+% of silica and of the other constituents present iron oxide is the most objectionable. Glass sands occur in nature, either in the form of loose unconsolidated sediments or in deposits in which the individual grains have been bonded together by some cementing agent so as to form sandstone. While deposits of sand and sandstones occur widely and are abundantly distributed, deposits that are sufficiently free from constituents other than quartz grains so that they can be employed in the manufacture of the better grades of glass are comparatively rare. The deposits in Pennsylvania of suitable chemical purity to use for the production of glass are all of the consolidated variety and occur as quartzite which must be ground to the desired degree of fineness for use. Glass sand produced in Pennsylvania in 1928 amounted to approximately 1,281,123 tons valued at about $2,088,795. This was produced by seventeen companies including one producer of flint. These figures also include some sand which is used for grinding plate glass.

FLINT

Flint is the term used to describe the cryptocrystalline variety of silica. However, in the ceramic industries this term has come to be applied to any form of ground silica which is used in the production of white ware bodies, glazes and enamels. The bulk of this material is not the cryptocrystalline silica such as is obtained from flint pebbles but is, in fact, quartz which has been pulverized. The production of flint in Pennsylvania is very small, only one producer reporting in 1928.

FELDSPAR

Deposits of feldspar were extensively worked in southeastern Pennsylvania in past years. These deposits have been largely worked out, the portion of them which remains being of inferior quality, and the feldspar industry in this State has practically disappeared. One producer reported making preparations to quarry some feldspar in 1928.

LIMESTONE

The production of ground limestone, which is logically included in the ceramic industries, includes those products which are sold for the production of glass, Portland cement, and fluxes in ceramic bodies. The production of limestone for structural purposes is not logically included in the ceramic industries, and because of the fact that many producers
of limestone sell their product for different purposes it is not possible
to divide the limestone production for ceramic purposes from that used
for other engineering purposes.

Limestone used for ceramic purposes must be relatively pure and
especially free from iron compounds.

DOLOMITE

Dolomite is a sedimentary rock consisting of calcium carbonate and
magnesium carbonate combined in the proportion of their molecular
weights. This material is used to a limited extent as a flux in porcelain
bodies and is extensively used as a flux in metallurgical operations. In
recent years processes have been developed for its use as a refractory
product. It has possibilities of being manufactured into refractory brick.
Dolomite production in Pennsylvania for ceramic purposes is as yet
very small. There are extensive deposits of the material in the State
which may at some future time be manufactured into refractories.

GYPSUM

Gypsum products are finding a rapidly expanding market. There
are no workable deposits of this material in Pennsylvania but manufac-
turers in Philadelphia are importing gypsum from Canada and pro-
ducing from it structural materials.

HEAVY CLAY PRODUCTS

HISTORICAL

Authentic information relative to the early history of clay products
industries in Pennsylvania is difficult to obtain. The outline here given
was obtained from Ellis Lovejoy, Columbus, Ohio, and in part
copied directly from Bulletin 8C, Topographic and Geologic Survey of

A letter from Mr. Lovejoy to the writer dated April 21, 1930, states:
"I gleaned from various histories of Virginia the following data which
may interest you. . . .

"The first mention of brickmaking I can find is in 1611 when Sir
Thomas Dale arrived. He set the colonists to work building additions
to Jamestown and making needed repairs and among other things at
'making brick.' I could find no mention of the use of these bricks in
Jamestown but later in 1611 Dale with 200 men built the town of Henrico
up the river from Jamestown. Among the men were potters, brick-
makers and brick-layers, besides smiths. Henrico was built in four
months and as the colonial secretary reported there were in this town
'three streets of well framed houses, a handsome church, and the founda-
tions for a more stately one laid in bricks, in length an hundred foot
and fiftie foot wide.'

"The date of the Jamestown tower which is all that remains of
Jamestown is in doubt, possibly in 1611 since a new block house was
built that year along with making bricks. One writer gives the date
of 1617, perhaps as late as 1639 when the brick church to which the
tower is attached was built.
Since the tower was for protection, there would be no need for it as late as 1639.

The bricks were made from the coastal plains clays which commonly contain kaolin or fire clay and such clays require a high temperature to burn—around cone 10. They were burned with wood in seved kilns and the lime, made from oyster shells, was burned in the kiln with the bricks, likely in the top of the kiln.

The bricks in the arches and adjacent to the arches had a thick glaze of a dirty white or light gray color notably tinged with green. The glaze developed in the burning and was not an applied glaze. The wood ash containing potash besides fine silica, perhaps some lime dust, and high temperatures gave the conditions for the production of the glaze.

Such glazed bricks are seen in many of the old coastal plains buildings, very commonly in Flemish bond, the glazed ends being used for headers.

The first soft mud machine made bricks were made in 1833 in Philadelphia but the machine was destroyed by the workingmen.

In 1840 the soft mud machine was again successfully put into operation.

It is said that the first dry press bricks were made in 1833. In 1848 there were several such machines in operation, probably the old Gregg press.

As I recall the first hydraulic press was developed in Cleveland, Ohio, in 1856 and later was put in operation in Louisville, subsequently going to St. Louis where it became the basis of the St. Louis Hydraulic Press Brick Co., business. When I entered the business in Union Furnace, Ohio, in 1886 I had two English cam presses which were installed in 1884 and were at that time the only dry presses in Ohio. One of these was the first English press to come to this country.

Stiff mud bricks and tile were first made by a horse driven machine in 1853 in Willoughby, Ohio. The first power driven stiff mud machine (Chamber's) was put in operation near Philadelphia in 1862.

It is difficult to say just when 'Rough Texture' bricks began. In early Virginia many buildings were trimmed with a ground faced brick, ground by rubbing the bricks on a 'rubbing stone' (sandstone). Whether this was done for architectural effect or for better alignment and plumbing is a mooted question. Rain drop bricks have been with us for a long time. The Harvard sand mould brick (soft mud) is an old product. Dry pressed bricks were rockfaced back in the '80s. The first stiff mud scratched faced brick was made in Pennsylvania at Radford, I think, in 1894 or 1896.

This was produced at the request of a Buffalo architect, and the bricks were made by scratching the surface of the brick column as it came from the machine with wire brushes wielded by hand.

Machine made wire cut stiff mud texture bricks were first made by the Imperial Clay Co., now the Ludwici-Celadon Co., New Lexington, Ohio, in 1903 when I was manager of this plant.

The development of the product was largely an accident.
“We had a repress for shapes which we wished to use and the machine bricks were too large to go in the mould. We stretched wires across the die and thus made smaller bricks for the repress. Some of these bricks as they were made through the auger machine were burned and recognized as a possible building product. Production started immediately and the bricks found favor in the market. I left the factory in 1904 and the brick product was abandoned and tile taken up, but the same year (1904) the wire cut product was taken up by the Claycraft Brick Co., Groveport, Ohio, and continued until a year or two ago.

“This probably does not interest you since it does not relate to Pennsylvania except that the first rough texture brick was produced in Pennsylvania by the Manager of the Martin- Yingling Brick Co., Johnsonburg, Pa. He may not now be living since he was along in the eighties when I last talked with him several years ago.”

The publication by Mr. Hice, in discussing early clay working in Pennsylvania, reads as follows:

“Clay working is undoubtedly one of the oldest established industries in Pennsylvania as in all other parts of the country, and owing to the fact that clay working establishments were early erected for making common red brick at many places, numerous references are found to the early history of the industry. In Pennsylvania as in every other section of the country the early developments were determined by the location of the materials used, and suitable materials for common brick were abundant nearby all the larger markets.

“T. C. Hopkins gives the following account of the early history of the brick industry near Philadelphia.

“The first authentic account I find of the brick industry in Philadelphia is given by William Penn himself, in a letter dated July 16, 1683, in which he says: “I have here the canoe of one tree, y. fetches four tons of brick,” which shows that brick were articles of transport at that time.

“In a further account written in 1685, Penn said, “Divers brickeries going on, many cellars already stoned or bricked and brick houses going up.” Penn published a letter from Robert Turner at Philadelphia, dated the third of the sixth month, 1685, which says, “and since I built my brick house . . . many people take example, and some that built wooden houses are sorry for it. Brick buildings are said to be as cheap; bricks are exceedingly good and better than when I built, and now many brave brick houses are going up with good cellars.”

“This house, erected by Turner in 1685, was located on the southeast corner of Front and Mulberry streets, and is said to be the oldest brick house in the city erected by a citizen. In 1707 Thomas Masters built the first three-story brick house.

“J. B. Bishop says that the Dutch brought bricks from New Netherlands for building purposes and that they manufactured brick as early as 1656 at New Castle (New Amstel). One of the first brick buildings erected by the Swedes was at Wicaco in 1700. He says that Wm. Penn’s instructions to his agents in 1684 was to build principally of brick.

“Pastorius, who founded Germantown, writing in 1684 in his history of “the lately discovered Province of Pennsylvania situated on the
frontiers of the Western World," records that at that time they had a sufficient number of brick kilns."

"Brick making on the Delaware, however, began prior to 1660. Among the records of New Amstel (New Castle), Delaware, is found the statements that in '1656 Ja Cobi Craft presented a petition conveying a plantation near New Amstel to work brick until they are made and baked.'

"Of the early history of brick making in the western portion of the state less is known. Ries and Leighton, in writing of the early history of Pennsylvania, state, on the authority of an article in the "Clay Worker," the first brick house west of the Alleghenies was erected in Kaskaskia in 1750. . . .

"It is difficult to trace the early history of clay working in the western portion of the State. General Stanwix used some brick in the erection of Fort Pitt in 1759, and as material for making common red brick could be had adjacent to the site of the Fort, it would seem they were probably made near the Fort.

"It does not seem, however, that brick were used in Pittsburgh (except as mentioned regarding Fort Pitt) prior to 1786. In this connection Dr. J. H. Bausman, the historian of Beaver County has furnished the following facts. 'Craig's history of Pittsburgh, page 281, quotes Niles register, volume 30, page 436 as saying that 'Pittsburgh in 1786 contained 38 log houses, one stone and one frame house, and 5 small stores.' Craig in commenting upon a statement as to the population of the town made by the Pittsburgh Gazette, in its issue of January 9, 1796, draws up a list of the houses as far as he could remember them for the same period. He finds about 102. In his list (page 250) Craig speaks of General Gibson's house as the "first brick house." If the statement of Niles register, quoted above, is correct, Gibson's house must have been built after 1786."

"The second edifice erected by the First Presbyterian Church of Pittsburgh, was built on Wood Street, 1804, and was of brick.

"Of the early developments outside of Pittsburgh even less is known. Prior to 1810 and probably between 1807 and 1810 'a small brick market house' was erected in Beaver, and in 1810 the second Court House in that town was erected, being built of brick. On March 7, 1812 the Trustees of the Beaver Academy contracted with Jonathan Mendenhall for the delivery of 140,000 brick, at $4.50 per thousand delivered, and on June 20 of that same year made a contract with Jonathan Coulter for the stone and brick work of the Academy building for the sum of $498.00.

"Undoubtedly a study of local history would show many other early developments in the brick industry in other portions of the state."

**Common Brick**

Common brick are described as low grade brick extensively used for backing up the walls of buildings and for all structural purposes
where the brick is not required to possess excellence as to color, strength or uniformity of shape. In the early history of the brick industry common brick were the only kind made. Clays or shales used for common brick are usually of low grade and in most cases red burning. The main requisites are that they shall mold easily and burn hard at as low a temperature as possible with a minimum loss from cracking or warping. Many common clays or shales when used alone show high shrinkage in drying and firing and to correct this it is customary to decrease the shrinkage by mixing some sand with the clay or by mixing a sandy clay with a more plastic one. Common brick clays are available in all sections of the State but the common brick industry in recent years has become largely localized because of economic conditions. In the early history of the industry fuel in the form of wood was available almost everywhere. Labor was cheap and it was customary when one wished to build a house to establish his brick plant on the site, mold his brick by hand, gather the fuel with cheap labor from the adjoining woodlots, set a seave kiln and burn it. Disappearance of wood and increase in the price of labor have completely eliminated this practice. The manufacture of common brick is now carried out largely by mechanical methods. The manufacturing establishments are situated at points where suitable clay is available, where railroad facilities make it possible to obtain fuel at a low price, and also where the product can be shipped to market at a low freight rate. Common brick are manufactured by the soft-mud process and by two different methods,—one known as slop molding, the other as sand molding. In the slop molding process water is freely used in the molds to prevent the clay from sticking to them. In the sand molding process sand is used for this purpose. The character of the resulting product is distinctly different in the two cases. The sand molded product has a surface which is imparted to the clay by virtue of the sand grains adhering to it and this results in a rather pleasing, velvety texture which has met with the approval of architects in recent years. These sand molded common brick are being used to some extent at the present time to replace the much more perfect face brick which are manufactured under more expensive conditions.

During the last four years a very extensive building campaign has been carried on at The Pennsylvania State College. The architects adopted as the brick to be used in most of these buildings a so-called colonial brick. The brick used were the sand molded, soft-mud product made from red burning surface clays. It must be admitted that the architectural effect produced from the combination of these brick with limestone and white cement is very pleasing, but it is a fact also that the quality of these individual bricks as regards their resistance to weather is decidedly inferior to that of face brick which are manufactured from shales and low grade fire clays and under processes which produce much more durable products. It is probably true, however, that these sand molded, soft-mud brick will last as long as the building is left to stand, and it is the expectation of the architects that the walls made from them will assume an appearance of age in a period of a very few years. This meets the present desire on the part of the public for antiques and that probably is the principal factor in developing the popularity of these brick for face brick purposes.
FLOW SHEETS

1. **Product:**
   **Common Brick**, face brick, drain tile, hollow tile

   **Material:**
   Soft or wet alluvial clay, plastic surface clay

   **Flow Sheet:**
   - Screw Feeder
   - Disintegrator
   - Rolls
   - Pug Mill
   - Auger Machine
   - Cutter
   - Off Bearing
   - Dryer
   - Kiln

2. **Product:**
   **Common brick** by soft mud process

   **Material:**
   Short or sandy surface clay

   **Flow Sheet:**
   - Rolls or Disintegrator
   - Automatic Soft Mud Brick Machine
   - Cable Conveyor or Rack Cars
   - Dryer
   - Kiln
   - Stock

**Face Brick:**

Face brick are manufactured from a wide variety of raw materials but, in general, shales and No. 3 fire clays are the most desirable raw materials for such use. Surface clays lend themselves more readily to common brick manufacture being as a rule impure and containing soluble salts liable to produce scumming. They also vary so widely in composition that they are used only to a limited extent for the production of face brick.

Processes used in the production of face brick are illustrated in the flow sheets following.
1. **Product:**
   
   **Face brick** by dry press process

**Material:**

Shale and No. 2 fire clay

**Flow Sheet:**

```
Storage Hopper
  Plate Feeder
  Single Roll Crusher
    Storage Bins
    Plate Feeder
      Dry Pan
        Elevator
        Coarse Screen
        Steamer
    Storage Bins
    Conveyor and Elevator
      Storage Bin
      Screw Conveyor

Dry Pan (or Pulverizer)
  Elevator
    Screen
      Mixer (Press Feeder)
        Press
          Kiln
    Dry Pan (or Pulverizer)
        Elevator
          Screen
            Mixer (Press Feeder)
              Press
                Kiln
```
2. **Product:**

   **Face brick**, Hollow tile, Paving brick

**Material:**

   Hard friable shale

**Flow Sheet:**

```
   Bin
   Plate Feeder
   Single Roll Crusher
   Elevator or Conveyor
   Storage Bins

   Plate Feeder
   Dry Pan Grinder
   Elevator
   Screen (s)
   Storage Bin or Bins
   Disc Feeder (s)
   Pug Mill (s)
   Auger Machine (s)
   Cutter (s)
   Off Bearing Belt (s)
   Dryer
   Kilns```

The manufacturers of face brick have developed within the last decade a knowledge of how to modify the texture and color of their product to such an extent that a great variety of products is produced from the same raw material. This is done by modifying the practice in the forming of the brick and in the burning process. We find, therefore, made from the same red burning shale, such products as smooth face repress brick in a great number of shades, rough texture brick with the character of the surface varying from a fine velvety roughness to a very coarse rough surface and these effects modified still further by varying the burning conditions so as to develop a wide range of colors.
VARIous EFFECTS OBTAINED WITH FACE BRICK

1. Hand made shapes
2. Smooth face brick
3. Hollow tile
4. Roofing tile
5. Enameled brick

ARTISTIC USE OF ROUGH TEXTURE FACE BRICK
Still further modifications are obtained by subjecting the surface of the brick while at high temperatures to vapors produced by throwing special substances such as zinc on the fireboxes resulting in the production of green colors. The production of face brick has thus reached a very high state of perfection and the architect has an unlimited field of products upon which to draw.

The manufacturing processes employed in the production of face brick require an extensive line of costly equipment. Furthermore, the standards set up by the industry are high and the product which sells as a first quality face brick is required to be well vitrified, true in shape and mechanically strong. Products of this character can not be manufactured at a cost to compete with the cheaper common brick formed by processes of mass production from low grade raw materials, frequently with no preliminary purification or treatment, and burned in cheaply constructed kilns with no particular requirements as to strength or quality of the finished product. The face brick industry is meeting competition not only from the cheaper grade of brick but from other structural materials, such as stucco, which can be cheaply obtained and installed at a low cost but which, of course, are decidedly inferior to face brick in the quality of structure obtained.

The face brick industry of Pennsylvania while distributed quite generally over the entire State is concentrated largely in those sections of the State where good quality shales and No. 3 fire clays are available, particularly in those counties west of the central portion of the State. The brick from this section of Pennsylvania find a considerable proportion of their markets in New England and the eastern seaport cities.

Statistics are not available so that all common brick and face brick plants can be determined separately, some plants producing both face and common brick as well as paving brick. The combined number, however, of producing plants making common, face and paving brick in Pennsylvania in 1928 was 126. These plants produced 1,042,298 thousands brick valued at approximately $17,171,363.

**Paving Brick**

Raw materials used in the production of paving brick are good quality shales and No. 3 fire clays. The first requirement of a paving brick clay is that it shall vitrify at a reasonably low temperature so that it will have an absorption of not more than 4%. It must have a range of temperature over which it will be thus vitrified such that the variation in temperatures in good industrial kilns will deliver a relatively high percentage of saleable product. This means that a shale or a fire clay to be used for the production of paving brick should be satisfactorily burned over a range of at least 100° C. in temperature.

Paving brick shales must possess more than the average degree of plasticity and must be capable of producing in the brick machine a dense column free from laminations. Shales which do not possess this property will not stand up in the “rattler” test to which paving brick are subjected even though they may have the required degree of density and low porosity. Color is a secondary consideration but paving brick are required to be of fairly uniform color when burned, the colors used being almost invariably red or buff.
Shales which possess these qualities of plasticity, long vitrification range and vitrification to high density, are not found everywhere. Many shales which will produce satisfactory face brick or hollow tile can not be used for the production of paving brick.

Flow sheet No. 2 under face brick is applicable to the production of paving brick.

The only purpose for which paving brick are ordinarily used is the paving of roads and streets. It is universally admitted that a road paved with brick when properly constructed is the most durable and at the same time the cheapest in the long run. The paving brick industry in recent years has declined because of competition from cheaper materials, that is, materials which could be laid in a road at a lower first cost. The cost of paving with brick has been materially reduced in recent years by cutting down the thickness of the brick. The quality of the road thus obtained is still superior to any other and by using the smaller size pavers the cost per mile is not so much greater than the cost of concrete or macadam pavement. There were 6 plants producing paving brick in Pennsylvania in 1928.

Hollow Tile

Vitrified hollow tile are commonly produced in the same plants in which face brick are produced. The shales which possess the necessary property of plasticity and burning properties capable of producing face brick ordinarily can be successfully manufactured into hollow tile. The same equipment can also be used with a change in the die on the brick machine to produce the tile instead of the brick product. Flow sheet No. 2 as shown for face brick would be applicable to the production of hollow tile. These tile are extensively used for the construction of interior walls and partitions and for backing up the outside walls of buildings, the hollow construction insuring against dampness coming through the wall and the surface of the tile being of such a character as to take mortar and therefore permit of plastering.

While color is not ordinarily of much importance in hollow tile, which are to be plastered, they are generally of a rather uniform red or buff color. Specifications generally require the tile to be very uniform in regard to size and they must be true in shape. Considerable criticism is made on the part of masons when hollow tile are too vitreous and can not be cut to shape when necessary. It is also desirable that the surface of the tile be not too dense, otherwise plaster will not adhere to it readily.

There were 16 plants in Pennsylvania producing hollow tile in 1928, the total production being valued at approximately $2,098,930.

Roofing Tile

The roofing tile industry in Pennsylvania is not very extensive. This is not because of a lack of suitable raw materials as there are many shales over the State, particularly the coal measure shales, which are capable of producing a good quality roofing tile. The clay roofing tile business has never assumed large proportions in the United States, although where cost of construction is not an important item no better roofing material can be found.
COMBINATION OF ENAMELED BRICK WITH SMOOTH FACE AND ROUGH TEXTURE BRICK

1. Enamed brick
2. Smooth face brick
3. Rough texture brick

STONEWARE, BRICK AND HOLLOW TILE
The requirements of a roofing tile shale are that it shall burn to a very uniform color; it must be particularly free from warping during burning and be practically impervious to water when fired. The flow sheet following shows the processes and equipment used in the production of roofing tile.

**FLOW SHEET**

**Product:**

**Roofing Tile**

**Material:**

Plastic shale or clay, mechanically strong and red burning, with reasonable and uniform shrinkage and wide gradual burning range.

**Flow Sheet:**

<table>
<thead>
<tr>
<th>Storage</th>
<th>Bin</th>
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<tbody>
<tr>
<td>Feeders</td>
<td>Feeder or Poidometer</td>
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<tr>
<td>Dry Pans</td>
<td>Pug Mill</td>
</tr>
<tr>
<td>Elevators</td>
<td>Combination Machine</td>
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<tr>
<td>Screens</td>
<td>Tile blank Cutter</td>
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<td></td>
<td>Tile blank Conveyor</td>
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<tr>
<td></td>
<td>Revolving Presses</td>
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<tr>
<td></td>
<td>Trimming and Off-bearing Belt</td>
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<tr>
<td></td>
<td>Dryer cars with pallets</td>
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<tr>
<td>Kiln</td>
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</tr>
<tr>
<td>Stock</td>
<td></td>
</tr>
</tbody>
</table>

Bin

Feeder or Poidometer

Pug Mill

Combination Machine

Tile blank Cutter

Tile blank Conveyor

Revolving Presses

Trimming and Off-bearing Belt

Dryer cars with pallets

Kiln

Stock
VITRIFIED SALT GLAZED SEWER PIPE

TILE AND TERRA COTTA PRODUCTS USED FOR INTERIOR CONSTRUCTION
There were only 2 plants listed as producing roofing tile in Pennsylvania in 1928, and one of these produced a very small quantity.

**Drain Tile:**

The drain tile industry in Pennsylvania is very small. Clays capable of producing drain tile are available in almost every section of the State and it is difficult to understand why this industry has not developed to a greater extent. Requirements of the agricultural section of Pennsylvania would seem to furnish a market for a considerable quantity of this product.

The requirements of drain tiles are that they shall be porous, sufficiently strong to admit of shipping and handling, and uniform in size. Almost any clay capable of producing common brick or face brick can be manufactured into drain tile. There was in 1928 one plant producing drain tile in Pennsylvania.

**Sewer Pipe and Wall Coping**

Shales and clays for the production of sewer pipe must possess properties similar to those used in the production of paving brick. In addition they must be capable of taking a salt glaze to produce a well glazed surface. In the production of sewer pipe, fire clays are combined with shales very commonly in order to develop in the body the requisite properties of vitrifying to a dense non-absorbent body at a relatively low temperature while at the same time possessing a high degree of plasticity and toughness and being free from the tendency to warp and buckle out of shape during drying.

A salt glaze is usually applied to sewer pipe by throwing common salt on the fire when the vitrifying process has been completed. This results in the volatilization of the salt; the vapor passing over into the kiln and coming into contact with the hot clay reacts chemically to produce a highly insoluble though alkaline glaze.

The flow sheet following indicates the type of process and equipment used in the production of sewer pipe.
**FLOW SHEET**

**PRODUCT:**
*Sewer Pipe*, Conduits

**MATERIAL:**
Shale, plastic and strong, capable of taking salt glaze

<table>
<thead>
<tr>
<th>Bin</th>
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<tbody>
<tr>
<td>Plate Feeder</td>
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<tr>
<td>Single Roll Crusher</td>
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<tr>
<td>Elevator or Conveyor</td>
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<tr>
<td>Storage Bin</td>
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<tr>
<td>Plate Feeder</td>
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<tr>
<td>Heavy Duty Dry Pan or Grinder</td>
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<tr>
<td>Elevator</td>
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<tr>
<td>Screens</td>
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Shuttle Conveyor or Stationary Conveyor or Direct

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<tr>
<th>Storage Bin</th>
<th>Storage Bin</th>
<th>Storage Bin</th>
<th>Storage Bin</th>
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</table>

Batch Boxes with car or batch car

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<tr>
<th>Wet Pan</th>
<th>Wet Pan</th>
<th>Wet Pan</th>
<th>Wet Pan</th>
</tr>
</thead>
</table>

(Conveyor)      (Conveyor)
Elevator        Elevator
Storage Belt    Storage Belt
Press Feeder    Press Feeder
2nd floor Press 3rd floor Press
Drying Floors  Drying Floors
Kilns           Kilns
The sewer pipe industry in Pennsylvania has been stimulated largely by the growth of cities which form the principal market for this product. The clay sewer pipe industry has in recent years met with considerable competition from cement pipe. Sewer pipe made from concrete are giving very satisfactory service in many places, especially when pure water is the only liquid encountered, but they are not as strong as vitrified pipe, thereby being more easily broken, and they are particularly not durable in places where the liquids which they carry are liable to contain a considerable quantity of acids. Vitrified clay sewer pipe are somewhat more expensive than concrete pipe but where there is any doubt as to the possibility of the sewer being subjected to acids it is a serious mistake to substitute the cheaper concrete pipe for the practically indestructible vitrified clay product.

There were 11 plants producing sewer pipe in Pennsylvania in 1928, the value of production being approximately $2,640,702. This figure includes the value of wall coping and flue linings, plants producing sewer pipe producing these products also.

**Electric Conduits**

The production of conduits for insulating electric cables is a development of very recent years but it seems probable that this industry will develop into large proportions in the near future. This product is required to possess practically all of the properties of electrical porcelain but the requirements are somewhat less rigid. The chief function of the conduit is to prevent water or moisture from getting to the cable. It must also be very accurate and true as to the dimension of the bore, and the inside of the opening must be free from roughness or protruding particles which will cut the cable which is drawn through it. This product is made from shales and No. 3 fire clays having characteristics similar to those used in the production of sewer pipe. The requirements of the product make it necessary that extreme care be exercised in the manufacturing process to insure the qualities listed above. The flow sheet shown for sewer pipe is applicable also to the production of conduits. Only 2 plants are thus far producing this product in Pennsylvania.

**Stoneware**

The stoneware industry has declined in Pennsylvania in recent years as in all other sections of the country, this product being replaced by more refined white ware bodies and particularly by enameled metal products and glass. Clays to be used for the production of stoneware are buff burning No. 3 fire clays. The product must be vitrified to develop high mechanical strength and a low porosity.

**Flower Pots**

Flower pots are produced from clays similar to those used in the production of drain tile except that the requirements indicate a clay of greater fineness and the manufacturing process requires a much more extensive manipulation in order to produce the finished product. Flower pots are required to be very porous in order to permit the passage of air
and water through the body. This process is essential to the life of plants to be grown in the pots. The following flow sheet shows the procedure in the production of stoneware and flower pots.

FLOW SHEET

PRODUCTS:
Pottery, Stoneware, Flower Pots

MATERIAL:
Low refractory plastic fire clays or synthetic clays

FLOW SHEET:

Bins
Feeders
Chaser Mills
Blunger
Shaking Screens with magnetic separation
Agitator
By pumps to Filter Presses
Pug Mills
Aging
To Benches
Dryer
Kiln

There were in Pennsylvania in 1928, 7 plants producing stoneware and flower pots, the total value of production being approximately $811,620.

REFRACTORIES

The refractories industry in Pennsylvania ranks fourth among the nine general divisions into which the ceramic industries have been divided for purposes of classification. Pennsylvania has ranked first among the states of the Union in the production of refractories for many years. There are several reasons why this industry assumed large proportions years ago and has continued to grow as other industries developed. First, the market for refractory products is very largely confined to the metallurgical industries and the outstanding importance of these industries in Pennsylvania has been an influential factor in promoting the growth of refractories production; second, the abundance
of first quality raw materials for the production of refractories and, third, the presence of abundant fuel in immediate proximity to the raw materials were important factors.

The refractories industry may be conveniently divided into the following products:

- Fire clay refractories
- Silica refractories
- Magnesite brick
- Chrome brick
- High temperature cements
- Abrasives and grinding wheels

**Fire Clay Refractories**

The bulk of the refractories manufactured in this State is produced from fire clays. Fire clay brick are manufactured from mixtures of three kinds of material,—plastic fire clay, flint fire clay and grog. (Some fire clays have properties intermediate between flint fire clay and plastic fire clay and are called semi-flint or semi-plastic clays.) The *grog* is made by grinding broken brick and bats or other fired refractory products. It is used in the body to serve two purposes,—first and primarily, it is added for the purpose of controlling shrinkage of the body; and, second, it serves as a source where waste materials, which are inevitably found around a fire brick plant, may be utilized. The *flint* fire clay which is the most refractory constituent of the body lends refractoriness and quality to the brick. It lacks plasticity and under normal processes can not be manufactured into brick alone. The *plastic* fire clay imparts to the body plasticity and the property of moldability when wet. It also promotes vitrification and imparts to the finished product its density and mechanical strength.

By variation of the proportions of these three ingredients and variation in methods of manufacture a great variety of products is produced, the properties of which differ widely. The refractories industry in recent years has been compelled to manufacture products which meet with specifications for a great many different purposes. Metallurgical industries have constantly raised their standard of requirements, as a result of which fire brick having properties suitable for use in one portion of a furnace are entirely unsuited for another part of the same furnace. In former years a fire brick was a fire brick, and brick from the same plant manufactured under the same conditions were required to answer for all purposes around a metallurgical plant where refractories were required. This condition no longer prevails. Specifications are rigid and the refractories manufacturer modifies his raw materials, mixtures and processes to produce a brick having the particular properties required for any given purpose.

Fire clay refractories are manufactured by soft-mud hand molding, stiff-mud repressing, dry press and casting. They are burned in a great variety of kilns, the principal of which are round and rectangular down drafts. Car tunnel kilns have been in use for several years but have not been as extensively adopted for the burning of refractories as in some
other industries. The flow sheets following show combinations of equipment used in the production of fire clay refractories.

FLOW SHEETS

1. PRODUCT:
   Fire brick

MATERIAL:
Fire clays and grog

FLOW SHEET:

<table>
<thead>
<tr>
<th>Fire Clays:</th>
<th>Grog:</th>
</tr>
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<tbody>
<tr>
<td>Bins</td>
<td>Bins</td>
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<td>Plate Feeders</td>
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<tr>
<td>Dry Pans</td>
<td>Dry Pans</td>
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<td>Elevators</td>
<td>Elevators</td>
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<td>Screens</td>
<td>Screens</td>
</tr>
<tr>
<td>Bins</td>
<td>Bins</td>
</tr>
</tbody>
</table>

Measuring cars or monorail

Wet Pans

Cars or Conveyors

Moulding tables or: Machine moulding

Partial Drying

Repressing

Repressing

Dryer

Dryer

Kiln
2. **Product:**

   **Special Refractories**, tank blocks, shapes, etc.

**Material:**

Fire clays and grog

**Flow Sheet:**

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Crusher

Elevator or Conveyor or both

Storage Bins

Feeders

Grog:

Dry Pan or Grinding Mill or both

Elevator

Screen

Equipment to avoid segregation

Bins

Clays:

Dry Pan or Pulverizer

Elevator

Screen

(Shuttle) Conveyor

Bins

Weighing equipment (monorail or trucks)

Batch Mixer

Bin (and Feeder)

(Pug Mill and) Batch Device

Wet Pan

Pug Mill

Aging

Hand Molding

Dryer

Kiln
```
The value of fire clay refractories produced in Pennsylvania has shown a healthy growth from 1900 to 1928, the value of production of 1900 being $4,500,000, 1910—$86,500,000, 1920—$22,000,000, and 1928—$31,000,000.

**Silica Brick**

Silica brick in Pennsylvania are manufactured from ganister or quartzite. The raw material used must contain approximately 97% of silica and the percentage of iron must be very low, under 2% and not sufficient to stain the product. Other materials must not be sufficient in quantity and character to materially decrease the fusion temperature of the quartzite. Silica brick are manufactured by hand molding and dry press processes. The quartzite is ground for variable lengths of time in a wet pan where it is mixed with about 2% of lime. The percentage of lime is an important factor and does not vary widely from this percentage at any time. The lime serves to bond the quartzite grains together before the brick is fired and in the firing process it reacts with the silica, assisting in production of the bond which results in a sound product. A well-fired silica brick will have a decided ring when struck with a hammer.

Silica acts differently from clay when subjected to fire in that, whereas the clay products invariably shrink and become smaller during the firing process, silica brick pass through a series of inversions which result in an expansion of the product. A silica brick leaves the kiln larger than it enters. Silica brick are fired in round and rectangular down draft kilns. The time and temperature of firing are very important factors in determining the final quality of the product. For best results silica brick should be fired at a temperature in the neighborhood of 2700° C. or above and the temperature should be held for a period of several days in order to provide time for completion of the inversion of the quartzite to cristobalite.

Silica brick are acid in character and possess the peculiar property of retaining their shape under high pressures until a temperature is reached which approximates the fusion temperature of the brick, which is in the neighborhood of 3000° F. Because of this property silica brick are used in the crowns of open-hearth furnaces and glass-tanks where enormous pressures on the refractories are inevitable and at the same time high temperatures. The most serious defect of silica brick is that they have a tendency to spall and crack when subjected to sudden changes of temperature. They are also subject to rapid deterioration when brought in contact with basic fluxing materials at high temperatures. The following flow sheet shows the procedure in the production of silica brick.
MAGNESITE BRICK

Magnesite brick are manufactured from dead-burned magnesite, a product obtained by calcining magnesium carbonate. This material has many properties similar to calcium carbonate. It differs from the latter, however, in that upon heating, two different types of product are obtained. When magnesite (magnesium carbonate) is heated at moderate temperatures, below 1000° C., a light weight magnesium oxide is obtained which is called caustic magnesia. This material has the property of combining with water resulting in the production of magnesium hydroxide, a product analogous to hydrated lime or calcium hydrate.

Upon heating magnesite to high temperatures, 1000° to 1200° C., for longer periods of time the resulting magnesium oxide loses its prop-
erty of hydration and becomes what is known as dead-burned magnesia. Calcium oxide can not be dead-burned. In other words, it makes no difference how long it is heated or how high the temperature, the ultimate oxide will, upon exposure to weather, immediately hydrate which results in expansion and for this reason calcium carbonate or limestone, which is abundant in nature and is in fact very refractory in itself, can not be used for the production of refractory products. Dead-burned magnesia being stable when exposed to weather, it may be converted to brick and will withstand reasonable weathering conditions without deterioration.

Deposits of magnesite are not widely distributed. Certain deposits occur in the western states and Canada but the most satisfactory deposits for the production of magnesite brick are found in Europe. Raw material for the production of magnesite brick may be obtained in Euboea (Greece), Styria, Hungary, Germany, the Ural Mountains of Russia, Sweden, Jugo-Slavia, South Australia, California, Washington, Canada, and Central India. The deposits which have been most extensively used in America for the production of magnesite brick are those in Styria and Hungary. These deposits contain intimately mixed with them about 7% of iron. It has been found that this percentage of iron does not seriously lower the refractoriness of the product and, on the other hand, it is a very helpful factor in promoting vitrification and hardening of the product during the burning process.

During the late War when shipments of this material could not be obtained our deposits from Washington and California were utilized for the production of magnesite brick. Experiments ultimately developed the fact that the best product was obtained when approximately 7% of iron oxide was incorporated in these American magnesites, since they are practically free from iron as found in nature. Some of the magnesite brick manufactured in the United States at the present time are made from American materials, but the bulk of them is now produced from materials which are imported.

The production of magnesite brick involves dead burning of the magnesite and subsequent grinding to at least 16 mesh size, in most cases the finest dust being removed. After grinding, the granular material is mixed with binder of some kind. A great variety of materials has been used for this purpose; some of them are caustic magnesia, clay, water glass, milk of magnesia, feldspar, silica, caustic soda, slag, magnesium chloride, Portland cement, and other materials of similar character. Better practice, however, is to use an organic binder which serves as a temporary bond during the period when the brick is unfired and must withstand handling and which burns out in the firing process leaving no mineral fluxing residue. Organic binders, such as tar, boiled linseed oil, cellulose, lye, gelatin, molasses, and dextrine have been used. The binder is mixed with the granular magnesite and water in sufficient amount to bond the product when pressed under very high pressure in steel molds. These brick have a low mechanical strength before they are fired and because of that fact can not be piled in high tiers in a kiln. They are frequently boxed in, a few bricks in a box, in a silica brick kiln and fired with the silica brick. Continuous tunnel kilns are also used for the production of magnesite brick. They are fired at various tem-
peratures, the better products reaching Cone 17 or 18, which corre-
sponds with a temperature approximating 2700° F.

Magnesite brick, while they are very refractory, are used only for
special purposes because of their cost. They are basic in character
therefore resisting the actions of basic slags for which purpose they are
most commonly used. In the construction of open-hearth furnaces in
the steel business magnesite brick find their most extensive market.

Chrome Brick

Chrome brick are manufactured from chrome ore which is a material
known as neutral chemically. The ore contains generally at least 50%
chromium oxide, other ingredients being iron, alumina, lime, magnesia,
and silica. Whereas magnesite brick are used at places where a material
resisting basic slags is required and silica brick or clay brick are used to
resist the action of acid slags, chrome brick are used at points where
either basic or acid slags may be encountered because of their neutral
character. Chrome brick are sometimes used as an intermediate layer
between the magnesite brick which form the bottom portion of the wall
of an open-hearth furnace and the silica brick forming the top portion.
In the production of chrome brick the chrome ore is ground to a coarse
powder and mixed with bonding material and enough water to make a
stiff paste. Binders used in the production of chrome brick are clay,
lime, plaster of Paris, bauxite, magnesia, tar, and potassium chromate.
The brick are manufactured by hand in iron molds and must be dried
thoroughly before burning. The firing is accomplished in any type of
kiln suitable for the burning of silica brick, and, in fact, chrome brick
are burned with silica brick very commonly. Temperatures for burning
them are the same as for silica brick and magnesite brick, the higher
the temperature the better the product.

Chrome brick are highly refractory but when a temperature approxi-
mating the fusion point of the material is reached the brick suddenly
disintegrate, decreasing in strength very materially.

High Temperature Cements

The manufacture of cementing materials to be used as mortar in
the laying of refractories in furnaces is rapidly developing into an impor-
tant industry. This development is the outgrowth of the situation
mentioned in the discussion of fire clay brick, namely, the raising of
standards of requirements on the part of consumers of refractories.
Manufacturers who use high temperatures and who require the con-
struction of furnaces in which expensive refractory materials are used
have come to realize that the cost of manufacturing their products
depends not only upon the first cost of building their furnaces and their
operation but that the up-keep of such furnaces is an important item
in their total cost of production. Not only is it expensive to buy ma-
terials and pay for the labor of rebuilding a furnace but the loss of time
and use of the furnace during the rebuilding period is in many cases a
source of considerable loss. It has become generally recognized that
structures built with fire brick break down and require rebuilding fre-
quently not because of the inferiority of the brick themselves but rather
because of the character of the mortar and workmanship used in construction of the furnace. In other words, a furnace wall is no stronger than its weakest part. It is folly to buy expensive fire brick for the construction of a furnace and then permit unskilled workmen to lay the wall in an improper manner or to use mortar for construction which will itself be an important factor in bringing about the destruction of the furnace. Consumers of refractories have learned that it pays to utilize the available knowledge of the chemical and physical reactions which take place in all parts of the structure when in operation. In recognition of the importance of the mortar used in laying refractories, consumers have forced the producers to provide a material for mortar which will enable the brick to give the maximum service of which they are capable. The production of this refractory mortar is the basis of what are known as high temperature cements. These high temperature cements are made from a variety of refractory materials; the particular type of cement purchased for any given structure depending entirely upon the type of brick to be used and the character of the chemical and physical reactions which will take place in the structure. Highly siliceous cements are made from pure ground ganister running about 97% silica. Cements of more plastic character which will develop a denser, more vitreous joint are produced from clays containing variable percentages of silica. Cement to be used in the laying of magnesite brick should be finely ground, dead-burned, or electrically fused magnesite.

Data on the production of high temperature cement is not available for past years. During 1928, however, 13 producers, the majority of whom produce fire brick or other refractories as well, reported a production of 38,335,479 pounds valued at approximately $2,885,183.

ABRASIVES AND GRINDING WHEELS

The abrasive industry is based upon the use of silicon carbide and alundum products. Justification for inclusion of the abrasive industry in the list of refractories manufactures is found in the fact that these products are highly refractory and are in fact extensively used for the production of refractory products. The production of abrasive wheels is one of the most exact and perfectly developed industries we have. A grinding wheel to be used for the grinding of steel must possess certain well defined abrasive qualities. Such a wheel would not be well adapted to the grinding of cast iron. In fact, the production of grinding wheels is controlled to such an extent that different wheels are produced for the grinding of steels of varying degrees of hardness. These varying abrasive properties of the grinding wheel are obtained by varying the fineness of the alundum or carborundum and by varying the character of the binder used. A large percentage of grinding wheels has for a binder some kind of clay. In the production of the wheel the abrasive material proper, having been carefully graded as to size, is mixed with a clay or mixture of clays which will develop in the process of burning a degree of vitrification sufficient to impart to the finished wheel mechanical strength to resist breaking under the severe punishment to which the wheel is to be subjected. It must at the same time hold the grains of abrasive together and not polish to a smooth surface during the grinding operation. The method of manufacture varies, but in all processes the
essential requirement is that the wheel when ready for burning shall have the proper dimensions and sufficient strength to withstand handling and the burning conditions in the kiln. The burning operation is carried out in kilns similar to those used in the burning of paving brick or fire brick. The wheels are carefully placed in saggers or otherwise protected from the flame of the kilns and the burning operation accurately controlled to bring about the proper vitrification in the clay bond which after all forms the body of the wheel and must be developed to its best strength.

The grinding wheel industry in Pennsylvania has an invested capital of approximately $3,000,000, 8 plants reporting producing in 1928, the value of their product being approximately $3,000,000.

WHITE WARE

The white ware industry in Pennsylvania includes the production of hotel and restaurant china, electrical porcelain, vitreous sanitary ware, floor tile, wall tile, and refractory porcelain.

HOTEL AND RESTAURANT CHINA

In the production of hotel and restaurant china the raw materials are seldom found in the immediate vicinity of the plant. The industry in the United States is localized in about half a dozen centers,—East Liverpool, Ohio; Trenton, N. J.; Zanesville, Ohio; Syracuse, N. Y.; and Beaver Falls, Pa. The particular factor in determining the location of these industries has been the labor market. The production of this type of product requires a great number of highly skilled workmen, and the work is of such character that an unusually long period of apprenticeship is necessary to acquire skill. This condition has resulted in the labor market dictating the location of this type of industry. The raw materials for the production of china are imported from foreign countries and shipped from great distances in this country. These raw materials are clays of special purity, which must burn to a white color; feldspar, which occurs in a very limited number of localities; and flint, which must be of a very high degree of purity, especially free from iron or any impurity that will upon burning impart a perceptible color to the finished product.

Practice differs widely among the plants as to the processes of preparing the bodies and glazes, but in all the requirement is that the mixing of the materials be thoroughly done and the body, when ready for shaping the article, be in a very fine state of subdivision. The materials are ground in water and mixed in blungers. The excess water is generally removed by pumping the slip through a filter press in which the water is filtered through canvas cloth, leaving the body in the press in a soft mud consistency. If the body is to be shaped by jiggering, which is the process most extensively used, this soft mud from the filter press is remixed in a pug mill, and then frequently subjected to a period of aging which results in a further development of plasticity and strength. The plastic body is delivered to the molder who shapes the desired article by any appropriate process. Bodies to be used for the production of dry-pressed articles are prepared with the same thorough-
ness and after taking from the filter press arc dried sometimes down to a point where they retain only 8% or 10% moisture and then pulverized leaving a powder in proper shape for the dry pressing machine. In other cases the filter cake is thoroughly dried and 3% to 10% water added to produce the desired dry press consistency. Throughout all processes in grinding and preparing the body meticulous care is exercised to prevent contamination and especially to prevent iron from any source becoming mixed with the body. A further precaution is taken to insure freedom from black specks by passing the slip over magnetic separators which remove any magnetic iron that may have accidentally gotten into the body.

In drying the product humidity dryers are extensively used, by virtue of which the warping and cracking, which were formerly a serious source of loss in the manufacturing process, have been reduced to a negligible factor.

Nearly all hotel china is fired at least twice, most of it being fired several times. The first firing is done in what are known as "biscuit" kilns. The ware is carefully stacked in saggars, which are boxes made from fire clay, these being stacked one upon the other in the kiln. The object of the sagger is not only to serve as a container for the product during the firing process but also to protect the ware from contact with flame or products of combustion from the burning fuels. The biscuit ware is simply the body without glaze or decoration, fired to such a temperature as to develop the necessary strength in the product. American practice is to fire the biscuit ware to a sufficiently high temperature to develop the ultimate strength of the body. The glaze firing which follows is carried out in what are known as glost kilns at lower temperatures. The temperature here is sufficient to mature the glaze which has been applied to the biscuit ware. This glaze is a glassy coating produced by mixing suitable materials together and grinding in water, the materials being in such proportion that they will fuse to a glass of the desired character at the temperature to be used in the glost kiln. The decoration in what is known as overglaze decorated ware is applied over the surface of this glaze. Many firings may be necessary in the decorating process in order to mature different colored decorative mixtures. The temperature of the decorating kiln is still lower than that of the glost kiln.

Underglaze decoration is obtained by applying a suitable design in the desired color immediately on the biscuit body. Over this is applied the glaze which, being transparent, permits the color under it to show through. Underglazed decorated ware is decidedly more durable in so far as the decoration is concerned than overglazed decorated ware.

Developments in the types of kiln used in the firing of hotel china have been radical in the past decade: Competition has forced the industry to adopt the most economical methods available. This has dictated adoption of the tunnel kiln whereas previously the up draft-bottle kiln was almost universally used for the burning of this type of ware.
FAMILIAR GLASS PRODUCTS

THE MOST COMMON USE OF CHINA
FLOW SHEET

PRODUCT:
Hotel China

MATERIAL:
Feldspar, china clay, ball clay, flint

FLOW SHEET:

Measurement of Batch
   Ball Mill
      Blunger
         Lawn
            Magnetic Separator
               (Casting Proc.) Filter Press

Water and Deflocculant—Blunger
   Lawn
      Aging Cellar
         Pug Mill

Magnetic Separator
   Molds
      Dryer

Glaze:
   Proportioning Frit
      Frit Furnace
         Weighing Batch

   Biscuit Fire
      Grinding Water
         Lawn
            Decoration
               Magnetic Separator

Hardening Oven
   Glazing
      Dryer
         Glost Kiln
            Inspection
               Storage Room
Electrical Porcelain

The production of electrical porcelain in Pennsylvania is limited to one manufacturing establishment. Their production, however, is large, being a very substantial percentage of the total production in the United States.

The raw materials used in the production of electrical porcelain are substantially the same in character as those used in the production of hotel china. The proportions in which these materials are mixed differ radically from the proportions used in the production of china but the methods of preparing the body are essentially the same. The essential requirements of electrical porcelain are that it must have a high dielectric strength, that is, a high resistance to breakage under the influence of electric current, that it have a high resistance to the passing of electric current through it and a very high mechanical strength. Porcelain insulators are manufactured by four principal processes,—dry-press, plastic pressing, turning on a lathe, and solid casting. Articles of small size are almost invariably dry pressed with the exception of spark plugs. Electrical porcelain differs from the hotel china in that it is generally fired only once; the glaze and body being fired at the same time must mature together.

Electrical insulators of great size and complex shape, such as those used on high tension lines, are among the most difficult articles manufactured in the white ware industry. In their production, the raw materials having been properly mixed in the plastic condition, a blank of sufficient size to give the desired insulator is formed and permitted to dry until it has assumed what is known as a leather hard consistency. In this state the product is tough and will withstand turning on a lathe. It is clamped in position and as it rotates a steel tool or carborundum wheel grinds off the excess material leaving the insulator of the desired shape. It is now dried, the glaze spread over it and burned. During the burning process great care must be exercised to insure against warpage of the product. In order to develop in these bodies the maximum dielectric and mechanical strength, the firing process must invariably be carried to a point where the body is substantially a fused liquid. When it is realized that this heavy article with overhanging aprons must support its own weight and at the same time must not warp and still be heated to a point where it is practically a viscous liquid, the difficulty of this process is understood. The production of these articles requires use of the most refined equipment and accurate control of all of the conditions through the manufacturing process; even then the losses are high.

The burning of electrical porcelain is carried out in round down draft kilns, up draft bottle-kilns, and ear tunnel kilns. The last have been adopted extensively in recent years and are proving satisfactory not only from the standpoint of the product obtained but from the standpoint of labor and fuel requirements in the burning operation.
FLOW SHEET

**Product:**

**Electrical Porcelain**

**Material:**

Feldspar, china clay, ball clay, flint

**Flow Sheet:**

```
Flint and Feldspar ----> Clay

Water                 Ball Mill

Blunger               Screen

(Casting)

Blunger - Deflocculant Aging (Dry Pressing)

Molds

Pugging

Dryer (Jiggering) (Wet Pressing) (Turning) Disintegrator

Jigger                 Press Auger Mach. Moisture Room

Dryer                  Dryer Dryer Pressing

Glass Tubs             Sprayers

Dryer

Finishing

Burning

Testing

Storage Room
```

**Vitreous Sanitary Ware**

The manufacture of sanitary products from mixtures of clays and fluxes is carried out on a large scale. The raw materials used are similar to those used in the electrical porcelain industry. The requirements of the products are that they shall be perfectly shaped, that the glaze be hard and resist scratching, and that the color be uniform and pleasing.
In former years sanitary ware was all white. The age of color which has come upon us in recent years has introduced serious problems for the manufacturer of sanitary ware. He had plenty of difficulties in manufacturing pure white products of great size and complex shape but in recent years he has been required to match the pink color of the tile on the wall with his sanitary ware glaze. The variety of colors and shapes demanded by the trade has compelled him to develop glazes of these colors which would have all of the mechanical excellence of his white glaze and which, when fired in standard kilns, would be uniform throughout.

In the manufacture of vitreous sanitary ware solid casting is the principal process of shaping used in Pennsylvania practice. The body is carefully mixed and ground by the same processes as previously described. Suitable deflocculating agents are added so as to give a slip that will flow into all corners of the mold which is of plaster of Paris. The body contains the minimum possible content of water thereby insuring a low shrinkage in the mold as the article dries. The molds are removed from the article as soon as sufficient drying has occurred to enable the body to stand and carry its own weight, after which the article is trimmed and dried, frequently in an open room, care being taken to prevent too rapid drying of any part which would result in warping or cracking of the piece. The common practice is to fire sanitary ware twice, this practice being the same as in hotel china. The reason for two firings is that the body must have maximum strength and,
FINISHING VITREOUS SANITARY WARE

VITREOUS SANITARY WARE ON MONO-RAIL CONVEYOR READY FOR THE KILN
VITREOUS SANITARY WARE ON CAR ENTERING TUNNEL KILN

HOTEL CHINA IN SAGGERS ON CAR READY FOR TUNNEL KILN
more particularly, the glaze must be entirely free from pinholes or blemishes of any kind. Efforts have been made from time to time to manufacture sanitary ware by firing body and glaze together but the loss, when this process is used, due to defective glaze is high. There are, however, at the present time some of these products being produced by this process and the manufacturers are gradually developing information so that they confidently expect to be able to abandon the process of firing the body twice. Obviously the firing of these articles twice introduces a substantial item of cost which it is desirable to eliminate if possible. Car tunnel kilns are extensively used in firing this product.

**Floor Tile**

Floor tile, which are properly classified with white ware bodies, are made from mixtures of white burning clays (kaolins and ball clays), feldspar and flint. The proportion of these materials is regulated so as to give a body having proper characteristics to admit of dust pressing and to produce when fired a very dense tough body. The principal requirements of a floor tile are that it be impervious to moisture and subsequent staining, and that it be resistant to the severe abrasion to which a floor material is always subjected.

When such tile are desired in colors other than white, the same general mixture of raw materials is used and there is added a silicate stain or metallic oxide which will combine upon burning with the other ingredients of the body to produce the desired color.

In manufacturing these tile the body is prepared in the usual way and the tile pressed in steel molds under relatively high pressure after which they are carefully set in saggers, several hundred being placed in a single sagger, and burned without glazing in any of the types of kilns used for the burning of white ware products.

These floor tile, which are square, hexagonal, or any other desired shape, being small in size, would be tedious to lay in a floor, if each tile were laid individually. For that reason the tile are placed on a mat in such a way as to enable the contractor with one movement to place a square foot or more of tile on the bed previously arranged. This placing also facilitates obtaining an even surface which would be practically impossible when placing individual tile.

**Wall Tile**

Mosaic wall tile are produced from the usual raw materials of the white ware industry, the most common process being dust pressing. In the case of wall tile the excellence of the glaze is paramount. For this reason these tile are generally fired twice. The wall tile body as distinguished from the floor tile body is not required to possess toughness and strength nor be particularly free from water absorption. The typical wall tile body is generally quite porous. The tile are burned in the biscuit kiln and after burning are carefully graded as to color, size and perfection of edges and corners. The glaze is applied to the biscuit tile and the color of the finished product is generally obtained by imparting the desired color to the glaze rather than the body. The second firing, known as the glost fire, must be carried out with great precision
in order to obtain the desired finish on the glaze. The tile must be set in the saggers for this firing with extreme care in order to prevent blemishes resulting from one tile touching another or foreign material coming in contact with the glaze.

Wall tile makes up a very large proportion of the white ware industry of Pennsylvania.

REFRACTORY PORCELAIN

Thermocouples used for high temperature measurements are made by welding two fine wires, one composed of pure platinum and the other of an alloy of 90% platinum and 10% rhodium or iridium. These metals are very expensive and the wires thus used are very delicate. They are not only subject to breakage but, still worse, they have the property of crystallizing and changing in structure when exposed to furnace gases at high temperatures. The junction of the two wires must be at the point where one desires to measure temperature, thus necessitating these wires extending into the furnace proper. It is therefore necessary that means be provided to protect these wires from the furnace gases while at high temperatures. Protecting tubes for this purpose are made from special white ware bodies, commonly termed refractory porcelain. These tubes are made by the casting process, their great length and small diameter introducing serious difficulties in the shaping process. The fact that these tubes must withstand sudden heating and cooling and be resistant to the maximum temperatures at which platinum couples are used dictates the use of very refractory materials for their production. In order to produce a condition of imperviousness these refractory materials must be fired at high temperatures. For that reason refractory porcelains are fired at higher temperatures than practically any other ceramic product, temperatures of 3000° F. being commonly used.

The furnaces in which these products are burned are of very small capacity, this being necessary because an ordinary kiln can not be fired at such temperatures with any degree of uniformity, and if it were possible to obtain uniform temperatures the cost of the repairs to such a kiln would be prohibitive. For that reason small kilns or furnaces which can be rapidly fired and in which very uniform temperatures can be obtained are used in the firing of these products.

TERRA COTTA

Terra cotta is the term used in referring to the ornamental relief work of various designs and sizes on large buildings. Strictly speaking, architectural terra cotta is the only product specifically designated as such but because of similarity in raw materials used, process of production and general utility certain other products are frequently classified with terra cotta, such as art tile, floor tile of larger sizes, and garden pottery. Enameded brick also would properly fall under the same classification, being produced from the same type of materials under identical processes and used for similar purposes.

Terra cotta products are generally made from buff burning, low grade fire clays mixed with about 50% of grog. They are molded by hand in
plaster molds and frequently require skillful cutting and modeling to obtain the desired effects. These articles are frequently of great size and intricate design. The body is required to possess great strength and resistance to weather while at the same time it must harmonize with all other parts of the structure in accordance with the design of the architect. In order to realize all of these conditions the manufacturer resorts to the use of clays which give the body the desired properties of strength, density, and permanence against the weather, applying over it a superficial coating of *slip* or *engobe*.

This slip is compounded from the same type of materials as those used in the production of porcelain bodies. The proportion of fluxes and clay is regulated so that the slip will adhere firmly to the clay base and at the same time will mature upon firing to a dense, impervious body under the same heat conditions as are required to impart to the clay base its maximum of strength and density. The slip may be colored in the same manner as described for mosaic floor tile, thereby producing an unlimited variety of colors and textures. A glaze is sometimes applied over the slip in case it is necessary to obtain a surface not obtainable from the slip itself. The difficulty of the terra cotta manufacturer's problem is at once realized when it is known that these massive articles of such intricate design are required to possess all of the structural properties of building materials and at the same time the architectural features specified by the architect to give the artistic finish to the building.

The architectural terra cotta industry of Pennsylvania is localized largely near the industrial centers and especially in the vicinity of Philadelphia. The industry in this State is represented by 4 manufacturers with a capital investment of $668,000; production in 1928 was valued at $772,000.

**Art Tile**

Art tile are produced by hand molding plastic clays and covering them with a glaze or not, whichever may be necessary to give the desired finish. The colors of the clays employed, variation of burning conditions, and application of principles of design enable producers of art tile to obtain effects by building up large units from individual tile made for the purpose. An illustration that may be cited is the Bok Tower in Florida. Much of the ornamental tile work in that structure was produced in the plant of the Enfield Pottery and Tile Works, Enfield, Pa. Art tile as referred to here differ from mosaic tile, discussed in previous paragraphs, in that the clays are generally low-grade, burning to buff or red colors, and the articles are almost invariably hand molded from plastic clay.

**Floor Tile**

Floor tile of large sizes are made from red burning or buff burning clays by molding the plastic clay in presses or extruding them through a die, cutting the tile to the desired size, and finishing by hand or repressing. Tile of this character are used in factory or office buildings and hallways and are distinguished from mosaic floor tile in that they are of sufficient size to enable them to be laid individually. Frequently a wide
mortar joint assists in imparting artistic quality to a floor laid from such tile.

Floor tile properly made make the most durable floor obtainable in so far as its wearing properties are concerned; such floors being produced from a vitreous impervious product are not subject to stain, can be readily flooded, and cleaned, and retain their original qualities practically during the entire life of the floor.

GARDEN POTTERY

A special type of terra cotta product is represented by bird baths, large vases, statues and other ornamental products molded from plastic clays, generally by hand, and decorated by laying on the surface colored stains, glazed, etc. These articles are well vitrified in the burning process and are practically indestructible in so far as resistance to weather is concerned. They are used as ornaments on lawns, in gardens and similar places.

CEMENT

Under the heading of cement there are generally included Portland, natural and oxychloride cement, plaster of Paris, gypsum and lime products. For the purpose of this discussion the cement has been subdivided into Portland and oxychloride cement.

PORTLAND CEMENT

Portland cement is an artificial chemical product of fairly definite composition containing primarily 60% to 65% lime, 20% to 25% silica, and 5% to 12% iron oxide and alumina. Each of the four constituents named may vary within certain limits but the variation in composition requires a corresponding variation in heat treatment, and in manufacture in order that the resulting product may have the definite qualities required of a Portland cement.

The Portland cement industry was the logical outgrowth of the natural cement industry which preceded it by many years. It also followed that the manufacturer producing Portland cement should utilize equipment, labor and raw materials which had formerly been used for the production of natural cement. This combination of circumstances led to the industry being localized in its early history in the eastern section of Pennsylvania where the cement rock and limestone were known to possess the chemical compositions favorable to the production of Portland cement and also where labor which had formerly been employed in the production of natural cement was available. This localizing of the Portland cement industry in that section of the State introduced some rather serious difficulties in recent years owing to radical increase in the cost of fuel which must be transported for long distances. It is also true that the market for Portland cement has spread and the capacity of plants in the region where the industry had its start is in excess of any market within cheap transportation reach. This situation resulted in cement plants being erected in various parts of the country where fuel and market as well as raw materials were available for the production of the cement.
Historical

Portland cement was invented by Joseph Aspdin, of Leeds, England, and was thus named from its fancied resemblance, when set, to the well-known oolitic limestone of Jurassic age quarried for building purposes on Portland Isle, Dorsetshire, England.

"The Portland-cement industry of the United States dates back to around 1875, when the first attempts at American manufacture of that commodity took place. For twenty years the growth of the industry was at a rapid though not surprising rate. The adoption of the rotary kiln with powdered coal as fuel led, however, to a very remarkable rate of growth during the decade 1895 to 1905, as is shown by the percentages of increase calculated for the table below.

"After its recovery from the financial crisis of 1907-8 the Portland cement industry recommenced its growth, but this time at rates corresponding quite closely to those of other great American industries. Hereafter it may be expected to keep in close touch with general industrial and business conditions; to advance when these are sound, to fall off temporarily when a financial crisis is on hand; but not to grow independently as it did during its period of youthful boom in 1895-1906.

"The facts as to growth of the American industry during its whole history are shown most clearly when the rates of growth, by periods, are calculated and tabulated as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Output, Barrels</th>
<th>Period Covered</th>
<th>Rate of Growth during Five-year Period, Per Cent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1880</td>
<td>42,000</td>
<td>1880-1885</td>
<td>257</td>
</tr>
<tr>
<td>1885</td>
<td>150,000</td>
<td>1885-1890</td>
<td>124</td>
</tr>
<tr>
<td>1890</td>
<td>335,500</td>
<td>1890-1895</td>
<td>195</td>
</tr>
<tr>
<td>1895</td>
<td>990,324</td>
<td>1895-1900</td>
<td>757</td>
</tr>
<tr>
<td>1900</td>
<td>8,482,020</td>
<td>1900-1905</td>
<td>316</td>
</tr>
<tr>
<td>1905</td>
<td>35,248,812</td>
<td>1905-1910</td>
<td>117</td>
</tr>
<tr>
<td>1910</td>
<td>76,549,951</td>
<td>1910-1915</td>
<td>12</td>
</tr>
<tr>
<td>1915</td>
<td>85,914,907</td>
<td>1915-1920</td>
<td>17</td>
</tr>
<tr>
<td>1920</td>
<td>100,302,000</td>
<td>1920-1925</td>
<td>61</td>
</tr>
<tr>
<td>1925</td>
<td>161,658,901</td>
<td>1925-1928</td>
<td>8</td>
</tr>
</tbody>
</table>

"The raw materials used in the manufacture of Portland cement may be grouped as (1) cement materials proper, including limestone, marl, shells, cement rock, clay, shale which are combined to form the actual cement mixture; (2) fuels, including the coal, oil, or gas used to burn the cement, as well as the fuel required to furnish power for the plant; (3) fluxes and retarders, including gypsum, lime, chloride, alkalies, fluorite, and the like, which may be added to the cement or the cement mixture at different stages to accomplish certain purposes."

Eckel, "Cements, Limes and Plasters."
FLOW SHEETS

1. **Product:**

   **Portland Cement**

**Material:**

   Fairly hard limestone, with shale

**Flow Sheet:**

   Limestone  
   1 Gates crusher, coarse rock sold; screenings used in cement plant  
   2 Bonnot rotary dryers  
   3 Kominuters to 20-mesh  
   4 Tube mills to 92\% through 100-mesh  
   8 Kilns  

   Shale  
   1 Disintegrator  
   2 Bonnot rotary dryers

2. **Product:**

   **Portland Cement**

**Material:**

   Limestone and cement rock

**Flow Sheet:**

   Limestone  
   2 Crushers  
   2 Rotary dryers  
   6 Ball mills  
   6 Tube mills  
   10 Kilns  

   Cement Rock
3. **Product:**

**Portland Cement**

**Material:**

Limestone and slag

**Flow Sheet:**

Limestone

3 Gates gyratory crushers

4 Rotary dryers

Rotary dryers

8 Gates ball mills

3 Gates ball mills

12 Tube mills

12 Kilns, 120-foot

These flow sheets were taken from Eckel, "Cements, Limes and Plasters."

In the manufacture of Portland cement we have a radical departure from that employed in the production of any of the ceramic products previously discussed. We have heretofore been discussing articles which were shaped from a suitable mixture of raw materials, with their properties of permanence and utility derived from application of heat to this previously formed article. In the production of Portland cement the final product in order to possess its required qualities must be reduced to a very fine powder. The point of greatest importance in the manufacturing process is that the chemical reaction between the raw materials be carried to the exact point where the finished product has the chemical structure necessary. Technically, the constituents in Portland cement which impart to it its property of setting and becoming hard with age are tricalcic silicate ($3\text{CaO} \cdot \text{SiO}_2$) and tricalcic aluminate ($3\text{CaO} \cdot \text{Al}_2\text{O}_3$). The raw materials must not only be present in proper proportion to produce these compounds but they must be ground so intimately as to bring these materials into contact so that the reaction can take place, it being remembered that this product is never reduced to a liquid during the manufacturing process, the reaction taking place between solids or at best very viscous liquids. This is the condition which necessitates fine grinding of the raw materials in order to assure each particle of silica having intimate contact with its quota of lime to result in the finished tricalcic silicate. The raw material being thus present in proper proportion, a further requirement is that the heat treatment be exactly sufficient to bring about this combination and assure all of the lime being in combination with silica rather than a portion left uncombined. This material is manufactured by passing raw materials through the necessary series of grinding and pulverizing machinery after which the well mixed pulverized material is fed into the upper end of the rotary kiln inclined at a slight angle. The heat of the kiln begins to produce reactions in the raw materials as soon as they have passed down along the kiln to a point where a temperature of say...
550° C. is reached. At this temperature clays begin to lose their chemical water which results in a change in the structure of the clay particles bringing them into a state of high chemical activity. Between 800° C. and 900° C. the limestone loses its carbon dioxide leaving caustic lime (CaO), which is also a very active chemical material. Soon after these decompositions, reactions begin to take place between the lime and clay products and as the material proceeds to the hotter portion of the kiln more and more lime reacts with the alumina and silica of the clay. There is always an excess of free lime until the latter stages of the burning period and if the temperature does not reach the desired point this free lime will result in a weak, unsound product. On the other hand, it is very necessary that the temperatures be not too high, for an excessive temperature will fuse the clinker to a liquid resulting in balling up the kiln and overburning, giving products which are undesirable and of poor quality.

The clinker leaves the lower end of the kiln in nodules varying from the size of a pea to that of a walnut and is a very hard tough product. This clinker as such has no value as a cementing material. If mixed with water it is inert and will not set. However, upon grinding to a fine powder its chemical activity is released and it becomes the Portland cement we know. This clinker when ground alone sets so rapidly in water that it can not be used commercially. It will not admit of proper working into form and because of this fact retarding agents such as plaster of Paris or gypsum, which regulate the rate at which the Portland cement will set when mixed with water, are added during the grinding process. This is the Portland cement of commerce.

Portland cements are of two general kinds, gray and white. Gray Portland cement is produced from raw materials carrying variable percentages of iron but always sufficient to impart to the cement its gray color. White Portland cement is manufactured by the same processes and from the same type of raw materials except that it is free from iron, relatively speaking, and the resulting product, which is essentially the same as the gray product except for color, is a white or a very light gray color.

The Portland cement industry is one of the largest ceramic industries in the State, ranking second in value of production in 1928. There are 19 producing plants having a capital investment of $147,000,000, their production for 1928 being approximately $64,500,000. They employed 9,044 people during the year. These plants are located for the most part in the extreme eastern section of the State. There are, however, three plants in the extreme western section.

**Oxychloride Cement**

Oxychloride cement is extensively used for stucco and for flooring purposes. It is frequently laid over old wood floors and is extensively used for the flooring in railway cars, street cars, and so forth. This material is produced from magnesium carbonate and magnesium chloride. The magnesium carbonate is heated at a low temperature, below 1000° C., so as to produce what is known as caustic magnesia referred to in discussion of dead-burned magnesite. This caustic magnesia (MgO) when mixed with a solution of magnesium chloride of proper strength (around
26° Baumé) has the property of hardening or setting giving a cement of extremely high strength and hardness. It also has the peculiar property of resilience when mixed as a flooring material with cork or sawdust and this resiliency, which makes the floor easy to stand and work upon similar to cork carpet, combined with the facility with which it can be flooded and washed and the possibility of obtaining pleasing colors, makes this material desirable for the production of floors in many places. It has been extensively used in office buildings and banks and has found considerable market for repairing old worn-out wooden floors. A half inch thickness of this material properly laid on wood floors reinforced with wire netting gives a new surface capable of years of service.

The raw materials for the production of oxychloride cements are obtained from Washington or California in America, or from Greece. The product can be made from dolomite when processes are carefully controlled. Such production, however, has never been carried on to any large extent, since it is practically as cheap to ship the magnesite from distant points and employ cheaper fillers for the finished product. This is especially true when the material is to be used for stucco which is perhaps the largest market for oxychloride cement.

**Plaster**

There being no available gypsum deposits in Pennsylvania, the production of wall plaster, plaster of Paris, and similar products is carried out by importing the gypsum, which is the basis of all these products, from other states. New York State and some of the western states have large deposits of this material and the plaster industry there is naturally of more importance than in Pennsylvania. However, there are some producing plants in the State, production in 1928 having a value of approximately $209,890.

**Lime**

The principal products of lime may be classified as agricultural lime, chemical lime, building lime, both hydrated and quick lime, pulverized limestone and dolomite. The production of lime products is largely a quarrying and lime burning problem and in principle is similar to the Portland cement industry. Here, again, the finished product is in the form of lime or powdered material and no shaping prior to heat treatment is necessary.

**Agricultural Lime**

Agricultural lime is perhaps the crudest of the products and is made from limestone of variable degrees of purity, generally quite impure. The process consists in simply heating the stone to a sufficiently high temperature to liberate the carbon dioxide, leaving the active calcium oxide or quick lime.

In former years the production of agricultural lime was somewhat similar to the common brick industry. The farmer who wished to obtain some lime for fertilizer or for structural purposes gathered limestone from his farm or quarryed it, mixed wood with it and built up what was called a lime kiln. The walls were carefully sealed up with clay, the fire
started and permitted to burn until all of the fuel had been consumed. The resultant pile of material was a kiln of burned lime, generally very imperfectly burned but nevertheless it answered the purpose. This condition has changed owing to the same circumstances which dictated the changes in the common brick industry. Fuel is not available on every farm in large quantities. Good transportation facilities such as railroads and highways enable the farmer to haul his lime for great distances more cheaply than he can produce it on his own farm, especially since large scale production at suitable centers enables lime manufacturers to burn agricultural lime more cheaply than it could possibly be done in smaller unrelated units. Agricultural lime therefore is now produced in large quantities in factories where other kinds of lime are also manufactured.

**Chemical Lime**

Chemical lime is the other extreme of the lime industry. As the term implies, lime which is to be used for chemical manufacturing purposes and for the manufacture of reagents for chemical analyses must be itself chemically pure. Very few deposits of limestone possess the degree of chemical purity necessary to produce chemical lime. One of the most extensive operations where this product is manufactured is located at Bellefonte, Pa. At this point limestone not only for chemical lime but for other purposes is mined, this being one of the few instances in the State where mining operations are employed as distinguished from the quarrying process in the winning of limestone. Lime for chemical purposes must be burned by processes which do not result in the depositing of impurities in the product. Hence rotary kilns similar to Portland cement kilns are employed, and gas is used as fuel.

**Building Lime**

Building lime is manufactured from limestone of varying degrees of purity, generally more pure than that used for agricultural lime but, on the other hand, not necessarily of such high degree of purity as chemical lime. Hydrated lime is largely displacing quick lime for structural purposes because of the greater facility with which it can be stored and handled. Quick lime, which is pure CaO, possesses the property of absorbing moisture from the atmosphere very rapidly. This hydration results in a large expansion in volume. This has been noted by everyone when a barrel or bag of quick lime is allowed to stand for a few days in the weather; the bag bursts and the barrel staves and hoops are broken and the lime comes oozing out through the cracks between the staves. This is simply the result of the expansion of the lime which inevitably occurs when it hydrates. This property makes it very expensive to store quick lime. Furthermore, the hydrated lime when used as mortar or for plaster has exactly the same properties as does the quick lime. It has therefore been found desirable to hydrate the lime in the factory, thus producing an article of commerce which can be stored in any reasonably dry place without loss. It also can be handled with less irritation and annoyance to workmen than the quick lime.
PULVERIZED LIMESTONE

Pulverized limestone is extensively used as a raw material in the production of glass. It is also used as one of the constituents in glazes and white ware bodies. Limestone for this purpose must be very pure, and especially free from iron in order that it may not impart to a glass body the undesirable green color of iron bearing impurities.

GLASS

HISTORICAL

The information following relative to the history of the glass industry in Pennsylvania has been obtained almost entirely from the report of Jos. D. Weeks, Special Agent for the United States Department of the Interior, Bureau of Census, published in 1884; and E. Ward Tillotson, Assistant Director, Mellon Institute of Industrial Research, Pittsburgh.

The report of Mr. Weeks is a very complete survey of the glass industry of the United States from the beginning up to 1884. The historical data is very full, particularly with reference to Pennsylvania. It is abstracted here at some length.

DISCOVERY OF GLASS

Theorizing as to the original discovery of glass, Weeks gives no credence to the story by Pliny which states that glass was accidently discovered by some storm-driven Phoenician mariners while cooking their food on the banks of the river Belus.

He gives as a more probable theory the statement that glass was probably discovered in connection with the older art of metallurgy. He says:

"Many metallurgical operations produce in their vitreous slag a coarse colored glass that may have led to the manufacture of glass as a direct product. All of the oldest specimens of glass are colored, and so far as these have been analyzed, the coloring matter is metallic. The extreme variability in the composition of this antique colored glass led Klaproth to the conclusion that many of the specimens are merely metallurgical slags remelted. It is also true that much of the ancient glass is 'cast.' These facts certainly indicate, if its discovery was not due to this old art, that metallurgy had an important influence on early glass-making.

"The earliest evidences of the existence of the art of glass-making are found in Egypt. It is impossible, however, to surmise even at what time it began to be made in that country, aside from the certainty that the art antedates by many centuries the time of its earliest inscriptions and specimens. Egyptian chronology is so uncertain, that the same events are assigned by different Egyptologists to periods thousands of years apart. Inscriptions, paintings, and the glass itself, however, indicate its manufacture at least from 4,000 to 6,000 years ago."
Glass-Making in the United States

"One of the first attempts at manufacturing within the limits of the thirteen original colonies was the production of glass. . . .

"Stith states that the glass house in which the glass was manufactured, and which was probably the first manufactory erected in the English colonies in America, being erected late in 1608 or early in 1609, stood in the woods about a mile from Jamestown. This enterprise was one of some daring. Glass-making at this time was by no means well established in Europe. Flint-glass was not yet invented, and plate was not cast, while the art of blowing window-glass and bottles and making glassware was imperfectly practiced in England. Wood, however, was becoming scarce, and the alkalies needed for the manufacture of glass high priced, and those of a good quality were brought from a distance. All of these materials were not only abundant in the new colony, but the wood was a burden and potash could be made readily from the wood-ashes. The great bulk of glass bottles made their importation expensive, and it is possible that the first glass house in Virginia made bottles only. What window-glass was used was imported."

Glass-Making in Pennsylvania

"The first mention of a glass works in Pennsylvania is found in a letter written in August, 1683, by Penn to the Free Society of Traders. In this letter he alludes to their tannery, saw-mill, and glass-house, 'the last two conveniently posted for water carriage.' Where this glass was located, or for what kind of glass it was intended, is not known; indeed, it is doubtful whether the works were ever used for the purpose for which they were erected. If they were, they proved unsuccessful, as did most of the early glass works in the colonies, and were soon abandoned. . . .

"From this time until just before the Revolution the record of glass-making in Pennsylvania is a blank. Governor John Penn, in a letter to the Lords of Trade and Plantations, dated Philadelphia, January 21, 1767, wrote:

The other is a glass manufactory, which was erected about four years ago in Lancaster county, seventy miles from this city, by a private person. It is still carried on, tho' to a very inconsiderable extent, there being no other vent for their ware, which is of a very ordinary quality, but to supply the small demands of the villages and farmers in the adjacent inland country.

"This was probably Baron Steigl's establishment, referred to below, who established himself at Manheim in 1762; but however this may have been, there is evidence that Steigl soon after this built a glass house. In June of the same year that Penn's letter was written (1767) Townsend's scheme for raising revenue from the colonies passed the British parliament and was met in this country by a storm of denunciation and agreements of non-importation. At public meetings it was determined to stimulate by all prudent ways and means the manufactures of the colonies, and glass and paper were particularly mentioned as articles deserving of domestic encouragement. Townsend's revenue act was repealed in 1776. At that time a flint-glass manufactory on a much larger scale than any before attempted in the country had been
built at the village of Manheim, near Lancaster, by a German baron, Henry William Steigel, and Mr. David Rittenhouse, in a letter to Mr. Barton, dated the 4th of February, 1770, speaks of his intention when he next visited Lancaster to have some pulse-glasses, then just introduced by Dr. Franklin from Germany, and other things he wanted, made there.

"About the time that Steigel built his factory at Lancaster the first glass works in Philadelphia of which we have any details was established at Kensington. The repeal of Townsend's act did not remove the determination of the people of the colonies to establish domestic manufactures in their limits, and though workmen skilled in the manufacture of glass were by no means common, some gentlemen engaged in trades quite foreign to glass-making were found who were willing to risk their capital in this undertaking. In October, 1771, Robert Towsar, skinner or leather-dresser, and Joseph Leacock, watchmaker, purchased a piece of land on the east side of Bank Street (now Richmond street) and built upon it a glass house, furnace, and other improvements.

"Though the records are very meager, there are evidences that several other glass works were built in eastern Pennsylvania between the breaking out of the revolutionary war and the close of the century, and no doubt the scarcity of glass during the war led to the erection of works in this and other states. That there were glass works of some importance in Pennsylvania at its close appears from Lord Sheffield's letter, written shortly after peace was declared. In November, 1787, the Society for the Encouragement of Manufactures offered a gold medal for the best specimen of flint glassware and bottles. It is hardly to be supposed that a $20 gold medal was offered as an inducement to parties to undertake the manufacture of flint-glass, but rather as a premium to works already in existence for the best samples of their products, and the fact that window-glass is not mentioned would indicate either that window-glass was not made, or that its manufacture was so well established as not to need encouragement. Some time between 1780 and 1786 Robert Morris and John Nicholson erected works at the falls of the Schuylkill for the manufacture of some kind of glass, probably window-glass. The glass house was about opposite the dwelling of Governor Mifflin, and a row of stone houses a little lower down the river was built to accommodate the hands working in this establishment. John Thoburn, about 1808, altered the glass house for the purpose of a calico-printing establishment, and the building was still standing in 1856. Mr. Eichbaum, who had charge of the erection of the Craig & O'Hara window-glass works at Pittsburgh in 1797, was 'superintendent of glass works at Falls of Schuylkill, near Philadelphia.'"

In 1810, the date of the first census of manufactures of the United States, "we find reported in Pennsylvania, outside of Allegheny county, five glass houses—one in Philadelphia city, two in Philadelphia county, and one each in Lycoming and Wayne counties. The value of the product of the Wayne county works is given at $86,000, while that of the three Philadelphia works was only $26,000. The Lycoming county works, which was probably at Williamsport, had a product of $20,000. This would indicate that glass-making in Philadelphia was not a prosperous business. At the census of 1820 but one works is reported in Phila-
delphia county, 'a flint-glass works, that had been out of operation for some years', while in Wayne county a window-glass works, with one furnace and six pots, is reported, which had been in operation for five years with good success'. Jarves also states that in 1820 a number of workmen left the New England Glass Company at East Cambridge, Massachusetts, and established a co-operative flint-glass works at Kensington under the title of the Union Flint Glass Company; but after a few years this works passed into other hands, and the first recorded attempt at co-operative glass-making in this country failed."

"In 1831, . . . . the Dyottville works were the most extensive in the county. There was also in Philadelphia a flint-glass works with six pots. No mention is made of the Wayne county works at this time, though it appears at the census of 1840. There were, however, two works in Lycoming county, at Williamsport, one for the manufacture of window-glass and the other for hollow ware (green glass, etc.). In 1840, according to the census, there were but two glass works in the eastern district of Pennsylvania: one in Philadelphia and one in Wayne county. But it is not necessary to follow the history of glass in this section further. Where there has been glass made in increasing quantities in eastern Pennsylvania since 1840, the industry has not attained the importance it has reached west of the mountains. It may be interesting to state, however, that though window-glass was at one time made in Philadelphia, none has been made in that city for seven years.

"Of early glass-making in western Pennsylvania quite full accounts remain, and at least four of those connected with the earliest works, Albert Gallatin, Colonel James O'Hara, Major Isaac Craig, and Major Ebenezer Denny, were prominent in the affairs of the nation. Their journals and papers have been saved from the destruction or oblivion that usually overtakes such documents, and from these very satisfactory statements of these early undertakings can be obtained.

"The generally received opinion for some years has been that the first glass works west of the Allegheny mountains was built by Albert Gallatin at his settlement of New Geneva, on the Monongahela river, some 90 miles south of Pittsburgh. Here Mr. Gallatin established a number of industries, and among them that of glass-making. Various dates have been assigned to his glass works, the most common one being 1787; but the evidence is quite conclusive that this is an error, and that the works was not started until 1797.

"The Gallatin works was used for the manufacture of window-glass. The furnace was a small one, with eight pots, using wood as a fuel and 'ashes for alkali'. The glass house was 40 by 40 feet, three sides frame and one side stone. The most creditable story regarding its erection is that a number of glass-workers, mostly Germans, left Amelung's factory at Fredericktown, Maryland, and crossed the mountains for the purpose of building a glass works at the point that is now Louisville, Kentucky. Gallatin accidently met them at Wheeling and persuaded them to turn back to New Geneva and establish the works there, Mr. Gallatin agreeing to furnish capital and they to do the blowing. The title of the firm at first was Gallatin & Co., but it was afterward changed to the New Geneva glass works."
In 1810 the manufactures of the United States began to attract considerable attention, and for the first time the census returns include a statement of manufactured articles. In this year Mr. Albert Gallatin, then Secretary of the Treasury, made a report to the House of Representatives on our industries, in the course of which he mentioned that 'two works, employing together six glass-blowers, had lately been erected at Pittsburgh, and made decanters, tumblers, and every other description of flint-glass of a superior quality'.

The Pittsburgh window-glass works is also mentioned, and it is stated that all of this kind of works in the country, with the exception of 'that of Pittsburgh', used wood as fuel, the latter using coal. According to the census returns for 1810, there were three glass works in Pittsburgh that year which produced $62,000 in value. If Gallatin's statement is correct, two of these were flint works, and one manufactured window-glass and green bottles.

Concerning the condition of glass-making in Pittsburgh in 1813 and 1814 Cramer's Navigator states:

The manufacture of glass has succeeded as well as the most sanguine had expected. The situation of this place is particularly favorable, notwithstanding some disadvantages in procuring some of the materials. The first was established by Colonel O'Hara about the year 1798. There were two glass works on the opposite sides of the Monongahela, erected by Trevor & Ensell, and one in the new town of Birmingham, under the firm of Beltzhoover, Wendt & Co. These, with the three before erected, to wit, O'Hara's, Robinson's, and Bakewell's, will be able to manufacture to the amount of $160,000 annually. Both flint and green glass are now made here to great perfection. Messrs. Bakewell, Page & Bakewell have lately built another flint-glass works in addition to their former one. There are now in the town and opposite two white and three green glass houses. Glass cutting is likewise executed in this place not inferior to the best cut-glass in Europe. The furniture of the apothecaries' shops is altogether of home manufacture.

This extract would indicate that some of the flint houses had gone out of existence and capital invested in glass-making was wisely turned to the branches that promised profit.

The number of glass houses after this increased so rapidly that it is impossible to enter into the details of the history of each. In 1819, according to the memorial adopted at a town meeting and sent to Congress, the manufacture of glass in Pittsburgh had rapidly declined since 1815. At the latter date 169 workmen were employed, producing $235,000 in value of glass annually, while in 1819 the number had fallen to 40, producing but $35,000, and the statement is made that in flint-glass alone the reduction was $75,000. In 1820 the census reports the product of 'glassware and colored flint' as $20,000, and of 'glass, window and hollow', as $24,000. In Fayette county, at the same time, there were three establishments making window-glass and hollow ware. In 1826 there were eight window-glass works in western Pennsylvania, producing 27,000 boxes (100 feet) of glass per annum, valued at $35,000, and, in addition, $30,000 worth of flint ware was made. In 1831 there
were four flint houses, with thirty-two pots, and four window-glass houses at Pittsburgh, four or five at Brownsville, one each at New Geneva, Bridgeport, New Albany, Perrysburg, and Williamsport, making window-glass, and one at the latter place making hollow ware. Mr. Bakewell at this time estimated that the value of glass produced in western Pennsylvania was more than $500,000 annually. In 1837 there were thirteen factories in Pittsburgh and its immediate vicinity, six flint and the balance window-glass or green hollow ware, making about $700,000 worth. Among these were the Sligo works of William McCully, established in 1828, and continued at the present day by W. McCully & Co.; the flint-glass works of Curling & Price, known as the Fort Pitt glass works, established in 1830, now carried on by their successors, E. D. Dithridge & Co.; and the window-glass factory of F. Lorenz, now continued by Thomas Wightman & Co. Twenty years afterward, in 1857, there were thirty-three factories at Pittsburgh, of which nine produced flint-glass and twenty-four window, green, and black glass to the value of $2,631,990, employing 1,982 hands, whose wages were $910,116, consuming material to the amount of $2,078,734.40. In 1865 there were fifteen bottle and vial factories, fifteen window-glass factories, and fifteen flint-glass works in Pittsburgh, being forty-five glass houses in all; an increase of 36 per cent. in eight years. These fifteen window-glass works, located immediately at Pittsburgh, had a capacity to make 520,000 boxes of glass in a year, but their average yield was about 490,000 boxes, whose entire value at that time was $2,600,000. The fifteen green or vial works produced annually about 420,000 gross of vials and bottles, worth, at the then rate, $2,100,000. The pressure upon these works at that time is best shown by the fact that, although only customary to run them for ten months in the year, yet many of them had run twenty-one months without stopping. The fifteen flint-glass works then in operation at Pittsburgh produced about 4,200 tons of glassware, worth then, in round numbers, $2,000,000. Their capacity was, however, double the amount produced, or about 8,000 tons."

The history of glass manufacture in Pennsylvania from the date of this publication in 1884 by Weeks up to the present time has paralleled many of our other industries in that small plants have combined to form larger units which operate with greater efficiency. The glass industry received a marked stimulus upon the discovery of natural gas in western Pennsylvania. While plate glass is not mentioned in Weeks’ history this product has developed until at the present time its value practically equals that of any other type of glass manufactured. Statistics of the industry show that in 1899 plate and window glass to the value of $9,000,000 was produced as compared with bottles and tableware valued at $12,000,000. In 1909 plate and window glass was valued at $15,000,-000 as compared with $17,000,000 for bottles and tableware. In 1920 plate glass was approximately $34,000,000, window glass $28,000,000, bottles and tableware $28,000,000 and in 1928 a total of 59 glass manufacturing plants in the State produced approximately $80,000,000 worth of glass, of which $24,000,000 was plate glass, $8,500,000 window glass, $35,500,000 bottles and tableware, and $11,000,000 miscellaneous.
GLASS MANUFACTURE

The glass industry is the largest of the ceramic industries of Pennsylvania when measured in value of annual production. The manufacture of glass is concentrated largely in those sections of the State where natural gas fuel is available. The history of the industry shows that the present manufacturing processes are the result of an evolution in the character of fuels used for production, the very earliest production depending upon wood and rosin for fuel. At that time of course wood fuel was abundant everywhere. The development of the country, however, led later to the necessity for resorting to coal fuel. It happens that the coal fuel of this State is located in the same region as the gas fuel so that the use of natural gas, which was a later discovery, did not necessitate moving the industry to an entirely new section of the State.

It is true, of course, that some glass plants are located at points far removed from the source of fuel, this being possible especially when a satisfactory market for the product is available. In such cases artificial gas is the fuel used.

In the production of glass the chemical reactions between the raw materials are brought to completion. In this regard the glass industry differs from nearly every other ceramic industry. Even in the production of Portland cement the reacting particles are never brought to such state of fluidity as to cause them to flow and hence the reactions are at best incomplete. In the case of production of glass, however, the final product must be a perfectly homogeneous liquid and, even when cold, glass is recognized not as a solid but as a congealed liquid.

While the raw materials used in the production of glass vary widely depending upon the type of glass to be made, in general all industrial glass has as its basis silica. To this is added basic fluxes in the form of alkalies, lime, lead, and similar basic compounds which react with the silica to produce a fusible mixture.

Many different methods are employed in making glass products. In most cases the shape and size of the article to be manufactured dictate the process to be used in shaping. In some cases special chemical and physical properties required of the product make it necessary to employ special shaping processes. In the production of optical glass, for instance, the metal, which is the term used in referring to the liquid glass, is subjected to a series of manipulations not employed in making any other glass product. These are necessary in order to insure a finished product which is absolutely homogeneous, uniform throughout, and which will have no strains, which if present make the glass useless for optical purposes.

The kind of raw materials used in any case depends largely upon the purpose for which the glass is to be used. In the production of cut glass, large amounts of lead compounds are used, because lead imparts brilliance and luster to the glass. Lead glass is also soft and easily cut and polished. Chemical glass ware and glass for household purposes require the use of large percentages of silica and special materials such as boric acid which impart to the glass the ability to resist sudden heating and also make it insoluble in acids and other strong solvents.

Representative batches illustrating the raw materials and compositions of a few different kinds of glass are given in the following table.
Representative Batches of Raw Materials and Analysis of Three Cooking Glasses

<table>
<thead>
<tr>
<th></th>
<th>Bottle Glass</th>
<th>Crystal Glass</th>
<th>Electric Light Bulbs</th>
<th>Opal Glass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>Soda Ash</td>
<td>372</td>
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<td>330</td>
<td>200</td>
</tr>
<tr>
<td>Limestone</td>
<td>175</td>
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<td></td>
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<td>Potash Trioxide</td>
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<td></td>
</tr>
<tr>
<td>Red Lead</td>
<td>660</td>
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</tr>
<tr>
<td>Potassium Nitrate</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Borax</td>
<td>30</td>
<td></td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Arsenious Oxide</td>
<td>2.5</td>
<td></td>
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<td>10</td>
</tr>
<tr>
<td>Manganese Dioxide</td>
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<td></td>
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<td></td>
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<tr>
<td>Feldspar</td>
<td></td>
<td></td>
<td>70</td>
<td>190</td>
</tr>
<tr>
<td>Sodium Nitrate</td>
<td></td>
<td></td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Fluorspar</td>
<td></td>
<td></td>
<td></td>
<td>220</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Jena</th>
<th>Austrian</th>
<th>Pyrex</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiO₂</td>
<td>73.88</td>
<td>76.78</td>
<td>80.5</td>
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<tr>
<td>Al₂O₃</td>
<td>2.24</td>
<td>2.72</td>
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<tr>
<td>CaO</td>
<td>Trace</td>
<td>6.52</td>
<td>0.3</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>Trace</td>
<td>Trace</td>
<td>0.3</td>
</tr>
<tr>
<td>Na₂O</td>
<td>6.87</td>
<td>11.14</td>
<td>4.4</td>
</tr>
<tr>
<td>K₂O</td>
<td>Trace</td>
<td>4.74</td>
<td>0.2</td>
</tr>
<tr>
<td>B₂O₃</td>
<td>16.48</td>
<td></td>
<td>11.8</td>
</tr>
<tr>
<td>MgO</td>
<td>Trace</td>
<td>0.24</td>
<td>0.1</td>
</tr>
<tr>
<td>As₂O₃</td>
<td>0.73</td>
<td></td>
<td>0.6</td>
</tr>
</tbody>
</table>

Melting the Glass

The fundamental principles are the same in the production of all kinds of glass articles. The first requirement is that the raw materials, after thorough mixing, must be melted to a homogenous liquid, free from gas bubbles and solid particles.

Glass melting is done in two general types of furnaces,—pot furnaces and tank furnaces. A pot furnace is a round or rectangular chamber, built of fire brick of such size that the required number of glass pots can be set around its outer edge. The pots are made of fire clay and of a size to hold 1000 pounds of glass more or less. In the production of plate glass the pots are open at the top and have a rugged shoulder built on them so that the pot, with its charge of melted glass, can be removed bodily by means of a huge crane.

When pots are used for melting other kinds of glass, they remain in the furnace and the glass is removed through a small opening in the wall of the furnace. Melting of lead glass requires that the top of the pot be covered, thus preventing the flame of the furnace from coming in contact with the glass. This is necessary because the carbon in the flame would reduce the lead compounds to metallic lead which would settle to the bottom and be lost to the glass. These pots are called covered pots. In melting optical glass for the production of large lenses,
the pot with its charge of melted glass is sometimes removed from the furnace and the glass and pot allowed to cool slowly together. When cool the pot is broken away from the glass, giving large individual pieces of clear glass.

In the production of optical glass, the raw materials are not only required to be of special purity but during the melting operation the batch is thoroughly stirred to insure perfect uniformity in all parts of the pot. The stirring rod must be made of material which will not contaminate the glass and the stirring must be done when the glass is of exactly the right consistency.

The period during which the glass batch is melting and combining chemically is called the "melting period." During this period much gas is given off by the raw materials and this gas becomes entrapped in the viscous glass. The molten liquid must be raised to a very high temperature to make it thin enough so that these gas bubbles can rise to the top and get out. This second period, during which the melted liquid is being freed from gas bubbles, is called the "fining period." If this is not thoroughly done, glass articles made from the metal will have gas bubbles entrapped in them. These gas bubbles are called seeds. They are often seen in window glass, fruit jars and cheap bottles. If the melting is not well done some of the solids may not be melted and the resulting glass articles will have solid particles entrapped. These solid particles in a piece of glass are called stones. They are even more injurious to the glass than seeds.

Metal which has been thoroughly melted and freed from gas bubbles is said to be fine and ready for shaping into the desired article.
"Tank" furnaces differ from pot furnaces in that the furnace itself is the container for the glass. Tanks are large rectangular boxes, 2½ to 4 feet deep, 10 to 20 feet wide, and 16 to 40 feet long. They are built of fire clay refractories, usually having silica brick in the crown. The raw batch is fed in at one end and the finished glass is worked out at the other. The furnace itself is divided into two or three compartments, the larger being the melting chamber, the others the refining and working chambers.

The glass batch passes through the same series of conditions in the tank furnace as in the pot.

**Shaping Glass Products**

Methods used in making glass articles are too numerous to describe here. Hand blowing is a process familiar to most people. The glass bottle machine has displaced hand blowing for all kinds of bottles, jars, etc., except very large sizes and special products. These bottle machines work automatically. They gather the melted glass from the furnace, blow the bottle and deliver it on a belt ready to be cooled in the lehr. They are among the most complicated mechanical devices ever built, and in operation almost human. No more fascinating sight can be found anywhere than to watch one of these machines at work. Production of 70 bottles per minute is common and it is recorded that a single machine produced over an eight hour period 10,000 one-fourth ounce bottles per hour.

Illuminating glass, cooking utensils and similar thick walled articles made from special glass compositions are shaped by pressing. Window glass was formerly blown in cylinders which were split and reheated sufficiently to flatten out again. This product is now being made by drawing in a continuous stream from the furnace. Production of plate glass by the same process has been done and this method is likely to replace the more costly method of melting the glass in pots, pouring on a table and rolling to the desired thickness.

Plate glass after shaping is subjected to grinding and polishing. The plates, which have rough and irregular surfaces when they come from the lehr, are cemented to revolving tables and subjected to "grinding." Sand and water rubbed over the surface of the plate by mechanically operated steel or cast iron discs result in grinding the glass to a smooth surface; following this is a similar operation in which the surface is polished, "rouge" held in contact with the glass by felt pads being the polishing medium.

**The Lehr**

Proper annealing is as essential to the production of good glass as melting. All glass articles, immediately after molding, contain what are known as strains. These can not be seen with the naked eye but if such glass is rapidly cooled it will be brittle and break easily. A slight scratch may cause it to shatter into thousands of pieces. These strains are removed by slow cooling and sometimes holding the article at just the right temperature for a considerable period of time. When
properly annealed the glass is tough and strong. In the manufacture of heavy lenses it is sometimes very difficult to remove all strains. A lens made by the United States Government about a year ago required six months for cooling; during this time it was necessary to accurately control the temperature of all parts of the lens.

**FLOW SHEET**

**PRODUCT:**
- Plate Glass

**MATERIAL:**
- Sand, limestone, soda ash, etc.

**FLOW SHEET:**
- Weighing of Glass Batch
- Charging the Furnace
- Melting the Glass
- Casting Table
  | Bichrom Process | Continuous |
  | Lehr            |            |
  | Cutting         |            |
  | Grinding        |            |
  | Polishing       |            |
  | Washing         |            |
  | Cutting         |            |
  | Storage Room    |            |

**ENAMELS**

The enameling of metals represents one of the ceramic industries of more recent development but one which is rapidly developing into a very large business. Enamed metals may be divided into three classes; enamed cast iron, enamed steel, and the enamed Noble metals, the last class being limited in quantity but quite important. Examples of this type are the enamels on watch dials, jewelry, and so forth.

Articles made from enamed cast iron and steel have the properties of great strength and durability, imparted to them by the melter, and of easy cleaning, resistance to corrosion and artistic beauty imparted to them by the enamel. The enameling industry is essentially a combination of metallurgy and ceramics. The production of the metal of proper composition and shape is essentially a metallurgical operation. The finishing of the product by covering the metal with a satisfactory coating of enamel is a ceramic operation. There is a great difference in the processes and in the composition of enamels used in enameling cast iron and steel.

**HISTORICAL**

J. W. Russell, president and general manager of The Marietta Hollow-Ware and Enameling Company, Marietta, Pennsylvania, states:

"Prior to 1860 the enamel industry was started in Philadelphia and Pittsburgh; as far as we know, in Philadelphia by the Stuart-Peterson Company and Barrows-Davy Company, and in Pittsburgh by the Standard Manufacturing Company. In the year 1869 arrangements were made to establish an enameling plant in this town (Marietta). The labor was brought here from England and the start was made in the beginning of 1870 by this plant which has been running ever since on cooking utensils. The incentive for starting the manufacture of enameled cooking utensils was furnished when a tariff was placed on these articles."

The following account of the early history of the enameling industry in Pennsylvania was obtained from E. L. Dawes, vice-president of the Standard Sanitary Manufacturing Company, Pittsburgh, Pennsylvania. It was attached to a letter addressed to the writer, dated April 18, 1930.

"So far as the early history of the enameling industry is concerned, I know but little outside of the sanitary line. . . . My knowledge began just forty-four years ago this month. At that time the J. L. Mott Iron Works were the only people in this country who made a pretense of making enameled sanitary ware, and I do not know if they had aspired to a bath tub as early as that; but in 1879 the Standard Mfg. Co., in whose employ I was, first as bookkeeper, and after as manager, made one or two cast iron tubs per day. We had but one style which was known then as the 'Prison' tub. They were too cold for comfort, etc. Of the two tubs per day, there were but few enameled, the greater part of the production being painted and galvanized."

"The old River Avenue property in Allegheny (now Pittsburgh) was built in 1870 by Ahlborn, Hartje, Wiley & Co., who made enameled stove (cast iron) hollow-ware. They failed in the panic of 1873 and in 1875 the property was bought at sheriff's sale by the late James W. Arrott and Francis Torrance and operated as the Standard Manufacturing Company. Mr. Arrott was father of the Arrocks who own and run the U.S. Sanitary Mfg. Co., and Mr. Torrance was father of the late Francis J. Torrance."

"The Standard's business was about 95% enameled stove hollow-ware, the other 5% consisted in 3% miscellaneous castings, and about 2% in the plumbing industry mostly in a couple of patterns of water closet hoppers and washstands for factory use. But few of these were enameled, the majority being painted."

"Up until this time there was but little known as to the making of enamel outside of a very soft leadless enamel for cooking utensils. But about 1879 the wood pump industry took on a boom, and created a
large demand for enameled iron cylinders. This business was divided practically between a small enameled concern, a split from Alhorn, Hartje, Wiley & Co., at the time of their failure, and the 'Standard' and it was soon learned that in the soft glass used in the hollow-ware industry, the soluble constituents in the enamel or glass dissolved and the enamels became so rough that it would wear out the leather suckers. This was about the first time there was a necessity to put some thought into the why's and wherefore's of the ingredients to make a non-soluble mixture and it was the first effort on our part to eliminate the soluble fluxes and incorporate insoluble ones.

"This pump cylinder business flourished for several years, until drawn brass tubing took the place of the enameled cylinders. Now, with the loss of this business, it was necessary to find something to take its place, and this was the time and opportunity to embark in the manufacture of enameled plumbing goods. About 1883 or 1884, the Standard added to their line several styles of lavatories, water closets, hoppers and one pattern of bath tub. This was made in what was then known as the French pattern, and the design followed closely the pattern or design of the old copper tub. It was made with a hard-wood rim fastened on with wood screws and the molder who could make such a tub was considered very skillful. We (the Standard) started an aggressive campaign to make a business out of the plumbing industry. To encourage the jobbing trade, we guaranteed stock in warehouses against defects, damage, price, etc.

"In embarking in the manufacture of tubs and other plumber's ware, it was necessary to discontinue the use of the hollow-ware enamel and to make enamel that was white and flexible enough. The cylinder and hollow-ware enamels were blended. Up to this time, what were made by the Mott Iron Works was first coated with a very soft and porous coat, known as bone coat; it was so porous it took on rust, which showed through the enamel as a discoloration, similar to lime spots. The manner of applying the enamel was by mixing it with alcohol, which would evaporate quickly, and floating it on the ware. This proved a very unsatisfactory process, but as long as the business was limited there was no object in trying out other ways.

"It was about 1882 or 1883 that August Haarlander, who was the enameling foreman, and the writer commenced experimenting to make an enamel that we could dredge on the article, as is now done. With improvements and modifications this is the method followed today. Even at that time there was but little thought of the ultimate future of the industry. At the time I severed my connections with the Standard Company we had not made more than 10 or 15 tubs per day, and the lavatories in proportion.

"In 1887 the writer, in company with the late W. A. Myler, who was the accountant of the Standard Mfg. Co., from 1881 until 1887, built the plant at New Brighton, Pa., known as the Dawes & Myler Works. Even at this time the growth in the business had been so slow that we started to make enameled stove hollow-ware, and it was not until about 1890 that we put in patterns to make bath tubs. From that date the business grew rapidly, so rapidly that when in 1893 the New Brighton Factory was burned, in rebuilding the plant was constructed to make enameled sanitary goods exclusively. The demand for enameled baths, lavatories and other sanitary goods having increased to such an extent, it was necessary to find means to increase production and at the same time reduce costs so that the modern appliances would be in reach of the masses.

"The output of the enameled plants of the country prior to 1900 was very small compared to present day production. There were fewer plants and the capacity of each was small. The production of bath tub by the Standard Mfg. Co., which was the largest producer in the world, was 45 tubs per day in 1893 and about 150 per day in 1900. This appears small compared to the present capacity of 2000 tubs per day of the Standard Sanitary Manufacturing Company.

"Shortly prior to 1900, John C. Reed, who was then manager of the Standard Mfg. Co.'s plant in old Allegheny, now North Side, Pittsburgh, Pa., conceived the idea of making tubs by what is commonly known as the match plate system. The process was new and original and was patented by him. About the same time, James W. Arrott, Jr., patented an automatically actuated dredger. By these two inventions the output was largely increased. Prior to that time a moulder would make two bath tubs per day. By the Reed process four men produced some 36 tubs per day of 8 hours. The automatic dredge added largely to the speed of the output which up to that time was a bath tub per hour or 24 tubs per furnace per day of 24 hours. With this, other improvements were injected into the shop; a mechanically operated table on which the red tubs were enameled, with other improvements from time to time, have cut the working force on a furnace one-half. Then the furnaces that could heat only one tub an hour were improved from time to time until at present 3 or 4 tubes per hour are obtained. While these improvements in the way of manufacturing were going on, the management was making improvements in designs. At first the tubs were made with wood rims. From wood the enameled roll rim was evolved—from the tub on feet, the one-piece tub, enameled inside and out, changing the bath room from a room for bathing purposes only into the pride of the house owner. The lavatory with the slab and bowl cast in two pieces and butted together, making an unsanitary and unsightly job, has grown into the beautiful one-piece lavatory of the present day.

"While a number of the men who laid the foundation for the large industry of the present day have passed away, the real life of the business is so recent that those who were instrumental in its growth, are still actively engaged in the business. As a finality, what I have passed over is the organization of the Standard Sanitary Manufacturing Company, in 1900. At that time the largest producers of enameled sanitary ware in the country were the Standard Mfg. Co., of Pittsburgh, Pa., and the Ahrens & Ott Mfg. Co., of Louisville, Ky., and Dawes and Myler of New Brighton, Pa. At the time of combining to form the Standard Sanitary Mfg. Co., they bought up several other concerns, consolidating such equipment as could be used in the three plants. The plants thus bought were scrapped and sold. From the time of its formation this company has maintained its position as the largest producers of enameled iron sanitary ware in the world."
CAST IRON ENAMELING

The enameling of cast iron is usually less difficult than the enameling of steel. This difference is primarily due to the fact that the casting presents a rough, granular surface to enamels enabling them to get a grip on the metal and to adhere firmly to it. Much of the difficulty in enameling steel is due to the smoothness of the surface which prevents the enamel from getting this firm grip on it. A further difference is in the flexibility of the steel as distinguished from the perfect rigidity of the cast iron. Cast iron enamels are of two general types—Dry Process Enamels, sometimes referred to as Sanitary Enamels, and Wet Process Enamels, sometimes called Store Enamels. The composition of the cast iron to be used is determined more largely by the metallurgical phase of the problem than by the ceramic phase, that is, the cast iron must be of such a composition as to enable the foundry to deliver the casting of the proper shape and size to make the desired article. While the metallurgist has a considerable field within which he can vary his iron, his problems are simplified by maintaining it within certain definite ranges of composition. However, almost any piece of cast iron can be successfully enameled.

Enamels to be used in the dry process method of application are generally rather complex in their composition and are so compounded as to make very fusible glasses. It is common practice to use large amounts of lead compounds in these cast iron enamels, these lead compounds being capable of producing great fusibility in enamels and also of producing enamels with high luster and great mechanical strength. The enameler is compelled to produce a glass having the desired color and strength and at the same time have a coefficient of expansion differing not too widely from that of the metal on which the enamel is to be applied. Enamels which do not "fit" the metal will either craze, that is, crack in fine lines, or they jump off the metal in more or less large patches. The problem of the enameler is greatly simplified if his castings are all of uniform thickness, free from sharp corners and edges, and have a uniform surface free from blemishes or bright spots.

Cast iron is usually cleaned preparatory to enameling by the sandblasting process. Fairly coarse sharp sand, 8 to 16 mesh, is desirable. Sometimes steel shot are substituted for the sand. The shot are said to give less dust but are at the same time less effective. The casting is sand blasted until the surface is bright and free from all oxide and foreign material. After cleaning, it is enameled as soon as convenient to prevent oxidation of the surface. It may, however, be allowed to stand for a considerable period of time if kept in a dry atmosphere free from dust.

In the preparation of enamels the process is very similar to the melting of glass. The raw materials are thoroughly mixed and put into a furnace known as a smelter. In this furnace the materials are melted to a homogeneous glass, the chemical reactions between the raw materials being brought to a practical state of completion, and the resulting material flows like water from the furnace. This melted product called "frit" is run out of the furnace into a tank of water which results in shattering the glass and producing a brittle and easily ground product. In the production of enamels to be applied to cast iron by the dry process,
the frit is ground in dry form and no raw materials are added. In the production of enamels to be applied by wet methods, the frit is placed in a mill with suitable raw materials to give a "slip" which can be applied in an even coating on the metal. The materials are ground to variable degrees of fineness depending upon the character of the enamel and the experience of the operator. This slip consists of the glass frit, water, clay and, when white enamels are desired, tin oxide, an antimony compound or other opacifying agent. The clay is added for the purpose of holding the frit in suspension in the water, preventing it from settling out immediately as it would do if it were not for the colloidal content of the clay.

Representative enamels used in dry process enameling are as follows:

<table>
<thead>
<tr>
<th>Ground Coat</th>
<th>SANITARY ENAMELS</th>
</tr>
</thead>
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<tr>
<td></td>
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<tr>
<td>FRIT:</td>
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<tr>
<td>Water 50 &quot;</td>
<td></td>
</tr>
<tr>
<td>Grind through 60 mesh.</td>
<td></td>
</tr>
</tbody>
</table>

**Cover Enamels**

<table>
<thead>
<tr>
<th></th>
<th>Leukomin Opax</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feldspar</td>
<td>120 120</td>
</tr>
<tr>
<td>Borax</td>
<td>125 125</td>
</tr>
<tr>
<td>Soda Ash</td>
<td>16 16</td>
</tr>
<tr>
<td>Nitrate</td>
<td>10 10</td>
</tr>
<tr>
<td>Fluorspar</td>
<td>40 40</td>
</tr>
<tr>
<td>Red Lead</td>
<td>80 30</td>
</tr>
<tr>
<td>Zinc Oxide</td>
<td>30 30</td>
</tr>
<tr>
<td>Tin Oxide</td>
<td>50 0</td>
</tr>
<tr>
<td>Leukomin</td>
<td>50 0</td>
</tr>
<tr>
<td>Barium Carbonate</td>
<td>0 0</td>
</tr>
<tr>
<td>Opax</td>
<td>0 50</td>
</tr>
</tbody>
</table>

The ground coat enamel is applied by spraying the wet slip over the surface of the casting. After drying, the casting is placed in a muffle or semi-muffle furnace heated ordinarily to a temperature somewhat below 1000° C. As soon as the casting has come up to the temperature of the furnace it is withdrawn and the white enamel, which has been converted to a glass and subsequently ground to a powder, is dusted over the surface of the hot casting. This dusting process requires great skill and is a very hot and difficult operation. The powder must be dusted uniformly over the surface, and a sufficient quantity must be applied to give the proper thickness of coating but not so much as to produce an excessive thickness at any point. The enamel fuses as it strikes the hot casting and adheres. During the time, however, necessary to cover the surface of the article the casting cools to a point below a red heat at which temperature the enamel no longer fuses. It is necessary therefore
that this operation be carried out with speed. As soon as the casting is properly covered with enamel it is placed in the muffle again and the enamel permitted to fuse to a glass. The operator watches the product during this fusion process and removes it from the muffle for a second "dredging," which is the term applied to covering the casting with this white enamel, done in the same manner as the first dredging. Ordinarily two dredgings are sufficient but, if necessary, the operator will apply a greater number of coats to produce the finished article desired.

This dry process enameling is the method used in the production of sanitary ware which is the largest of the cast iron enameling industries. Other articles made of heavy castings for special purposes are enameled in the same way.

Wet process enamels, or the so-called stove enamels, for cast iron are even more fusible than the enamels used in the dry process. These enamels are applied to castings of smaller size and frequently thinner cross-section, such that they do not lend themselves readily to the processes used in application of dry powdered enamels. They are also required to withstand more severe destructive agencies than the general run of sanitary ware. For this reason they are generally applied in a very thin coat. The composition of enamels used in this process is represented in the following formulas:

**WET PROCESS**

<table>
<thead>
<tr>
<th>Ground Coat</th>
<th>STOVE ENAMELS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FRIT:</strong></td>
<td></td>
</tr>
<tr>
<td>Feldspar</td>
<td>84</td>
</tr>
<tr>
<td>Flint</td>
<td>6</td>
</tr>
<tr>
<td>Borax</td>
<td>76</td>
</tr>
<tr>
<td>Fluorspar</td>
<td>0</td>
</tr>
<tr>
<td>Soda Ash</td>
<td>3</td>
</tr>
<tr>
<td>Cryolite</td>
<td>3</td>
</tr>
<tr>
<td>Nitre</td>
<td>3</td>
</tr>
<tr>
<td>PbO</td>
<td>91</td>
</tr>
<tr>
<td>CaCO₃</td>
<td>10</td>
</tr>
<tr>
<td><strong>Mill:</strong></td>
<td></td>
</tr>
<tr>
<td>Frit 100 lbs.</td>
<td></td>
</tr>
<tr>
<td>Clay 8 &quot;</td>
<td></td>
</tr>
<tr>
<td>MgSO₄ 2.5 &quot;</td>
<td></td>
</tr>
<tr>
<td>Water 50 &quot;</td>
<td></td>
</tr>
</tbody>
</table>

**Cover Coat**

| FRIT:       |               |
| Felspar     | 55            |
| Flint       | 40            |
| Borax       | 75            |
| Fluorspar   | 10            |
| Cryolite    | 10            |
| Nitre       | 2             |
| Red Lead    | 155           |
| Tin Oxide   | 90            |
| **Mill:**   |               |
| Frit 100 lbs.|               |
| Clay 3 "    |               |
| MgSO₄ 2.5 " |               |
| Water 50 "  |               |

This gives good white enamel with 10% tin oxide in mill when applied over ground coat. 2% to 6% coloring oxide added in the mill will produce colored enamels with one or two coats.

**CERAMIC INDUSTRIES OF PENNSYLVANIA**

These enamels can be made harder and stand more fire by increase of clay in the mill. If they craze, there is too much enamel on the ware.

A few technical suggestions relative to these enamels are given as follows:

These are the softest, lowest temperature enamels used on iron. They are produced and applied to the iron in the same manner as sheet steel enamels.

These enamels must be kept thin. If applied too heavy they can not be burned smooth, and they will not be serviceable even though they pass inspection. To produce a white enamel it is better to apply a ground coat and two thin coats of white enamel over it.

Colored enamels are produced with one or two coats of the desired color without ground coat.

It is important that as little raw material as possible be added to the frit. Unfitted coloring oxides detract from the gloss but are necessary if desired colors are to be obtained.

Never use more than 3% raw clay in the mill to cover enamels. Compare this with 8% to 12% clay used in sheet steel enamels. Ground coat to be used under white enamel can carry 8% raw clay.

It is sometimes possible to spray twice before burning and produce good results.

Burn these wet process enamels at dull red heat—600° to 700° C.

The most important application of these wet process cast iron enamels is in the stove industry. Within recent five years stove manufacturers have turned to beautifying heating and cooking ranges in order to make them harmonize with other furniture and to make them easily cleaned. This type of enamel is also finding very wide application in the refrigerator industry. The enameling of iron by this process is the most recent development in the enameling industry. Work of this character was not done to any considerable extent ten years ago but at the present time it occupies an important place in the ceramic industries of the country.

**SHEET STEEL ENAMELING**

The character of enamels to be used on steel differs from those used on cast iron in that they seldom contain lead compounds. The enameling of steel was in the early history of this industry confined almost entirely to the production of cooking utensils. The fact that lead compounds are poisonous, producing what is known as lead poisoning, introduced a prejudice against the use of any lead bearing materials in enamels for the production of articles which would be used in the preparation of food. On the other hand, it was common practice in the early days to use such compounds as arsenic and antimony as opacifying agents in white enamels, and tin oxide and antimony compounds are the principal materials now used in developing opacity in enamels which are used on steel. It is highly improbable that any case of poisoning ever developed as a result of solubility of any of the compounds used in the enamels on cooking utensils but it is true that enamels containing large percentages of lead are more soluble than leadless enamels and even though such
solubility would not likely result in lead poisoning these enamels would be less durable where subjected to the solvent action of cooking fluids than the leadless enamels.

The steel used in the enameling industry varies widely in its composition and, while certain special kinds of steel are extensively advertised as having qualities giving superior products, it is true in steel, as was stated above in cast iron, that any piece of steel can be successfully enameled if proper precaution is taken throughout the enameling process. Benefits to be derived from the use of special steels are those resulting in lower loss in the manufacturing process rather than in the production of superior products.

In the manufacturing process the steel articles properly shaped are cleaned by some process which removes grease and organic materials either burning them off or removing them by chemical agents. This is followed by a pickling process using generally hydrochloric or sulphuric acid which removes all oxide and scale from the metal, leaving a clean metallic surface to which the enamel can be applied. The enamels are almost invariably applied by the wet process and in the case of steel enameling a ground coat, containing invariably one of its constituents a cobalt compound, is applied directly to the metal. No explanation has ever been found for the fact that cobalt compounds even in very small percentages are essential to the production of a ground coat enamel which will adhere firmly to steel. Ground coats without cobalt have been brought forward many times but it is common knowledge that no enameling company has ever been able to operate successfully without the use of this compound in their ground coat enamels. Cobalt has the property of imparting a blue color to glass and these colored ground coats when applied to the metal and burned result in a blue or brown color. When a white product is desired it is necessary to apply two or three coats of white enamel over this blue ground coat in order to produce the desired white result. The process therefore consists in applying a dark colored ground coat to the steel, firing it, and after cooling applying a sufficient number of cover coats to produce whatever color is desired in the finished product. A cheap, low quality product known as one coat ware is produced but it is always inferior in quality.

Suitable compositions of enamels to be used in the production of steel cooking utensils, signs, and so forth are as follows:

<table>
<thead>
<tr>
<th>Ground Coat Enamel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frit:</td>
</tr>
<tr>
<td>Feldspar</td>
</tr>
<tr>
<td>Flint</td>
</tr>
<tr>
<td>Borax</td>
</tr>
<tr>
<td>Soda Ash</td>
</tr>
<tr>
<td>Potassium Nitrate</td>
</tr>
<tr>
<td>Fluorspar</td>
</tr>
<tr>
<td>Manganese Dioxide</td>
</tr>
<tr>
<td>Cobalt Oxide</td>
</tr>
<tr>
<td>Copper Oxide</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mill: Frit 100 lbs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay 8 &quot;</td>
</tr>
<tr>
<td>Borax 2 &quot;</td>
</tr>
<tr>
<td>Water 50 &quot;</td>
</tr>
</tbody>
</table>
THE PENNSYLVANIA STATE COLLEGE

FRIT:

White Enamel

Spar................................. 1
Flint................................ 22
Borax................................ 22
Soda Ash............................. 22
Sodium Nitrate..................... 22
Clyolite............................. 22
Barium Carbonate.................. 22
Zine Oxide......................... 22
Antimony Oxide.................... 22
Leukonin............................ 22
Opax................................ 22

Mill: Frit 100 lbs
      Enamel Chy 6
      MgSO₄ 5
      Tin Oxide 8
      Water 60

A few technical precautions in the enameling of steel follow:

In preparation of steel for pickling, grease or oil must be removed
either by scaling (burning off at dull red heat), or by cleaning solution.

This is followed by pickling in 5% to 10% hydrochloric acid (cold)
until all scale has been removed.

Wash in cold running water to remove all acid. Do not expose to
the air at any time after entering the acid until removal from the follow-
ing soda bath, or borax, if used last.

Boil in 5% solution of soda ash.

Remove from soda bath and dry immediately. Sometimes the soda
bath is followed by a boiling solution of borax.

Ground coat is applied to steel as soon as practical after pickling.

If steel is allowed to stand for any considerable period of time, it must
be kept in a dry atmosphere.

Ground coat should not be too finely ground; 40 mesh is sufficient.

Apply by dipping or spraying. This coat must be very thinly and
evenly applied; proper application and burning of the ground coat is
absolutely essential to securing good enamels.

Dry ground coat promptly and as rapidly as possible without causing
to boil.

Burn ground coat in a furnace at approximately 1750°F.

The time required for burning will depend upon the weight of the
article, thickness of the enamel, refractoriness of the enamel and tem-
perature of the furnace. Best results are obtained by trained burners
who burn by “eye.” Usually 2 to 4 minutes are sufficient.

Handle ware carefully at all stages.

Cover enamels may be applied as soon as ware is cool. Standing for
a few days is not detrimental after ground coat has been fired. Cover
enamels are applied by dipping or spraying. They may be much thicker
than the ground coat.

Ground coat can not easily be over-fritted but it is useless to con-
tinue after quiet fusion has been reached. White enamels should not be
fritted too rapidly nor in too high temperatures. The frit should be
removed from the furnace as soon as quiet fusion is reached.

Weigh all material added to mill. Do not add too much water; 50%
is generally sufficient. Do not wash enamel out of mill; pour out
through screen.

RAW CLAY ADDED TO MILL SHOULD BE GROUND TO POWDER AND MIXED WITH
FRIT BEFORE ADDING WATER.

NEVER ADD MgSO₄ TO GROUND COAT. 2% RAW BORAX MAY BE ADDED
TO THE MILL, OR THE ENAMEL MAY BE TEMPERED WITH A BOILING SOLUTION
 OF BORAX AFTER IT IS REMOVED FROM THE MILL.

MgSO₄ (5%) IS SUFFICIENT TO TEMPER COVER ENAMELS.

PROPER CONSISTENCY FOR DIPPING OR SPRAYING DEPENDS UPON THE PROCESS
BEING USED AND THE ENAMEL.

COVER ENAMELS SHOULD BE THICK LIKE HEAVY CREAM.

GROUND COAT SHOULD BE THIN, BUT “SHORT” FOR DIPPING OR SPRAYING;
THIN AND NOT SO SHORT FOR “DRAINING.”

THE SHEET STEEL ENAMELING INDUSTRY IS EXPANDING IN THE SAME WAY AS
THE CAST IRON ENAMELING INDUSTRY. NEW USES ARE BEING DEVELOPED FOR
THESE PRODUCTS RAPIDLY, THE MOST EXTENSIVE RECENT LARGE USE BEING IN
THE GREAT EXPANSION IN THE REFRIGERATOR INDUSTRY. THESE ENAMELS ARE SILICATES
AND BOROSILICATES HAVING ESSENTIALLY THE SAME PROPERTIES AS GLASS. THEY
ARE VERY DURABLE, EASILY CLEANED, AND THE GREAT VARIETY OF COLORS WHICH
IT IS POSSIBLE TO PRODUCE MAKES THEM DESIRABLE FOR A GREAT MANY HOUSE-
HOLD AND INDUSTRIAL PURPOSES.

USE OF CERAMIC PRODUCTS IN THE HOME

1. Enamelled steel sink and chair
2. Floor tile
3. Wall tile
4. Vitreous sanitary products
5. Enamelled cast iron tank
6. Glass mirror
7. Porcelain electrical fixtures
<table>
<thead>
<tr>
<th>Raw Materials</th>
<th>No. of Producing Operators</th>
<th>Quantity of Production</th>
<th>Value of Products</th>
<th>Capitalization</th>
<th>No. of Employees</th>
<th>Wages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay</td>
<td>40</td>
<td>533,989T</td>
<td>2,009,106</td>
<td>2,669,564</td>
<td>836</td>
<td>971,269</td>
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<tr>
<td>Crimson Clay</td>
<td>6</td>
<td>163,427T</td>
<td>220,545</td>
<td>796,000</td>
<td>101</td>
<td>117,524</td>
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<tr>
<td>Glass Sand</td>
<td>16</td>
<td>9,981,327T</td>
<td>3,988,809</td>
<td>5,965,378</td>
<td>809</td>
<td>3,740,017</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>62</strong></td>
<td><strong>1,978,437T</strong></td>
<td><strong>5,914,449</strong></td>
<td><strong>7,370,948</strong></td>
<td><strong>1,761</strong></td>
<td><strong>1,629,410</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heavy Clay Products</th>
<th>No. of Producing Operators</th>
<th>Quantity of Production</th>
<th>Value of Products</th>
<th>Capitalization</th>
<th>No. of Employees</th>
<th>Wages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brick</td>
<td>26</td>
<td>1,042,298M</td>
<td>17,171,309</td>
<td>23,598,735</td>
<td>6,503</td>
<td>8,410,017</td>
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<tr>
<td>Hollow Tile</td>
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<td>414,919T</td>
<td>2,906,303</td>
<td>2,633,573</td>
<td>588</td>
<td>837,541</td>
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<tr>
<td>Sewer Pipe</td>
<td>11</td>
<td>574,751T</td>
<td>2,540,703</td>
<td>2,475,491</td>
<td>1,210</td>
<td>1,653,560</td>
</tr>
<tr>
<td>Stoneware</td>
<td>7</td>
<td>20,178,067T</td>
<td>611,629</td>
<td>949,066</td>
<td>273</td>
<td>383,703</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>160</strong></td>
<td><strong>22,722,616</strong></td>
<td><strong>32,297,462</strong></td>
<td><strong>6,060</strong></td>
<td><strong>11,315,153</strong></td>
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<table>
<thead>
<tr>
<th>Refractories</th>
<th>No. of Producing Operators</th>
<th>Quantity of Production</th>
<th>Value of Products</th>
<th>Capitalization</th>
<th>No. of Employees</th>
<th>Wages</th>
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<tbody>
<tr>
<td>Crucibles</td>
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<td>733,280</td>
<td>368,957</td>
<td>113</td>
<td>255,151</td>
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<tr>
<td>Firebrick</td>
<td>44</td>
<td>491,911T</td>
<td>25,988,410</td>
<td>45,348,420</td>
<td>8,385</td>
<td>10,580,327</td>
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<tr>
<td>Abrasives</td>
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<td>9,939,025</td>
<td>2,981,585</td>
<td>548</td>
<td>811</td>
<td>7,573</td>
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<td><strong>Cementes</strong></td>
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<td><strong>38,335,479T</strong></td>
<td><strong>2,685,184</strong></td>
<td><strong>3,184,938</strong></td>
<td><strong>363</strong></td>
<td><strong>550,726</strong></td>
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<td><strong>Total</strong></td>
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<td><strong>31,314,209</strong></td>
<td><strong>49,184,553</strong></td>
<td><strong>9,014</strong></td>
<td><strong>12,197,987</strong></td>
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</table>

<table>
<thead>
<tr>
<th>White Ware</th>
<th>No. of Producing Operators</th>
<th>Quantity of Production</th>
<th>Value of Products</th>
<th>Capitalization</th>
<th>No. of Employees</th>
<th>Wages</th>
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</thead>
<tbody>
<tr>
<td>12</td>
<td>19</td>
<td>10,522,474</td>
<td>120,153,351</td>
<td>4,124</td>
<td>5,216,585</td>
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<td>13</td>
<td>4</td>
<td>5,586T</td>
<td>772,248</td>
<td>608,000</td>
<td>295</td>
<td>449,840</td>
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</table>

<table>
<thead>
<tr>
<th>Ceramics, Etc.</th>
<th>No. of Producing Operators</th>
<th>Quantity of Production</th>
<th>Value of Products</th>
<th>Capitalization</th>
<th>No. of Employees</th>
<th>Wages</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>19</td>
<td>41,439,238B</td>
<td>64,523,228</td>
<td>147,970,715</td>
<td>9,044</td>
<td>15,324,167</td>
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<tr>
<td>15</td>
<td>5</td>
<td>4,221T</td>
<td>245,801</td>
<td>271,396</td>
<td>330</td>
<td>341,501</td>
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<tr>
<td>16</td>
<td>2,400T</td>
<td>75,083</td>
<td>48,905</td>
<td>35</td>
<td>81,058</td>
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<tr>
<td><strong>Total</strong></td>
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<td><strong>64,808,302</strong></td>
<td><strong>147,970,715</strong></td>
<td><strong>9,413</strong></td>
<td><strong>15,500,716</strong></td>
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</table>

<table>
<thead>
<tr>
<th>Lime</th>
<th>No. of Producing Operators</th>
<th>Quantity of Production</th>
<th>Value of Products</th>
<th>Capitalization</th>
<th>No. of Employees</th>
<th>Wages</th>
</tr>
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<tbody>
<tr>
<td>17</td>
<td>114</td>
<td>790,328T</td>
<td>5,711,812</td>
<td>31,279,704</td>
<td>2,120</td>
<td>2,983,296</td>
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<td>18</td>
<td>6</td>
<td>51,018T</td>
<td>151,237</td>
<td>258,638</td>
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<td>85,518</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>120</strong></td>
<td><strong>5,874,849</strong></td>
<td><strong>31,583,342</strong></td>
<td><strong>2,174</strong></td>
<td><strong>2,944,804</strong></td>
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</table>

<table>
<thead>
<tr>
<th>Glass</th>
<th>No. of Producing Operators</th>
<th>Quantity of Production</th>
<th>Value of Products</th>
<th>Capitalization</th>
<th>No. of Employees</th>
<th>Wages</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>25</td>
<td>7,600,279Gt</td>
<td>35,620,609</td>
<td>18,052,801</td>
<td>10,301</td>
<td>13,067,574</td>
</tr>
<tr>
<td>20</td>
<td>5</td>
<td>73,103,240Sf</td>
<td>24,029,694</td>
<td>73,372,150</td>
<td>5,860</td>
<td>8,586,100</td>
</tr>
<tr>
<td>21</td>
<td>8</td>
<td>134,592,171Sf</td>
<td>8,729,452</td>
<td>17,291,915</td>
<td>3,125</td>
<td>3,956,738</td>
</tr>
<tr>
<td>22</td>
<td>21</td>
<td>11,061,827</td>
<td>4,787,564</td>
<td>3,241</td>
<td>4,028,990</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>59</strong></td>
<td><strong>77,458,382</strong></td>
<td><strong>113,943,416</strong></td>
<td><strong>22,052</strong></td>
<td><strong>20,705,447</strong></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Enamels and Chemicals</th>
<th>No. of Producing Operators</th>
<th>Quantity of Production</th>
<th>Value of Products</th>
<th>Capitalization</th>
<th>No. of Employees</th>
<th>Wages</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>7</td>
<td>4,482,466</td>
<td>4,523,496</td>
<td>1,208</td>
<td>1,696,448</td>
<td></td>
</tr>
</tbody>
</table>

| Table of Statistics Based on Data for Pennsylvania, Fiscal Year, 1928. |
|-----------------------------|-----------------------------|------------------|------------------|
| **No. of Producing Operators** | **Quantity of Production** | **Value of Products** | **Capitalization** |
| 24. Enameling on cast | 17 | 28,712,481b | 23,319,762 | 9,021,117 |
| iron            | 25. Ceramic Chemicals | 8 | 447,325,893b | 8,242,376 | 2,614,615 |
| **Total**       | **551**                    | **256,777,308,561,236,634** | **66,061** | **90,345,471** |

**Industrial Statistics Based on Data obtained directly from producers and other sources.**

T stands for "tons"  B stands for "barrels" M stands for "thousands"  P stands for "pounds"  Or stands for "gross"
<table>
<thead>
<tr>
<th>Year</th>
<th>Value in Penna.</th>
<th>Value in U.S.</th>
<th>% of total produced in Penna.</th>
<th>Rank of Penna.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLAY</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>1900</td>
<td>2,404,857</td>
<td>1,840,077</td>
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<tr>
<td>1910</td>
<td>645,613</td>
<td>3,625,485</td>
<td>18</td>
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<tr>
<td>1920</td>
<td>2,832,225</td>
<td>11,614,288</td>
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<td>1928</td>
<td>2,606,106</td>
<td>14,200,739</td>
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<td>HEAVY CLAY PRODUCTS</td>
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<tr>
<td>1900</td>
<td>6,591,264</td>
<td>63,748,189</td>
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<tr>
<td>1910</td>
<td>10,011,589</td>
<td>110,729,245</td>
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<tr>
<td>1920</td>
<td>19,558,887</td>
<td>201,906,396</td>
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<tr>
<td>1928</td>
<td>22,722,516</td>
<td>211,521,883</td>
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<td>2</td>
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<td>WHITE WARE</td>
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<td>1900</td>
<td>1,046,734</td>
<td>19,798,370</td>
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<tr>
<td>1910</td>
<td>1,777,992</td>
<td>33,739,978</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>1920</td>
<td>4,835,706</td>
<td>106,716,676</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>1928</td>
<td>10,522,474</td>
<td>107,780,399</td>
<td>10</td>
<td>4</td>
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<td>TERRA COTTA</td>
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<td>1900</td>
<td>180,100</td>
<td>2,372,558</td>
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<td>1910</td>
<td>472,150</td>
<td>6,976,771</td>
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<td>1920</td>
<td>255,915(a)</td>
<td>3,988,182(a)</td>
<td>2</td>
<td>5</td>
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<tr>
<td>1928</td>
<td>772,248</td>
<td>13,517,777</td>
<td>2</td>
<td>4</td>
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<td>REFRactories</td>
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<tr>
<td>1900</td>
<td>4,678,339</td>
<td>10,353,058</td>
<td>45</td>
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<td>1910</td>
<td>6,587,495</td>
<td>18,615,280</td>
<td>36</td>
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<tr>
<td>1920</td>
<td>22,075,040</td>
<td>54,195,598</td>
<td>47</td>
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<td>1928</td>
<td>31,501,206</td>
<td>64,814,122</td>
<td>49</td>
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<td>CEMENT</td>
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<tr>
<td>1900</td>
<td>4,984,417</td>
<td>9,290,525</td>
<td>54</td>
<td>1</td>
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<tr>
<td>1910</td>
<td>8,221,206</td>
<td>66,805,600</td>
<td>30</td>
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<td>1920</td>
<td>52,632,022</td>
<td>104,390,025</td>
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<td>1928</td>
<td>64,529,228</td>
<td>261,736,000</td>
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<td>LIME</td>
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<td>1900</td>
<td>910,903</td>
<td>6,797,496</td>
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<td>7,518,147</td>
<td>37,648,840</td>
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<td>1928</td>
<td>5,683,049</td>
<td>36,449,633</td>
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<tr>
<td>GLASS</td>
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<tr>
<td>1900</td>
<td>21,830,085</td>
<td>39,443,478</td>
<td>55</td>
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<tr>
<td>1910</td>
<td>32,584,064</td>
<td>92,060,203</td>
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<tr>
<td>1920</td>
<td>88,626,800</td>
<td>261,884,080</td>
<td>34</td>
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<td>1928</td>
<td>79,346,502</td>
<td>282,394,330</td>
<td>28</td>
<td>1</td>
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<td>TOTAL CERAMIC PRODUCTS</td>
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<td>1900</td>
<td>40,462,990</td>
<td>153,574,251</td>
<td>21</td>
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<tr>
<td>1910</td>
<td>74,061,721</td>
<td>347,937,424</td>
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<tr>
<td>1920</td>
<td>197,835,892</td>
<td>872,287,015</td>
<td>23</td>
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<tr>
<td>1928</td>
<td>256,777,396(c)</td>
<td>1,012,338,855</td>
<td>22</td>
<td>1</td>
</tr>
</tbody>
</table>

(Data for 1900, 1910, 1920 based on statistics of the U. S. Bureau of the Census and Mineral Resources of the United States.)
(a)—Value for 1919.
(b)—Value for 1927.
(c)—Values of production for enamels and chemicals, glass sand, ganister, plaster and stucco are included for Pennsylvania for 1928, but not used in calculation of per cent of total produced nor in determining rank of Pennsylvania among states.)
CHAPTER V

ALPHABETICAL LIST OF CERAMIC PRODUCERS

RAW MATERIALS

ALEXANDRIA FIRE CLAY CO., ALEXANDRIA
Works—Alexandria
Pres., W. C. Phillips
Secy., Treas. and Gen. Mgr., G. I. Phillips
No. of employees: 15
Product: Hatfield silica fireclay.

ATLAS PORTLAND CEMENT CO., 25 BROADWAY, N. Y. C.
Works—Kunkletown, Monroe County
Saylorburg
Pres., J. R. Morrow
Secy., H. E. Harding
No. of employees: 54
Product: White Clay.

BAKER, F. M. HUEFFNER
Works—Lucinda,
Shippenville
Owner, F. M. Baker
Capacity: 11 cars per day
Process: Clay shipped in crushed form to pot and fire brick makers.
Fuel: Gas.
No. of employees: 5
Product: Flint fireclay.

BALDRIDGE AND CO., E. R., HOLLIDAYSBURG
Works—Barree,
Wolfsburg
Pres., W. L. Baldridge
No. of employees: 36
Product: Ganister.

BETTY COAL AND FIRE CLAY CO., BRISBIN
Works—Morgan Run
Owner, W. A. Gould and Bro. (Not operated in 1928.)
Product: Hard flint fireclay.

BOILER, C. N., 2000 BAYOUARD BOULEVARD, WILMINGTON, DEL.
Works—Embreveville
Operated only from Aug. 1, 1928.
Product: Feldspar.
Production: 28 tons

BROCKWAY CLAY CO., BROCKWAY
(See Heavy Clay Products.)
Product: Clay.

BUCHER, J. C., BOILING SPRINGS
Works—S. Middletown Twp.
Cumberland County
Prospecting in 1928
No. of employees: 4
Annual wages: $254.00
Product: White clay.

CHIOQUES MINING AND MFG. CO., COLUMBIA
Works—Chikies
No. of employees: 25
Production: 30,000 tons
Product: Ganister rock.

CRYSTAL SAND CO., FIRST NATIONAL BANK BLDG., LATROBE
Works—Vineyard Station
Pres. and Gen. Mgr., H. H. Hopwood
Secy. and Treas., J. F. Irwin
Supt., John Geedy
Product: Glass and molding sand, washed, screened and graded.

DALE COAL CO., P. O. DRAWER 1, JOHNSTOWN
Works—Dale, Cambria County
No. of employees: 7
Product: Clay.

DARLINGTON FIREPROOFING CO., THE, ALLIANCE, OHIO
(See Heavy Clay Products.)
Product: Fireclay.

DERistine, DAVID D., TELFORD
(See Heavy Clay Products.)
Product: Clay.
RAW MATERIALS (Continued)

DICK SAND CO., FRANKLIN
Works—Polk
Pres., H. Lamberton
Secy., C. Lamberton
No. of employees: 44

Product: Silica molding sand.

DILLER CLAY AND STONE CO., LANCASTER
Works—Narvon, Lancaster County
Product: Clay.
Principal officers:
I. S. Diller, A. P. Diller, I. S., Diller, H. Lafferty
Capacity: $70,000
Process: W. N. Best Co. fuel oil burning system;
2 Scovell air separators,
2 continuous rotary dryers, 42" x 30 ft.
Fuel: Fuel oil for drying; 33,716 gal. annually, value: $2,359.91
Coal and gasoline for power 167 tons coal, value: 788.76
729 gals. gasoline, annually, value: 172.18
No. of employees: 11
Annual wages: $12,929.20

EASTERN CLAY PRODUCTS, INC., 614 ELLICOTT SQ., BUFFALO, N. Y.
Works—Hutchins
Product: Clay.
(Plant sold, 1929,
Reported will function again under Mr. B. T. Nelson,
Box 75, Mt. Jewett.)

EDGE HILL SILICA ROCK CO., INC., 29 ADELAIDE AVE., NEW BRUNSWICK, N. J.
Works—Edge Hill, Montgomery County
Product: Mica Schist rock.
Pres., R. C. Kenyon
Secy. and Supt., T. L. Kenyon
Capacity: $50,000
Process: All hand quarried.
Fuel: Used for acid lumas; high in silica, mica and alumina.
No. of employees: 10
Annual wages: $10,070.19

EGAN, WEBSTER AND CO., INC., OLIVER BLDG., PITTSBURGH
Works—Claytonia
Product: Grude and ground plastic
Burnham, Pa.,
East
Darlington, Pa.
Pres., Richard M. Egan
Gen. Mgr., Albert R. Kenney
Capital: $100,000
Production: 88,000 tons (1928)
75,000 tons (1929)
No. of employees: 40

ELLWOOD STONE CO., ELLWOOD CITY
Works—Koppel, Beaver County
Product: Silica sand, (Curb stone).
Pres., D. J. Jones
Treas., D. J. Sartwell
Secy., D. J. Jones, Jr.
Capital: $25,000
Capacity: 30,000 tons sand
Fuel: Coal; 800 tons annually, value: $1,630.00
Electricity purchased, 350 HP capacity: $4,518.44
No. of employees: 14
Annual wages: $79,986.85

FAIR VALLEY CLAY CO., COMMERCE BLDG., ALTOONA
Works—Martinburg
Product: White clay.
Pres. and owner, W. J. Henry
No. of employees: 11

FALLS CREEK SAND AND STONE CO., FALLS CREEK
Works—Falls Creek
Product: Glass sand, (Molding, Furnace, etc. sand.)
Pres., A. H. Gofney
Gen. Mgr., Morgan W. Hall
Capital: $350,000
No. of employees: 40 to 60

FISHEL CLAY CO., I. S., DILLSBURG
(Plant not in operation at present)
Product: White clay.

FOOTE MINERAL CO., INC., 1600 SUMMER ST., PHILADELPHIA
Works—Wyndmoor, Montgomery County
Product: Minerals, ores, Magnesia, Zirconium, Needle antimony, etc.
Pres., W. M. Foote
Secy., H. C. Meyer
No. of employees: 31

FORD MOTOR CO., DEARBORN, MICH.
Works—Caban
Product: Grinding sand.
No. of employees: 48

GARFIELD FIRE CLAY CO., ROSEMONT
(See Refractories.)
Product: Ground fire clay.

GENERAL REFRACTORIES CO., 106 S. 16TH ST., PHILADELPHIA
(See Refractories.)
Product: Ground fire clay.

HALLMAN, M. LUTHER, 1678 BUTLER PIKE, CONSHOHOCKEN
Works—Conshohocken
(No clay sold in 1928)
Product: Clay, Kaolin.

HALLSTON COAL CO., 390 BUTLER COUNTY NATIONAL BANK BLDG., BUTLER
Works—Hallston, (P. O. Keister)
Pres., T. C. Lesdon
Secy. and Treas., James B. Mates
Supt., W. J. Donaldson
Capacity: 3,000 tons per month
Production: 28,000 tons per year
Process: Clay taken out as coal is mined.
Ground and screened to any size desired.
Fuel: Electricity purchased, annually: $4,000.00
No. of employees: 126
Wages for clay mining only $30,000.00

HARISON-WALKER REFRACTORIES CO., FAIRMONT BANK BLDG., PITTSBURGH
(See Refractories.)
Product: Ground fire clay, Special clays, Ground ganister.

HARTMAN CO., J. L., HOLLIDAYSBURG
Works—Flowing Spring
Product: Ganister rock.
Sprout
Owner, J. L. Hartman
Secy., C. M. Beek
No. of employees: 50

HAYS REFRACTORIES CO., FAIRMONT TRUST AND MORTGAGE BLDG., JOHNSTOWN
(See Refractories.)
Product: Ground fire clay.

INDUSTRIAL SILICA CORP., 662 STAMBAUGH BLDG., YOUNGSTOWN, OHIO.
Works—Lisbon,
Polk, Utica.
Pres., E. E. Kloos
Capital: $1,500,000
No. of employees: 240
Production: 124,727 tons
Annual wages: $50,124.41
RAW MATERIALS (Continued)

JOHNSTOWN MINING CORP., Main St., Johnstown
Works—Dean, Cambria County
Pres., H. L. Tredenick
Secy., Campbell Patch
No. of employees: 37
Product: Flint clay.

KAOLIN CORP. OF PENNA., 119 N. Prince St., Lancaster
Works—Dillsburg
Pres., W. F. Woodruff
Gen. Mgr., J. H. Riley
Capital: $250,000
Production: 60 tons per day
Process: Open surface excavating; doing away with all tunnels.
Property developed in 1928.
No. of employees: 24
Product: Kaolin clay.

KELSEY MINING CO., 214 E. Water St., Lock Haven
Works—Hannenville (Shipping Point, Waterville)
Gen. Mgr., E. R. Kelsey
No. of employees: 18
Product: Flint fire clay.

KIER FIRE BRICK CO., 1844 Olver Bldg., Pittsburgh
(See Refractories.)
Product: Fire clay.

KING CLAY AND FEED CO., J. B., Box 501, Scottsdale
Works—Upper Tyrone Twp., Fayette County
Capital: Stock, $18,000
Production: 3,717 tons
Annual wages: $1,678.15
No. of employees: 4
Product: Wash and core clay, high in lime.

KOLD, GEORGE AND WILLIAM, MEADOW, AND JACKSON STS., PHILADELPHIA
(See Refractories.)
Product: Ground fire clay.

LAYNO REFRACTORIES CO., BULLITT BLDG., PHILADELPHIA
(See Refractories.)
Product: Clays.

MEDUSA PORTLAND CEMENT CO., 1002 Engineers Bldg., Cleveland, Ohio
Works—York
Pres. and Gen. Mgr., J. B. John
No. of employees: 32
Product: White and gray clays.

MIFFLIN SAND CO., Lewistown
Works—Lewistown
Pres., D. H. Miller
Secy., H. Stetler
No. of employees: 19
Product: Washed silica sand.

MINERAL POINT CLAY CO., Johnstown Savings Bank Bldg., Johnstown
Works—Mineral Point
Managing Partner, H. L. Tredenick
No. of employees: 18
Product: Flint and soft fire clay.
Capacity: 10,000 tons
Production: 7,318 net tons
Annual wages: $12,207.89

MONT ALTO SAND CO., Waynesboro
Works—Pantbank
Pres. and Gen. Mgr., M. H. Landis
Capital: $25,000
Production: 1,500 tons
Annual wages: $1,000.00
No. of employees: 3
Product: Fire clay.

MORGAN RUN MINING CO., Trust Bldg., Clearfield
Works—Decewir, Clearfield
Pres., G. R. Bigler
Gen. Mgr., A. D. Bigler
Capital: $50,000
Production: 23,642 net tons
Annual wages: $28,500.00
No. of employees: 20

CERAMIC INDUSTRIES OF PENNSYLVANIA

MORRIS RUN COAL MINING CO., Miners Bank Bldg., Wilkes-Barre
Works—Morris Run, Tioga County
Pres., Theodore S. Barber
Capital: Stock, $1,000,000
Bonds, $40,000
(Not mined at present.)
Product: Fire clay (Low volatile coal).

MOUNT JEWETT FIRE CLAY CO., Mt. Jewett
Works—Freeman, McKean County
Pres., Joseph Vogel
Gen. Mgr., Edward M. O’Neill
Capital: $50,000
Production: 21,274 tons
Annual wages: $22,600.00
No. of employees: 14
Product: Ground fire clay, Wallow clay.

NILES FIRE BRICK CO., Niles, Ohio
Works—New Brighton, Lucinda
Pres., J. Thomas
Gen. Mgr., D. S. Parry
No. of employees: 21
Product: Plastic fire clay, Flint fire clay.

NORTH AMERICAN REFRACTORIES CO., NATIONAL CITY BANK BLDG., Cleveland, Ohio
(See Refractories.)
Product: Ground fire clay.

ODONNELL BROTHERS, Morris Run
Works—Morris Run
Product: Fire clay.

O’KILL AND CO., H., Lucinda
Pail: 140 tons clay used for power annually, value: $100.00
Power capacity of plant, 25 HP
Production: 1,000 tons
Annual wages: $9,000.00
No. of employees: 6
Product: Fire clay.

OSCEOLA SILICA AND FIRE BRICK CO., Osceola Mills
(See Refractories.)
Product: Fire clay.

PENN PRODUCTS CORP., ASHBU, Works—Bellingham Springs
No. of employees: 10
Product: Natural black burning clay, Red and white clays.
Production: 400 tons
Annual wages: $6,600.00

PENNsylvania Glass Sand Co., Lewistown
Works—Mapleton (3 plants)
Vineyard (2 plants)
Pres., W. H. Woods
Secy., J. C. Brown
No. of employees: 133
Product: Glass sand, washed, screened graded.

PENNsylvania Pulverizing Co., Lewistown
(See Heavy Clay Products.)
Product: Clay.

PHILADELPHIA CLAY CO., 1201 Chestnut St., Philadelphia
(See Heavy Clay Products.)
Product: Clay.

PITTSBURGH PLATE GLASS CO., 2200 Grant Bldg., Pittsburgh
Works—Kensertown
Pres., H. F. Wharton
No. of employees: 43
Product: Glass sand.

POPE CO., FRANK B., 1811 Oliver Bldg., Pittsburgh
Works—Maysport
Pres. and Gen. Mgr., Frank B. Pope
Capital: $150,000
Production: 13,263 net tons
Annual wages: $21,170.85
No. of employees: 16
Product: Ground fire clay.
RAW MATERIALS (Continued)

RELIEF SAND CO., BERN
Works—Bern, Berks County
Individually owned.
No. of employees: 4

RHODEWALT, H. T. A., NOTTINGHAM
Works—Nottingham
Product: Flint.
No. of employees: 1

SAVAGE FIRE BRICK CO., MEYERSDALE
Works—Meyersdale
Product: Flint and plastic clays.
(Plant not in operation.)

SAYLOR SILICA CO., BUTLER
Works—Butler
Pres., N. S. Garbisch
Sey., J. J. Jackson
No. of employees: 16

SILICON PRODUCTS CO., RIDGEWAY
Works—Dugnubandha
Pres., P. R. Smith
Gen. Mgr., W. J. Garrison
No. of employees: 16

SMITH CO., A. F., THE, NEW BRIGHTON
Product: Glass sand.
(See Heavy Clay Products.)

STANDARD CLAY PRODUCTS CO., FALLSTON
Product: Ground fire clay.
(See Heavy Clay Products.)

STANDARD PLATE GLASS CO., FIRST NATIONAL BANK BLDG., PITTSBURGH
Product: Grindng sand.

STONE-FULLER REFRACTORIES CO., 2008 UNION TRUST BLDG., CLEVELAND, OHIO
Product: Fire clay.
(See Refractories.)

TEMPLE FIRE CLAY CO., TEMPLE
Works—Temple, Berks County
Pres., J. S. Hipple
Gen. Mgr., G. M. Lawyer
No. of employees: 7

TURNER BRICK CO., J. L., 118 MARKET ST., NANTICOKE
Product: Fire clay.
(See Heavy Clay Products.)

UNITED STATES REFRACTORIES CORP., MOUNT UNION
Product: Fire clay.
(See Refractories.)

WELCH-BRIGHT CO., MONACA
Product: Fire clay.
(See Refractories.)

WEST DARLINGTON CLAY CO., 402 GROGAN BLDG., PITTSBURGH
Product: Ground and slip clay.
(White Clay Mine Co., owner.)
Pres., D. B. Heinzer
Gen. Mgr., J. E. White
Capital: $100,000
(Clay development started Jan. 1, 1929.)

WESTMORELAND BRICK CO., 900 FEDERAL RESERVE BLDG., PITTSBURGH
Product: Mortar clay.
(See Refractories.)

WHITAKER CLAY CO., NARVON
Works—Narvon
Owner, L. H. Whitaker
No. of employees: 11

Product: Cupola clay, (Molding sand).

SAYLOR SILICA CO., BUTLER
Pres., N. S. Garbisch
Sey., J. J. Jackson
No. of employees: 16

SMITH CO., A. F., THE, NEW BRIGHTON
Product: Glass sand.
(See Heavy Clay Products.)

STANDARD CLAY PRODUCTS CO., FALLSTON
Product: Ground fire clay.
(See Heavy Clay Products.)

STANDARD PLATE GLASS CO., FIRST NATIONAL BANK BLDG., PITTSBURGH
Product: Grindng sand.

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Works—Temple, Berks County
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(White Clay Mine Co., owner.)
Pres., D. B. Heinzer
Gen. Mgr., J. E. White
Capital: $100,000
(Clay development started Jan. 1, 1929.)

WESTMORELAND BRICK CO., 900 FEDERAL RESERVE BLDG., PITTSBURGH
Product: Mortar clay.
(See Refractories.)

WHITAKER CLAY CO., NARVON
Works—Narvon
Owner, L. H. Whitaker
No. of employees: 11

Product: Crude and dry clay.

CERAMIC INDUSTRIES OF PENNSYLVANIA

RAW MATERIALS (Continued)

WHITE ROCK SILICA CO., GREENVILLE
Product: Crushed ganister, Silica sand.
Works—Hempfield Twp., Mercer County
(Successor to GREENVILLE SILICA PRODUCTS CO.)
Pres., J. G. Kingery
Secy., John H. Fry
No. of employees: 11

WINDBER SAND CO., WINDBER
Product: Washed silica sand.
Works—Carmichaels
Pres., L. C. Penrod
Secy., and Treasurer, J. Louis Stever
Supt., F. A. Sterling
Capital: $50,000
Capacity: 60,000 tons
Production: 18,782 tons
Process: Primary and secondary screening, 3 grinding mills and apparatus in connection with spiral screw system of washing and screening.
Fuel: 100 tons coal for heating, annual value: $750.00
Electricity purchased, 300 HP capacity: $4,660.47
Annual wages: $20,449.60
No. of employees: 17

WOODBURY CLAY CO., HOLLIDAYSBURG
Product: Fire clay.
Works—Orefield
Owner, J. R. Baldridge
No. of employees: 37

HEAVY CLAY PRODUCTS

ALLIANCE BRICK CO., THE, ALLIANCE, OHIO
Product: Gray manganese fireclay brick, Fire clay.
Works—Darington
Pres., F. A. Hoiles
V. Pres., E. L. Guthrie
Sey., R. M. Serante
Supt., J. C. Sanfor
Capital: Stock, $200,000
Bonds, $100,000
Capacity: 19,000,000 brick
Fuel: Coal, 17,000 tons annually; value: $24,500.00
Electricity purchased, annual value: $20,000.00
Annual wages: $109,300.00
No. of employees: 79

ALTOONA BRICK CO., 115 ELEVENTH ST., ALTOONA
Product: Building brick.
Works—Altoona
Pres., Enos M. Jones
No. of employees: 43
Annual wages: $54,340.00

ALUMINA SHALE BRICK CO., P. O. BOX 388, BRADFORD
Product: Building brick.
Works—Lewis Run
Pres., A. P. McConell
Secy., C. C. Stratton
Capital: $75,000
No brick manufactured in 1928.

ALWINE BROTHERS BRICK CO., NEW OXFORD
Product: Common brick.
Works—Berlin Junction
Pres. and Gen. Mgr., W. C. Alwine
Capital: Surplus, $15,000
$130,000 common
No. of employees: 28
Annual wages: $37,080.65
HEAVY CLAY PRODUCTS (Continued)

AMERICAN VITRIFIED PRODUCTS CO., 15 BROAD ST., AKRON, OHIO
Works—New Brighton (Factory No. 2) Product: Sewer pipe, Hot top brick.
Pres., D. M. Cowell
Secy., H. C. Maurer
Treas., W. G. Murray
Supt., Carl W. Keller
Capital: Stock, $300,000
Capacity: 24,000 tons
Production: 23,915 tons
Process: 2 Stevenson sewer pipe presses, 2-9' dry pans; 2-7' wet pans, 14 round down draft kilns, four 28', three 35', three 32', three 34', one 36'.
Clay mined by Company
Fuel: Coal: 13,900 tons, annual value: $59,730.00
4,700 tons coal for power, value: $14,305.00
4700 tons coal per ton brick.
Electricity purchased, 30 HP capacity, value: $1,680.00
No. of employees: 97
Annual wages: $16,283.15

ANTHRACITE BRICK AND TILLE CO., 528 N. NEW ST., BETHLEHEM
Pres., W. R. Royer
Secy., Elmer L. Mack
No. of employees: 28

ATLAS BRICK AND CONCRETE PRODUCTS CO., CHARLES AND
CHAPIN STS., N. S., PITTSBURGH
Works—N. S., Pittsburgh Product: Building brick.
Pres., J. P. Hilldorfee
Secy., J. McKissick
No. of employees: 27

AUBURN SHALE BRICK CO., INC., AUBURN
Works—Auburn Product: Rough texture face brick, Radial chimney block.
Pres., A. R. Frederie
Secy., J. H. Hall
Treas. and Mgr., Thomas B. Dreher
Capital: Stock, $111,300
Bonds, $50,000
Capacity: 80,000 per day
Production: 4,811,000 brick, 2,826 tons block
Process: Stiff mud; American grinder.
5 round draft kilns, 28 ft. diam.
14,615 cu. yds. shale and clay mined by Company.
Fuel: Bituminous coal; 8379 tons annually, value: $30,963.15
Electricity purchased, 200 HP capacity, value: $9,152.72
1150 lbs. coal burned per 1000 brick.
No. of employees: 41
Annual wages: $47,323.37

BEAVER CLAY MFG. CO., NEW GALLILO
Pres., E. S. Hones
V. Pres., George Davidson
Secy. and Tres., E. M. Long
Capital: Stock, $200,000
Capacity: 90,000 daily
Production: 13,189,700 brick
21 down draft beehive, rectangular and round kilns.
42,405 tons clay mined by Company, annual value: $41,486.21
Fuel: Coal: 10,299 tons annually, value: $30,822.89
1225 lbs. coal per 1000 brick.
Electricity purchased, 425 HP capacity, value: $11,928.26
No. of employees: 98
Annual wages: $143,369.90

CERAMIC INDUSTRIES OF PENNSYLVANIA

HEAVY CLAY PRODUCTS (Continued)

BEAVER TOWN BRICK CO., BEAVER TOWN
Product: Building brick, Face brick.
Capital: Stock, $100,000
Capacity: 2,000,000 brick
Process: Stiff mud; one Stevenson dry pan.
6 bee hive kilns, 30 ft.
Fuel: Egg coal, semi gas; 1400 tons, annual value: $5,642.00
800 lbs. coal per 1000 brick.
Electricity purchased, 165 HP capacity, value: $2,225.00
No. of employees: 38
Annual wages: $18,000.00

BETHLEHEM BRICK MFG. CO., 336 ADAMS ST., BETHLEHEM
Works—Bingen Product: Building brick.
Pres., W. A. Snooker
Gen. Mgr., G. T. Hasken
No. of employees: 36

BETHLEHEM MINES CORP., HANOVER
Works—Hanover Product: Building brick.
(Idle in 1928)

BLOOMSBURG BRICK CO., FIRST NATIONAL BANK BLDG., BLOOMSBURG
Works—Bloomburg Product: Face and common brick.
Pres., George L. Low
Secy. and Tres., J. Clair Peck
Capital: $40,000
Production: 11,072,775 brick
Annual wages: $92,693.45

BOSTONICA COAL AND CLAY PRODUCTS CO., NEW BETHLEHEM
Pres., E. W. Sweasy
Secy., H. L. Wheeler
No. of employees: 89

BRICK AND STONE CO., 46 E. HIGH ST., WAYNESBURG
Works—Waynesburg Product: Common, face and paving brick, Backup and foundation tile.
Pres., F. R. Hill
Secy. and Tres., A. L. Moresock
Supt., Howard Guest
No. of employees: 17

BRIGHTON CLAY PRODUCTS CO., NEW BRIGHTON
Pres., William H. Schwartz
Secy., A. F. Schwartz
No. of employees: 30

BROCKWAY CLAY CO., BROCKWAY
Works—Brockway Product: Sewer pipe, Flue lining, Wall coping, fire clay.
Pres. and Gen. Mgr., H. E. Kilgus
Capital: Stock, $100,000
Bonds, $150,000
Process: 24 round dry draft kilns, 36 ft., 60 tons capacity.
All fire clay mined by Company.
Fuel: Coal: 50,000 tons, annual value: $150,000
5,000 tons coal for power, value: $15,000
Electricity purchased, 500 HP capacity: $2,830
No. of employees: 205
Annual wages: $310,000

BUDDING CO., J. G., 142 N. QUEEN ST., LANCASTER
Works—Mountville Product: Face brick.
Owner, J. C. Budding
No. of employees: 50 to 60
Annual wages: $3,355.98
CERAMIC INDUSTRIES OF PENNSYLVANIA

HEAVY CLAY PRODUCTS (Continued)

CAMBRIA CLAY PRODUCTS CO., 501 North St., Johnstown

Product: Face and common brick, Ladle brick, Brattic blocks.

Privately owned. Capacity: 10,000,000 annually
Production: 5,200,000

Process: Slab mud; 10 round down draft kilns, 30 ft. diam.
All shale and plastic clay quarried by Company.

Fuel: Bituminous coal; 20,000 tons, annual value: $200,000

Electricity purchased, 200 HP, capacity of: $7,659.42

No. of employees: 40 Annual wages: $49,689.95

CARROLL AND SONS, H. C., 67th and Girard Ave., Philadelphia


Supt., E. A. Carroll No. of employees: 52

CHESTER BRICK CORP., 550 Edgemont Ave., Chester

Works—Chester Product: Building brick.

Pres., J. A. Moss (Plant idle)

CLAUSI PBRICK CO., W. F., N. Quebec St., Allentown


(Plant idle)

CLEARFIELD BRICK MFG. CO., 301 Bradford St., Clearfield


No. of employees: 104 Annual wages: $78,683.92

CLERMONT CLAY PRODUCTS CO., 1612 Market St., Philadelphia

Product: Vitrified clay conduit.

Pres., John J. McIlroy Supt., H. K. Leigle Capacity: 6,000,000,000 ft. diam.

Process: Slab mud; 16 down draft kilns, 30 ft.

Fuel: Coal; 13,000 tons, annual value: $49,323.00

5,257 tons for power; 300 HP: $17,083.00

No. of employees: 106 Annual wages: $150,600.00

CLYDESDALE BRICK AND STONE CO., 807 Empire Bldg., Pittsburgh

Product: Common and paving brick.

Works—Ellwood City Pres., W. A. Boiton Secy., S. G. Robison No. of employees: 88

COEN BRICK AND TILE WKS., J. B., 847 Forrest Ave., Homestead

Works—Homestead Product: Common brick.


No. of employees: 34

COLEINGRAVE BRICK CO., 1409 Franklin Trust Bldg., Philadelphia

Works—Glendale, Delaware County Product: Building brick.


COLONIAL CLAY PRODUCTS CO., 1225 Grant Bldg., Pittsburgh

Product: Face brick.


Capital: Stock, $125,000 Annual wages: $18,000.00

Process: Slab mud; 12 round down draft kilns, 33 to 40 ft. diam.

Fuel: 4½ lumps soft coal; 11,000 tons, annual value: $22,011.47

7½ lumps soft coal per 1000 brick

Electricity purchased, 512½ HP, capacity of: $7,965.73

No. of employees: 72 Annual wages: $18,319.53

CONTINENTAL CLAY PRODUCTS CORP., (Fallston Division), 1524 Oliver Bldg., Pittsburgh

Works—Bigler, Fallston Product: "Iron Spot" flashed face brick, Quarry tile.


Process: Slab mud; 25 round down draft kilns, 28, 30, 32, 35 ft. diam.

All fire clay mined by Company.

Fuel: Soft coal; 15,000 tons, annual value: $48,750.00

1200 lbs. coal per 1000 brick

Electricity purchased, 150 HP, capacity of: $18,000.00

No. of employees: 136 Annual wages: $25,000.00

CONWAY, WILLIAM, 5800 Walnut St., Philadelphia

Product: Building brick.


Capital: Individually owned Annual wages: $75,000.00

No. of employees: 65 Annual wages: $12,000.00

COPE AND SON, WILMER, Lincoln University

Product: Red fire bricks.

Production: 500,000 to 600,000

Process: Slab mud; 6 down draft kilns, 30 ft.

Fuel: Hard coal; 70 tons, annual value: $850.00

Cool for power, 100 HP, capacity of: $400.00

No. of employees: 2 Annual wages: $2,000.00

CORAOPOLIS BRICK AND TILE CO., 112 Washington St., W. E. Pittsburgh

Product: Face brick.

Pres., Herman J. Busch

No. of employees: 47

Corry Brick and Tile Co., Inc., 1375 W. Perry St., Corry

Product: Common and face brick, Chemical floor tile, Paving blocks.

Works—Corry, Erie County

Pres., J. L. Stone Secy., A. J. Haseltine

No. of employees: 37

DARLING BRICK AND MINING CO., Darlington

Product: Face Brick.

Works—Darlington Pres., C. F. Miller Secy., H. F. Reed

No. of employees: 52

DARLINGTON FIREPROOFING CO., THE, Alliance, Ohio

Product: Common and face brick, Hollow tile, Fire clay.

Production: 40,000 net tons

No. of employees: 75

Annual wages: $96,100.00
HEAVY CLAY PRODUCTS (Continued)

DAVIDHEISER AND SONS, F. B., STOWE  
Product: Brick.  
Capacity: 18,000 per day.  
Fuel: Steam; 500 HP capacity.

DERSINE, DAVID D., TELFORD  
Product: Building brick, Clay.  
Capacity: 150,000 brick per day.  
No. of employees: 10

DEIHL AND WAMPOLE, PERKASH  
Product: Red clay flower pots.

DONLEY BRICK CO., WASHINGTON  
Product: Common brick, Building block, tile, Radial chimney brick.  
Annual wages: $32,500.00  
No. of employees: 34

DUNN BRICK AND TILE CO., EXTENSION E. 12th St., ERIE  
Product: Face and common brick, Construction tile.  
Production: 500,000 brick, 7,500,000 tile  
No. of employees: 62

ELIVERS POTTERY CO., W. H., NEW BRIGHTON  
Product: Flower pots.  
Production: 5,993,454 pieces  
Annual wages: $58,001.00  
No. of employees: 46

EMAUS BRICK CO., EMAUS  
Product: Building brick.

ENTRESS BRICK CO., 2408 BEDFORD AVE., PITTSBURGH  
Product: Common building brick.  
Production: 4,218,000  
Annual wages: $24,183.65  
No. of employees: 34

EPHATA BRICK WORKS, 20 EPHATA ST., EPHATA  
Product: Smooth pressed and rough texture face brick.  
Capacity: 20,000 daily  
Production: 444,000  
No. of employees: 8

CERAMIC INDUSTRIES OF PENNSYLVANIA

FAIRVIEW STATE HOSPITAL, WAYNE  
Product: Brick.

FAYETTE FIRE BRICK CO., 708 CITIZENS' BLDG., UNTONTOWN  
Product: Building brick. (Closed in 1928)

FENATI BRICK CO., 339 LAUREL BOULEVARD, NEW CASTLE  
Product: Face and common brick, Roofing tile.  
Proprietor: H. M. Fenati  
Capacity: 8,000,000  
Production: 7,415,000

FERRO BRICK CO., WATSONTOWN  
Product: Building brick.

FIELDS BRICK CO., THE, 10TH AND BROOMALL ST., CHESTER  
Product: Building brick.

FISKE AND CO., INC., 18 NEWBURY ST., BOSTON  
Product: Buff and gray face brick.

FLURIE, E. F., 5TH AND BRANDY ROAD, NEW CUMBERLAND  
Product: Common brick.

FLURIE, E. F., 5TH AND BRANDY ROAD, NEW CUMBERLAND  
Product: Common brick.

G. E. FLEURIE  
Capacity: $3,000,000  
Production: 1,760,000

G. E. FLEURIE  
Capacity: $3,000,000  
Production: 1,760,000

One ceramic engineer.

One ceramic engineer.
HEAVY CLAY PRODUCTS (Continued)

FLOREY'S BRICK WORKS, INC., ROSELYN
Works—Fairview Village, Product: Building brick.
Roselyn
Pres., W. Florey
Secy., James Florey, Jr.
No. of employees: 32

FOX CO., JAMES T., SHALER AND MCKNIGHT STS., W. E., PITTSBURGH
Works—Pittsburgh, Product: Common brick.
Pres. and Gen. Mgr., J. T. Fox
Capital: $100,000
Production: 2,659,481
Annual wages: $25,287.97
No. of employees: 80

FREDERICK BROTHERS, 15TH AND ALLEN STS., ALLENTOWN
Works—Allentown, Product: Building brick.
Pres., R. I. Frederick
No. of employees: 30

FREEPORT BRICK CO., FREEPORT
Works—Freeport, Product: Building brick.
Pres., W. F. Heinle
Secy., J. H. Oppenheimer
No. of employees: 69

GETTYSBURG DRAIN TILE WORKS, GETTYSBURG
Works—Gettysburg, Product: Round drain tile.
Owner and Gen. Mgr., Edwin P. Pfeffer
(Plant run from April 30 to Oct. 20)
Capital: $19,000
Production: 850 tons
Fuel: Gas coal; 210 tons, annual value: $1,050.00
Electricity purchased, 25 HP capacity: $270.00
No. of employees: 7
Annual wages: $2,107.00

GLEN-GERY SHALE BRICK CO., 210 N. FIFTH ST., READING
Works—Reading, Product: Building brick, Face brick.
Glen-Gerysville, Hollow and floor tile.
Pres., A. A. Gery
V. Pres., F. S. Gery
Treas., W. S. Weaver
Secy., M. H. Gery
Gen. Mgr., A. A. Gery
Capital: Stock, $2,891,118.75
Bonds, $644,500.00

HARRISBURG FACTORY, 11TH AND SIKANA STS., HARRISBURG
Supt., Harry E. Potteiger
Process: Stiff mud; one continuous 22 chamber Haigh kiln
5 down draft kilns, 30 ft. round.
All shale quarried by Company.
Fuel: Coal for burning. Total consumption for 4 factories, 60,000 tons.
Electricity purchased, 450 HP capacity, annual value: $144,000.00
No. of employees: 62
Annual wages: $85,152.00
2 ceramic engineers.

SHOEMAKERSVILLE FACTORY, SHOEMAKERSVILLE
Supt., Frank Kline
Capacity: 110,000 per day
Process: Stiff mud; 12 rectangular down draft kilns
Fuel: Electricity purchased, 900 HP capacity, annual value: $240,000.00
No. of employees: 94
Annual wages: $229,163.62

CERAMIC INDUSTRIES OF PENNSYLVANIA

HEAVY CLAY PRODUCTS (Continued)

READING SHALE FACTORY, WYOMISSING
Supt., Frank Noll
Process: Stiff mud; 21 round down draft kilns, 28 ft. diam.
Fuel: Coal for burning. 900 HP capacity.
Power consumption for Reading Shale and Wyomissing factories, annual value: $300,000.00
No. of employees: 90
Annual wages: $161,235.07
One ceramic engineer.

WYOMISSING FACTORY, WYOMISSING
Supt., William Katzmann
Process: Stiff mud; one 56 chamber continuous down draft kilns.
Fuel: See Reading Shale Factory. 900 HP capacity.
No. of employees: 75
Annual wages: $147,611.04

GISE TILE WORKS, 1901 MARKET ST., YORK
Works—York, Product: Tile.
Gen. Mgr., Howard Gise
No. of employees: 9
Production: 218,120
Annual wages: $3,518.36

GLONINGER AND CO., MALONEY BLDG., PITTSBURGH
Gen. Mgr. and Prop., J. H. Gloninger
Capital: $250,000
No. of employees: 53
Production: 7,122,000
Annual wages: $72,888.00

GOODWIN, JOHN A., PERKASIE
Works—Perkasie
Pres., J. A. Goodwin
Secy., Edwin Goodwin
No. of employees: 8

GOUGH BRICK AND TILE CO., PAULSON AND NELSON STS., PITTSBURGH
Works—Pittsburgh, Product: Common and face brick, Tile.
Owner and Mgr., Thomas H. Gough
Plant Supt., A. S. Schreckengost
Production: 1,599,900 brick
26,500 tile
Process: Stiff mud; 4 up draft kilns.
All clay and shale quarried by Company.
Fuel: Natural gas; annual value: $10,317.22
Electricity purchased, 12½ HP capacity: $2,499.46
No. of employees: 15
Annual wages: $13,980.41

GRAFF-KITTANNING CLAY PRODUCTS CO., INC., WORTHINGTON
Works—Craigs ville, Product: Sewer pipe, Fire lining, Wall coping.
Pres., Secy., and Gen. Mgr., Richard M.
Treas., Peter Graff, 3rd.
Capital: Stock, $250,000
Production: 30,000 tons
Fuel: Coal; 900 HP, annual value: $25,367.00
328 tons coal for power, value: $5,577.00
Gas for engines purchased, 330 HP, value: $4,900.00
No. of employees: 83; one ceramic engineer.

GROTHE, WILLIAM H., 1211 MT. ROSE AVE., YORK
Works—York, Product: Soft mud brick.
No. of employees: 15
HEAVY CLAY PRODUCTS (Continued)

HAMILTON AND KELLEY, INC. (Trading as Keystone Brick Co.), Tabor and Godfrey Aves., Philadelphia

Product: Building brick.

Pres., R. D. Hamilton
V. Pres., Frank Kelley
Secy. and Treas., Edward Kelley
Capital: Stock, $679,000
Production: 25,641,000
Process: Stiff mud; Chambers Bros. Co. end cut brick machines.
9 Dutch kilns, seven 12 arch, two 24 arch.
Price: $0.75 per 1000 bricks.
Electricity purchased, 360 HP capacity, value: $9,165.22
Annual wages: $1,731,744
No. of employees: 116

HANLEY COMPANY, Bradford

Product: Face, paving, common and glazed brick, floor and hollow tile.

Capital: $1,200,000
Production: 87,000,000 brick
Annual wages: $425,100.00
No. of employees: 38

HANOVER BRICK CO., Hanover

Owner, Edwin Snyder, Jr.
(Plants for sale; closed in 1927)

HARDY, F. H., 914 Manor St., Lancaster

Product: Red earthen flower pots.

Pres. and Gen. Mgr., F. H. Hardy
No. of employees: 3

HARPER BRICK WORKS, C. M. C., Boro, Pa.

Product: Common red shale brick.

Owner, C. M. C. Harper
No. of employees: 15

HAWS CLAY PRODUCTS CO., W. H., Box 302, Clarion

Product: Face and common building brick.

Pres., J. W. Whitehill
V. Pres., L. H. Shteifer
Secy. and Treas., Russell Hopfer
Capital: Stock, $100,000
Annual wages: $4,450.00
No. of employees: 30

CERAMIC INDUSTRIES OF PENNSYLVANIA

HIGHLAND CLAY PRODUCTS, Wimberne

Product: Face brick.

Pres., R. R. Summerville
Gen. Mgr., C. R. Drummond
Capital: $300,000
Production: 5,350,000
No. of employees: 60
Annual wages: $67,000.00

HUMPHREY BRICK AND TILE CO., Brookville

Product: Hollow building tile.

Pres., L. B. Humphrey
Treas., C. H. Scott, Jr.
No. of employees: 31

HYDRAULIC PRESS BRICK CO., DEPOT NATIONAL BANK BLDG., DuBois

Product: Building brick.

Pres., E. C. Watson
Secy., W. Kleinheinz, Jr.
No. of employees: 214

JARDEN BRICK CO., 25TH ST. AND PASSENGER AVE., Philadelphia

Product: Building brick.

Pres., H. J. McKeen
V. Pres., W. W. Martin
Secy., A. M. Custer
No. of employees: 45

JOHNSTOWN BRICK AND TILE CO., P. O. Box 1006, Johnstown

Product: Building brick and tile.

Pres., W. H. Whitehill
V. Pres., L. H. Shteifer
Treas., C. M. C. Harper
No. of employees: 116

KANE, Elisha K., Kusherqua

Product: Roofing and floor tile.

Pres., E. K. Kane
Secy., G. C. Burch
No. of employees: 40

KANE BRICK AND TILE CO., Market St., St. Marys

Product: Face brick.

Pres., W. G. Bauer
V. Pres., H. J. Vollmer
Secy., D. J. Driscoll
Treas., W. H. Grant
Capital: Stock, $250,000

KANE WORKS, Kane

Capacity: 10,000,000
Production: 6,29,000

Process: Stiff mud, wire cut;
9 round down draft kilns, multiple stack type.
Fuel: Natural gas; 77,618,000 cu. ft., annual value: $29,495.00
13,000 cu. ft. gas per 1000 brick.
Electricity purchased, 250 HP capacity, value: $7,913.00
Annual wages: $43,717.97
No. of employees: 38
HEAVY CLAY PRODUCTS (Continued)

KITTANNING BUFF AND GRAY BRICK CO., 710 CHAMBER OF
COMMERCE BLDG., PITTSBURGH
Works—West Mifflin
Pres., W. A. Martin
Seyc., O. C. Yingling
No. of employees: 45
Product: Building brick.

KITTANNING CERAMICS CO., 707 E. PEARL ST., BUTLER
Works—West Franklin Twp.
Pres., Jess Cornelius
Seyc. and Tres., R. S. Cornelius
Capital: $100,000
No. of employees: 26
Product: Building tile, Backups, Partitions.
Production: 26,720 tons
Annual wages: $46,318.49

KUSCHEQUA BRICK CO., KUSCHEQUA
Works—Kuschequa
Pres., Elisha K. Kane
Seyc., G. C. Burch
No. of employees: 46
Product: Building brick, Paving and floor brick.

LANCASTER BRICK CO., P. O. BOX 484, LANCASTER
Works—B. D. B. Lancaster
Pres., W. W. Fohey
Seyc., H. A. Bevis
No. of employees: 30
Product: Building brick.

LANDIS, S. B. AND C. B., BOTETOURT TOWNSHIP
Works—New Berlinville, Berks County
Gen. Mgrs., S. B. and C. B. Landis
No. of employees: 15
Product: Common building brick.
Production: 600,000
Annual wages: $4,727.24

LANSDALE BRICK CO., LANSDALE
Pres., Robert D. Hamilton
Seyc., Edward Kelley
No. of employees: 45
Product: Building brick, Face brick.

LANZ BRICK AND TILE CO., M., 2007 E. CARSON ST., PITTSBURGH
Works—30th and Jane Sts.
S. S. Pittsburgh
Pres. and Gen. Mgr., A. Lanz
Capital: $75,000
No. of employees: 30
Product: Brick and tile.
Production: 5,800,791 pieces
Annual wages: $45,208.98

LATROBE BRICK CO., FIRST NATIONAL BANK BLDG., LATROBE
Works—Vanes
Pres., J. C. Head
Seyc., O. M. Yingling
No. of employees: 29
Product: Building brick.

LAYTON FIRE CLAY CO., McKEEFSPORT
Product: Common and paving brick, Tile.

LEHIGH BRICK WORKS, 617-18 COMMUNALITY BLDG., ALLENTOWN
Works—Salisbury Twp., Lehigh County
Gen. Mgr., Robert K. Mooser
No. of employees: 57
Product: Common building brick.
Production: 6,800,000
Annual wages: $88,945.00

LENTEN BRICK CO., 24TH ST. AND PARSIFAL AVE., PHILADELPHIA
Pres., Edward Alkins
Seyc., J. P. Hollman
No. of employees: 80
Product: Building brick.
HEAVY CLAY PRODUCTS (Continued)

MCAvoy VITRIFIED BRICK CO., THE, Liberty Trust Bldg., Philadelphia
Works—Perkiomen Junction, Philadelphia
Pres., Thomas D. McAvoy
Gen. Mgr., Eugene L. Dooye
No. of employees: 56

McFARLAND, G. R. (Lock Haven Brick and Tile Co.), Castanea
Works—Castanea
Pres., O. E. Primilble
Secy., Fred Blanctrice
No. of employees: 37

McFETRIDGE BROTHERS BRICK CO., THE, Peoples National Bank Bldg., Tarentum
Works—Greighton
Pres. and Gen. Mgr., George E. McFetridge
Capital: $70,000
Production: 2,722,824
No. of employees: 24

MAHONING SHALE PRODUCTS CO., 1522 Hanna Bldg., CLEVELAND, Ohio
Works—Edinburgh, Lawrence County
(Plant not operating)

MARTIN BRICK CO., 719 Chamber of Commerce Bldg., Pittsburgh
Works—Caldery, Butler County
Pres., S. C. Martin
Secy., Orvis C. Yingling
No. of employees: 24

MARTIN BRICK AND PAVING CO., Glasseroe, Nescopeck, Pennsylvania
Pres. and Gen. Mgr., T. Martin
Capital: $75,000
No. of employees: 15

MAYER, F. C., Bridgeville, Pennsylvania
Works—Bridgeville
Owner, F. C. Mayer
Capital: $50,000
Production: 8,000,000
No. of employees: 60

MENEFEE, J., Monessen, Pennsylvania
Works—Monessen, Butler County
Owner, J. Menefee
No. of employees: 12

METROPOLITAN PAVING BRICK CO., 1017 Renkert Bldg., Canton, Ohio
Works—Bexhoer
Pres., O. W. Renkert
V. Pres., C. C. Blair
Secy. and Treas., J. G. Barbour
Gen. Supt., R. C. Walks

Plant No. 1
Supt., Chester Chaddock
Capacity: 6500 tons per month
Production: 25,345,000

Capital: Stock, $200,000
Process: Stiff mud; 13 rectangular periodical down draft kilns, 13 x 87.
Shale, overlaying Vanport limestone, and Lower Kittanning Fire clay mined by Company
Fuel: Bituminous coal; 7320 tons, annual value: $15,000
375 lbs. coal per 1000 brick
Electricity purchased, 278 HP capacity: $6,521.80
No. of employees: 50
Annual wages: $55,075.49

CERAMIC INDUSTRIES OF PENNSYLVANIA

HEAVY CLAY PRODUCTS (Continued)

PLANT No. 2
Supt., Paul Kamerzanger
Capital: Stock, $150,000
Production: $54,131.00
Process: Stiff mud; one Haigh continuous tunnel kiln
Fuel: Gas slack coal; 20,800 tons, annual value: $55,471.99
350 lbs. coal per ton brick
Electricity purchased, 500 HP capacity: $2,454.90
No. of employees: 50
Annual wages: $20,816.10

MILL HALL BRICK WORKS, THE, MILL HALL
Works—Mill Hall
Pres., Iras H. Smith
V. Pres., Alexander Bleth
Secy. and Treas., Richard W. Kintzing
Capital: Stock, $31,400
Production: 1,000,000
Process: Stiff mud; side out.
Fuel: Soft coal; 370 tons, annual value: $6,886.25
151 tons coal per 1000 brick
1815 tons coal for power, 250 HP capacity: $8,612.25
No. of employees: 46
Annual wages: $24,899.41

MILLER AND SON, C. E., York, Pennsylvania
Works—York
Pres., C. E. Miller
Secy., C. H. Miller
No. of employees: 10

MILLIKEN BRICK CO., 1201 St., Wilkinsburg, Pennsylvania
Works—Wilkinsburg
Pres., W. F. McCrady
Treas., A. H. McCall
Secy., K. C. Milliken
Capital: Stock, $200,000
Production: 12,000,000 annually
Fuel: Stiff mud; rotating wire cutter.
6 Wilson down draft rectangular kilns.
Fuel: Bituminous coal; 7320 tons, annual value: $15,000
375 lbs. coal per 1000 brick
Electricity purchased, 278 HP capacity: $6,521.80
No. of employees: 50
Annual wages: $55,075.49

MONONGAHELA CLAY MFG. CO., ALEXANDER BANK BLDG., Monongahela
Works—Monongahela
Pres. and Gen. Mgr., H. B. Simpson
Capital: $200,000
Production: $56,015 face
8,007,761 common
117,599 tile
No. of employees: 40
Annual wages: $34,530.23

MOUNT GRETN A BROWNSTONE CO., SHEFFIELD AND WOODLAND CO., Lebanon, Pennsylvania
Works—Mt. Gretna, Lebanon County
Pres., T. T. Linesrower
Secy., W. L. Linesrower
No. of employees: 10

NAZARETH BRICK CO., Nazareth, Pennsylvania
Work—Nazareth
Pres., H. C. Rafetto
Secy., W. J. Rafetto
No. of employees: 64

Product: Building brick.
HEAVY CLAY PRODUCTS (Continued)

NEW BETHELHEM TILE CO., NEW BETHELHEM
Works—New Bethlehem
Product: Salt glazed hollow building blocks.
Gen. Mgr., Ira E. Lower
Secy., Clarence G. Lower
Treas., Lloyd C. Lower
Factory Mgr., Harold J. Lower
Capacity: 100 tons per day
Fuel: Natural gas for burning.
Bonnet No. 22 machine. 13 round down draft kilns.
All clay quarried by Company.
Electricity purchased, 318 HP capacity.
No. of employees: 35
Annual wages: $45,143.04

NEW CASTLE MINING AND CLAY PRODUCTS CO., 705 COUNTER ST., NEW CASTLE
Works—New Castle
Product: Building brick, Face brick, Tile.
Pres., M. A. McQuire
Secy., C. H. Andrews
No. of employees: 41
Annual wages: $81,000.00

NEW CUMBERLAND BRICK CO., NEW CUMBERLAND
Works—New Cumberland
Product: Building brick.
No. of employees: 19
Annual wages: $45,143.04

NORRISTOWN BRICK CO., 629 NOBLE ST., NORRISTOWN
Works—Norristown
Product: Building brick.
Pres., J. Frank Boyer
Gen. Mgr., William H. Mull
Capital: $50,000
Production: 4,924,000
No. of employees: 50
Annual wages: $66,510.76

PATERSON FIRE BRICK CO., CLEARFIELD
Works—Paterston, Clearfield County
Product: Building brick.
Pres., A. Paterson
Secy., R. S. Paterson
Treas., R. B. Paterson
No. of employees: 85

PATTON CLAY MFG. CO., PATTON
Works—Patton
Product: Sewer pipe, Brick.
Pres., Henry F. Good
V. Pres., George S. Good
Treas., Ralph E. Good
Secy., F. Fred Blankenhorn
Capital: Stock, $50,000
Capacity: 50,000 tons pipe, etc.
18,000,000 brick
Production: 21,000,000 pipe
10,000,000 brick
Process: Stiff mud; 2 sewer pipe presses, one Freese machine.
7 square and 30 round down draft kilns.
10,000 tons fireclay purchased annually.
Fuel: Bituminous coal; 27,739 tons, annual value:...$85,546.60
44 tons coal per ton product
8120 tons coal for power, annual value:......$19,633.57
Electricity purchased, 600 HP capacity,......$14,927.27
No. of employees: 256
Annual wages: $317,000.48

PAXTON BRICK CO., (WATSONTOWN BRICK CO.), WATSONTOWN
Works—Paxtonville
Product: Building brick, Paving blocks.
Pres., Edgar Summers
Gen. Mgr., J. C. Fowler
Capital: $100,000
Production: 11,450,000
No. of employees: 50
Annual wages: $88,073.00

CERAMIC INDUSTRIES OF PENNSYLVANIA

PEARSON BRICK CO., 115 E. NORTH ST., NEW CASTLE
Works—Hickory Tp., Volant, Lawrence County
Product: Face, Common, Building brick, Fireproofing tile.
Pres. and owner, S. D. Pearson
No. of employees: 60
Production: 50,000 tons

PEARSON BRICK MFG. CO., PEARSON BLDG., NEW CASTLE
Works—Plant No. 2, Volant
Product: Hollow warre, Backup, load bearing and partition tile.
Pres., C. A. Stewart
Secy. and Treas., P. W. Griffin
Gen. Mgr., S. D. Pearson
Capital: Stock, $60,000
Capacity: 36,000 tons
Process: Stiff mud; combined Fate machine Stevenson dry pans.
8 round down draft kilns, 32' diam., 120 tons capacity.
Fuel: Coal; 5000 tons, annual value:......$827,000.00
Electricity purchased, 200 HP capacity:......$7,000.00
No. of employees: 29
Annual wages: $85,000.00

PENN BRICK CORP., 27 MAIN ST., BRADFORD
Works—Bradford
Product: Building brick.
No. of employees: 41

PENNSYLVANIA CLAY PRODUCTS CO., WEST WINFIELD
Works—West Winfield
Product: Sewer pipe, Flue lining.
Pres., Col. William Kaul
Secy., B. T. Darr
No. of employees: 77

PENNSYLVANIA FIREPROOFING CO., ST. MARYS
Works—St. Marys
Product: Hollow building tile.
Pres., J. M. Emerson
Secy., Treas. and Gen. Mgr., W. A. England
Capital: Stock, $325,000
Capacity: 350 tons per day
Production: 84,004 tons
Process: Stiff mud; Maximuller grinders.
40 round down draft kilns, 32 ft.
Fuel: Coal; 29,010 tons, annual value:......$80,746.98
500 lbs. coal per ton tile.
Electricity purchased, 1100 HP capacity:......$24,715.75
No. of employees: 161. (Extensive improvements designed to cut cost of production and improve tile)

PERRY MFG. CO., 82 FAYETTE ST., UNXZTOWN
Works—Perryopolis, Fayette County
Product: Common building brick.
Alson C. Eggers
S. E. Eggers
John F. TORRENS
Capital: Stock, $60,000
Capacity: 35,000 per day
Production: 2,167,000 annually
Process: Stiff mud; E. M. Freese equipment.
2 round kilns, 35 ft. diam. (inside)
One rectangular Wilson-type kiln, 17 x 60 ft.
7233 tons shale quarried annually by Company.
Fuel: Washington Run Red Ash coal for burning; value $1,494.00
Gas for drying; annual value:.......$45,935.17
Electricity purchased, 215 HP capacity,......$2,674.12
No. of employees: 15
Annual wages: $15,300.00

PFALTZGRAFF POTTERY CO., YORK
Works—York
Product: Stoneware, Flower pots.
Pres. and Gen. Mgr., G. W. Pfaltzgraff
Capital: $200,000
Production: 3,000,000 gals.
Process: 5 periodic kilns.
No. of employees: 100
Annual wages: $164,010.00
HEAVY CLAY PRODUCTS (Continued)

PHILADELPHIA CLAY CO., 1201 CHESTNUT ST., PHILADELPHIA
Works—Sharon Hill, Tolland, Cumberland County
Pres., W. R. Chapman, Jr.
Secty., F. H. Wiess
Gen. Mgr., W. S. Rodgers
No. of employees: 148
Product: Common building brick, Clay.

PITTSBURGH CLAY PRODUCTS CO., KEENAN BRIDGE, PITTSBURGH
Works—Pittsburgh, Beaver County
Pres. and Treas., T. E. Wilson
V. Pres., J. S. Hunter
Secty., R. F. Warren
Capital: Stock, $150,000
Capacity: 10,000,000
Process: Stiff mud, wire cut; one brick machine.
Fuel: 5½" lump coal; 5800 tons annually
$20,000.60
1600 lbs. coal per 1000 bricks
Electricity purchased, 300 HP capacity:
$6,517.37
No. of employees: 42
Annual wages: $57,235.80
Product: Brick and tile.

PRICE BRICK CO., CHESTER
Works—Chester
Gen. Mgr., W. L. Phalen
Capital: $250,000
Production: 7,250,000
No. of employees: 30
Product: Building brick.
Annual wages: $62,000.00

ROBINSON CLAY PRODUCT CO. OF PENNA., CLEARFIELD
Works—Clearfield
Pres., E. B. Munton
Treas., J. C. Sarr
Secty., D. J. Rockwell
Capital: Stock, $500,000
Production: 40,344 tons
Process: 27 round down draft kilns, 35', 75 tons capacity.
Fuel: Coal: 30,000 tons, annual value:
$20,000.00
10,000 tons coal for power, value:
$20,000.00
8½ ton coal per ton ware.
Electricity purchased, 450 HP capacity:
$3,196.62
No. of employees: 158
Annual wages: $312,999.65
Product: Sewer pipe, Wall coping, Fire clay.

ROTH, ADAM E., POTTS TOWN R. D. 5
Works—Stone, Montgomery County
Gen. Mgr., John D. Roth
No. of employees: 12
Product: Building brick.

ROYALTON FACE BRICK CO., MIDDLETOWN
Works—Royalton
Pres., George H. West
Secty., C. W. Kellogg
Treas., E. L. Winner
Mgr., W. W. Swengel
Capital: Stock, $100,000
Capacity: 13,100,000
过程: Rough; Mccoe Roll crusher; American pulverizer.
Fuel: Westmoreland gas coal: 4020 tons, annual value:
$18,719.00
650 lbs. coal per 1000 bricks
Electricity purchased, 225 HP capacity, value:
$2,744.46
No. of employees: 53
Annual wages: $70,882.00
Product: Face brick, No. 2 backers.

SAINT MARYS CLAY PRODUCTS CO., 8TH ST., MARYSVILLE
Works—Marysville
Pres., William Kaul
Secty., B. T. Darr
No. of employees: 120
Product: Sewer pipe, Wall coping,
Flue linings.

CERAMIC INDUSTRIES OF PENNSYLVANIA

HEAVY CLAY PRODUCTS (Continued)

SAINT MARYS SEWER PIPE Co., ST. MARYS
Works—St. Marys
Pres., William Kaul
Secty., B. T. Darr
No. of employees: 195
Product: Sewer pipe, Flue lining, Wall coping.

SANKEY BROTHERS, 2112 CORSON ST., S. S. PITTSBURGH
Works—Head 21st St., Pittsburgh
Pres., William E. Sankey
V. Pres., Edwin W. Sankey
Secty. and Treas., Frank M. Sankey
Mgr., James W. Sankey
Capital: Stock, $100,000
Capacity: 9,000,000
Process: Stiff mud; 3 down draft, 3 open top kilns.
Fuel: Coal, annual value:
$18,470.00
Electricity purchased, 100 HP capacity:
$6,494.00
No. of employees: 53
Annual wages: $83,014.39
Product: Red common brick, Face brick, Hollow tile.

SCHMITT'S SONS BRICK MFG. CO., JOHN A., SIMPSON ST., WILLERS-BARRE
Works—Wilkes-Barre
Pres., J. A. Schmitt
Secty., Martin E. Schmitt
No. of employees: 23
Product: Building brick.

SCHUYLKILL PRESSED BRICK CO., 132 W. MARKET, POTTSVILLE
Works—Spring Garden Jet., Schuylkill County
Pres., T. R. Dallavale
Secty., J. P. Ryan
No. of employees: 24
Product: Building brick.

SEITERS SONS CO., F., "G" ST. AND ERIE AVE., PHILADELPHIA
Works—Philadelphia
Partnership
Gen. Mgr., Girard Seitter
Capital: $200,000
Production: 11,849,000
No. of employees: 44
Product: Common brick.
Annual wages: $98,463.20

SHAWMUT CLAY MFG. CO., ST. MARYS
Works—Shawmut, Elk County
Product: Flue lining, Electrical clay conduit.

SHERICK SHAPE BRICK CO., 245 W. WALNUT ST., LANCASTER
Works—Lancaster
No. of employees: 2
Product: Building brick.

SHERWOOD BROTHERS CO., NEW BRIGHTON
Works—New Brighton
Pres., G. P. Kennedy
V. Pres., J. S. Sherwood
Secty., F. G. Elverson
Gen. Mgr., R. W. Kennedy
No. of employees: 52
Product: Stoneware.

SINER, H. M. AND C. B., CHURCH AND CONWAY STS., PHILADELPHIA
Works—Oxford Pike and Devereux St., Product: Building brick.
Church and Stiles Sts., Phila.
Pres., H. M. Siner
Secty., G. S. Martin
No. of employees: 170
HEAVY CLAY PRODUCTS (Continued)

**SMITH CO. A. F., THE, NEW BRIGHTON**
Works—New Brighton
V. Pres., Lee B. Smith
Gen. Mgr., P. A. Smith
Capital: $30,000
No. of employees: 10

**SOISSON BRICK CO., CONNELSVILLE**
Works—Volcanic Plant, S. Connelsville, Product: Common, face, paving and fire brick.
Moyer Plant, Moyer, Fayette Cty., Davidson Plant, Connelsville
Pres., E. C. Bigbee
Gen. Mgr., V. R. Soisson
Capital: $80,000
No. of employees: 30
Annual wages: $24,364.26

**SPRING GARDEN BRICK AND CLAY PRODUCTS CO., 516 ETHEAN AVE., YORK**
Works—York
Pres., Elmer E. Frey
Gen. Mgr. and Secy., I. C. Frey
Treas., E. K. Frey
Capital: Stock, $25,000
Capacity: 10,000,000 brick
Production: 9,000,000 brick
Process: Soft mud; waste heat and steam dryers.
Fuel: Gas; 5000 tons, annual value: $25,000.00
Production: 10,000 tons for power, value: $5,000.00
Electricity purchased, 200 HP capacity: $2,189.00
Annual wages: $49,782.26
No. of employees: 44

**SQUIRREL HILL BRICK CO., BIGELOW AND BRISTOL STS., PITTSBURGH**
Works—Pittsburgh
No. of employees: 14

**STANDARD CLAY PRODUCTS CO., FALLSTON**
Works—Fallston
Gen. Mgr., E. H. Pettis
No. of employees: 31

**STARR CO., A. Q., 300 BRUSHINGTON AVE., PITTSBURGH**
Works—Mars
Capital: Stock, $140,000
Production: Face and common brick.
Capacity: 5,000,000
Fuel: Coal
Annual wages: $44,000.00
No. of employees: 30

**STUEMLEE'S SONS, DAVID, WILLIAMSPORT**
Works—Williamsport
(Not operating; plant for sale.)
Product: Red shale wire cut brick.

**TORRESDALE BRICK CO., PHILADELPHIA**
Works—Torresdale
Pres., A. J. Rothensall, Jr.
Gen. Mgr., J. J. Brine
Capital: $100,000
No. of employees: 54

**CERAMIC INDUSTRIES OF PENNSYLVANIA**

**TURNER BRICK CO., J. L., 118 MARKET ST., NANTICOKE**
Works—Nanticoke, Pennsylvania
Pres., Thomas W. Turner
Treas., J. L. Turner
Mgr., A. D. Smith
Capital: Stock, $150,000
Production: 767,600 brick
782 tons clay
35 tons cement
Process: Soft mud; exhaust steam dryer.
7 round down draft kilns, 30' inside diam.
Fuel: Rice anthracite coal; 600 tons, annual value: $1,110.00
400 tons coal for power, 200 HP capacity: $740.00
No. of employees: 17
Annual wages: $17,800.00

**TYRONE BRICK AND TILE CO., TYRONE**
Works—Tyrone
Product: Building brick.
No. of employees: 20

**UNION SEWER PIPE CO., McKeesport**
Works—Fleming Quarry
(Not in operation in 1928)
Produced: Saver pipe, Fire clay products.

**UNITED SHALE BRICK CO., S. STADIUM ST. AND R. L., EPHRATA**
Works—Ephrata
Pres. and Gen. Mgr., George W. Kinzer
Product: Face brick, Common brick, Hollow tile, Paving brick.
Capital: Authorized, $100,000
Capacity: 12,000,000

**UPPER KITTANNING BRICK CO., 1 NEWARK ST., HOBOKEN, N. J.**
Works—Beauchamp
Prod.: Face and fire brick.
Treas., G. M. Armstrong County
Secy., F. Ginnery
No. of employees: 40

**VALLEY BRICK CO., Tarentum**
Works—Valley Camp
Pres. and Gen. Mgr., H. W. Boyd
Secy., and Supt., R. H. Boyd
Capital: Stock, $5,000
Capacity: 6,000,000
Production: 3,493,000
Process: Soft mud; Presses brick machines.
6 down draft round kilns, 32 ft. diam. All shale quarried by Company.
Fuel: Bituminous coal for burning and power, 5275 tons; $10,775.14
One ton coal per 1000 brick.
Power capacity of plant, 125 HP.
No. of employees: 22
Annual wages: $30,880.14

**VAN ORMER BRICK CO., INC., BROADWAY, PITCAIRN**
Works—Pittsburgh
Pres., George I. Beavick
Treas., J. H. Cunningham
Capital: Stock, $50,000
Capacity: 10,000,000
Process: Soft mud; Riddell grinder and double-shaft mill.
Tyler vibrating screen; Blaw Knox dust bin; Chambers sugar machine; Steeple cutter.
4 Wilson down draft rectangular kilns, 21' x 70'.
Fuel: Coal and natural gas; 2829 tons coal, annual value: $7,050.00
13,541,215 cu. ft. gas, annual value: $3,018.61
Electricity purchased, 303 HP capacity, annual value: $4,822.72
No. of employees: 26
Annual wages: $52,926.53
HEAVY CLAY PRODUCTS (Continued)

WAGNER, THOMAS A., LEBANON, R. D. 1
Works—N. Lebanon Twp.  
Capital: Stock, $90,000  
Product: Brick, Lime.  
Capacity: 3,000,000 brick  
12,000 tons lime  
Production: $91,000 brick  
8,607 tons lime  
Process: Soft mud; 2 Dutch kilns.  
5 vertical kilns for lime burning.  
Fuel: Coal and coke.  
No. of employees: 27  
Power capacity of plant 332 HP.  
Annual wages: $28,183.31

WALKERS MILLS STONE AND BRICK CO., 1304-7 KEENAN BLDG.,  
PITTSBURGH  
Works—Walkers Mills  
Pres. and Gen. Mgr., T. E. Wilson  
Capital: $35,000  
Production: 6,900,000  
Annual wages: $51,955.00  
No. of employees: 40

WALTER ESTATE, SCOTT B., GREENCASTLE  
Works—Green Castle  
Product: Common brick.  
(No brick manufactured in 1928.)

WARD AND SONS CO., JOHN IL, OAKWOOD AND BAYTIA STS., PITTSBURGH  
Works—Pittsburgh  
Pres., D. C. Ward  
Secy., W. J. Ward  
No. of employees: 18  
Product: Common brick, Building tile.

WATSONTOWN BRICK CO., WATSONTOWN  
Works—Watsonstown  
Pres., Edgar Summers  
Gen. Mgr., J. C. Fowler  
Capital: $100,000  
Production: 18,200,000  
Annual wages: $92,606.00  
No. of employees: 77

WEST SHORE BRICK CO., NEW CUMBERLAND  
Works—(New Cumberland Brick Co.).  
Product: Building brick.  
New Cumberland  
Partnership: Frank Fishman  
No. of employees: 4

WILKES-BARRE BRICK CO., WILKES-BARRE  
Works—Breslaw, Luzerne County  
Pres., William Aston  
Secy., John R. James  
No. of employees: 10  
Product: Building brick

WILLARD KITTANNING BRICK MFG. CO., KITTANNING  
Works—Kittanning  
Pres., W. R. Willard  
V. Pres., C. T. Willard  
Supt., G. W. Foster  
No. of employees: 118  
Product: Face brick.

WINDBER BRICK CO., HILLSIDE AVE., WINDBERG  
Works—Winder  
Pres., E. E. Reese  
Gen. Mgr., E. P. Ammerman  
Capital: $40,000  
Capacity: 8,000,000  
Process: Soft mud  
6 round kilns, 33 ft.; 15,000 capacity.  
Fuel: Coal; 6,000 tons, annual value: $8,559.00  
500 tons coal used for power, value: $750.00  
1200 lbs. coal per 1000 brick.  
Steam capacity of plant, 305 HP.  
No. of employees: 41  
Annual wages: $57,486.25

CERAMIC INDUSTRIES OF PENNSYLVANIA

HEAVY CLAY PRODUCTS (Continued)

WISE AND BROTHER, C., 750 W. VINE ST., LANCASTER  
Works—Lancaster  
Gen. Mgr., J. A. Wise  
Capital: $15,000  
Production: 2,000,000  
No. of employees: 18  
Annual wages: $22,115.65

WYNN BRICK CO., TRAPPIST, WESTMORELAND COUNTY  
Pres., H. T. Wynn  
Secy., C. B. Yorkers  
No. of employees: 20  
Product: Face brick.

VINGLING-MARTIN BRICK CO., 710 CHAMBER OF COMMERCE BLDG.,  
PITTSBURGH  
Works—Johnstown  
Pres., S. C. Martin  
V. Pres., W. H. Signor  
Secy. and Treas., O. C. Yingling  
Capital: Stock $100,000  
Capacity: 60,000 daily  
Production: 6,515,000  
18 round down draft kilns, 30 ft.; individual stacks.  
Clay quarried at plant.  
Fuel: Bituminous coal; 1766 tons, annual value: $14,298.51  
1200 lbs. coal per 1000 brick.  
Electricity purchased, 300 HP capacity, value: $7,204.20  
No. of employees: 55  
Annual wages: $32,889.77

YOUGH CLAY MFG. CO., 229 W. MAIN ST., MONTONORO  
Works—Grafton  
Pres. and Mgr., W. S. Coofer  
Supt., Charles Town  
Treas., J. K. Coofer  
Capital: $250,000  
Capacity: 4,000,000  
Process: 8 oblong kilns.  
Fuel: Coal; 3000 tons, annual value: $6,774.50  
Gas for power, 275 HP capacity, value: $1,500.00  
No. of employees: 30  
Annual wages: $37,559.79

ZACHARIES AND SON, JOSEPH H., EAST STRoudSBURG  
Works—E. Stroudsburg  
Product: Common brick.  
Production: 57,120  
No. of employees: 10  
Annual wages: $6,386.00

ZEHNKER BRICK CO., PHILADELPHIA ROAD, EASTON  
Works—Easton  
Pres., Daniel Zehnstra  
Capital: $30,000  
No. of employees: 17  
Product: Common building brick.  
Production: 1,250,000  
Annual wages: $9,851.65

REFRACTORIES

ABRASIVE COMPANY, TACYON AND FRALEY ST., PHILADELPHIA  
Works—Philadelphia  
Product: Grinding wheels, Polishing grain.  
Pres., Alvan T. Simonds  
Gen. Mgr., Joseph W. McLean  
Capital: $1,500,000  
Annual wages: $304,225.00  
No. of employees: 258

AMERICAN VITRIFIED PRODUCTS CO., AKRON, OHIO  
(See Heavy Clay Products.)  
Product: Hot top brick.
REFRACTORIES (Continued)

ARMSTRONG CORK AND INSULATION CO., LANCASTER
Works—Beaver Falls
Pres., J. J. Evans
Treas., W. R. Hamilton
Gen. Mgr., Austin L. Moore
Supt., Elmer C. Ridgway
Product: Insulating brick, Insulating cement.
Capacity: 7,300,000 brick
Process: Wet mud; one Harrop continuous tunnel kiln 276 ft.
(Second continuous kiln added 1929.)
Cork, diatomaceous earth and clay purchased.
No. of employees: 27

BESSEMER BRICK CO., JOHNSTOWN
Works—Large, Allegheny County
Pres., T. M. Walton
Gen. Mgr., Austin L. Moore
Capital: $500,000
Product: Fire clay refractories.
No. of employees: 24

BOTFIELD REFRACTORY CO., SWANSON AND CLYMER STS., PHILADELPHIA
Works—Philadelphia
Proprietor, C. B. Botfield
Product: Adamant fire brick, Cement.
No. of employees: 24

BOUR REFRACTORY CO., L. J., THE, 822 CONNELLY BLDG., SCRANTON
Works—Scranton
Pres., J. A. MacFadyen
Gen. Mgr., L. J. Bour
Capital: $20,000
Product: “Bour’s Formula” High temperature cements.
No. of employees: 3
Production: 298 tons (1929)
Annual wages: $3,200.25

BRIGHTON FIRE BRICK CO., NEW BRIGHTON
Works—Pulaskie Twp., Beaver County
Pres. and Gen. Mgr., T. W. D. Addenbrook
Capital: $100,000
Product: Refractory brick, Special refractory shapes.
No. of employees: 55
Production: 3,000,000 (9’ equiv.)
Annual wages: $56,000.00

BROWN GAS LOG CO., 118 SAWMILL BOTTLE YARD, PITTSBURGH
Works—Pittsburgh
Partnership composed of:
Eugene S. Brown
Charles H. Brown
Artur S. Brown
George W. Brown
Capital: Stock, $21,500
Product: Gas and electric logs.
Production: 3,399 logs
No. of employees: 6
Annual wages: $16,070.00

CAREY MFG. CO., PHILIP, LOCKLAND, OHIO
Works—Plymouth Meeting
Pres., G. D. Crubs
Secy., E. L. Buse
No. of employees: 274
Product: Magnesia block and pipe, Magnesia asbestos cement, Cement carbonate powder.

CLEARFIELD BRICK MFG. CO., TRUST BUILDING, CLEARFIELD
(See Heavy Clay Products.)
Product: Fire brick.

CERAMIC INDUSTRIES OF PENNSYLVANIA (Continued)

CLIMAX FIRE BRICK CO., CLIMAX
Works—Climax
Pres., David Barry
Secy., T. R. Morgan
No. of employees: 102
Product: Fire brick.

CURTIS FIRE BRICK CO., MONONGAHELA
Works—Curtis
Pres., W. C. McCallister
V. Pres., H. T. Billick
Secy. and Treas., R. C. Scott
Capital: Stock, $50,000
Product: Clay sleeve, nozzle, stopper head and bottom pour brick for steel mills.
Capacity: 3,000,000 pieces
Process: 20 rectangular down draft kilns.
Fuels: Bituminous coal; annual value: $7,300.00
Electricity purchased, 220 HP capacity; value: $405.00
No. of employees: 61
Annual wages: $20,090.00

EUREKA FIRE BRICK WORKS, MOUNT BRADDOCK
Works—Mt. Braddock
Pres., E. L. Meelee
V. Pres., W. C. Mellof
Secy. and Treas., J. M. Dilworth
Product: Special refractory shapes, Standard coke oven and mill brick, Fire clay.
Capacity: 5,000,000 (9” equiv.)
Process: Stiff mud and hand molded; freeze peg and auger.
10 end fired New Castle kilns, 10’ x 14’ x 34’.
11,062 tons clay mined annually by Company.
Fuels: Pittsburgh and Lower Kittanning coal; 2914 tons, $11,742.00
1500 to 3000 lbs. coal per 1000 brick.
Electricity purchased, 2743/4 HP capacity; value: $6,717.35
No. of employees: 73
Annual wages: $82,525.35
One ceramic engineer.

FINDLAY CLAY PRODUCTS CO., WASHINGTON
Works—Washington
Pres., J. M. Lambie
Treas., C. H. Lambie
Capital: Stock, 4000 shares
Product: Melting pots, Tank blocks, Special shapes.
Capacity: 20 tons per day
Process: Slip casting; 2 grinding units, 6 peg mills.
8 kilns, 8 x 12 to 16 x 32.
Fuels: Coal for burning; electricity purchased.
No. of employees: 100
Annual wages: $120,200.00
One ceramic engineer.

FOX AND CO., E. S., FRONT AND FRANKLIN STS., READING
Works—Reading Partnership:
Webb S. Fox
G. Ell Fox
Secy., W. S. Fox
No. of employees: 10
Product: Stove linings, Fire brick.

FRANCE REFRACTORY CO., J. H., SNOW SHOE
Works—Snow Shoe
Pres., J. H. France
Secy., James C. Bates
Treas., H. C. McClure
Capital: Stock, $500,000
Product: Fire clay brick, Fire clay.
Capacity: 9,500,000 (9” brick)
Process: 10 round kilns, 30’, 60,000 capacity.
All fire clay mined by Company.
Fuels: Coal for burning; all electricity manufactured.
No. of employees: 140
Annual wages: $202,096.29
**REFRACTORIES (Continued)**

**GARDNER, JAMES, JR., ENSHURG**
Works—Lockport Station
(Plant shut down)

**GARFIELD FIRE CLAY CO., ROBINSON**
Works—Bolivar
Pres., W. M. Robinson
Secy., P. A. Robinson
No. of employees: 125

**GENERAL GRINDING WHEEL CORP., 3132 E. THOMAS ST., PHILADELPHIA**
Works—Philadelphia
Pres., W. D. Gherky
Gen. Mgr., S. P. Wallace
No. of employees: 86

**GENERAL REFRACTORIES CO., 106 S. 16TH ST., PHILADELPHIA**
Works—Beech Creek, Clayburg, Karthaum, Mill Hall, Mt. Union, Orvinston, Sandy Ridge, Spraul, West Decatur
Pres., Burrows Sloan
V. Pres., E. A. McKelvey and C. C. Chaney
Treas., John R. Spraul
Secy., R. A. Hirsch
Capital: 300,000 shares common capital
No. of employees for all plants in stock without par value: 
Pennsylvania: 1000

**BEECH CREEK PLANT, BEECH CREEK**
Supt., W. H. Clark
Capacity: 10,500,000
Process: 16 rectangular down draft kilns, 32,000 capacity.
Fuel: Soft coal; 1.2 tons per 1000 brick.
No. of employees: 117

**CLAYSBURG PLANT, CLAYSBURG**
Supt., P. M. Stueft
Capacity: 115,000 per day
Process: 20 round down draft kilns; 125 to 150M capacity.
Fuel: Coal; 1.57 tons per 1000 brick.
No. of employees: 344.

**KARTHAUM PLANT, KARTHAUM**
Supt., W. E. Kyler
Capacity: 7,500,000
Process: Hand made press brick, 15,000 daily.
Hand molded shapes, 10,000 daily.
12 rectangular down draft kilns, 32 x 15 x 11 ft.
Fuel: Coal;
(Plant not operated during 1928.)

**MILL HALL PLANT, MILL HALL**
Supt., A. C. Cross
Capacity: 7,500,000
Process: Dry press, stiff mud; hand molded shapes.
10 round down draft kilns, 25 inside diam.
Fuel: Coal;
(Plant not operated during 1928.)

**MOUNT UNION PLANT, MOUNT UNION**
Supt., E. G. Cowan
Capacity: 85,000 per day
Process: 28 round down draft kilns, 75 to 90M capacity.
Fuel: Coal.
No. of employees: 6

**ORVINSTON PLANT, ORVINSTON**
Supt., C. C. McChesney
Capacity: 10,000,000
Process: 20 rectangular down draft kilns, 32,000 capacity.
Fuel: Coal; 1.2 tons per 1000 brick.
No. of employees: 86

**CERAMIC INDUSTRIES OF PENNSYLVANIA**

**REFRACTORIES (Continued)**

**SANDY RIDGE PLANT, SANDY RIDGE**
Supt., R. H. Peters
Capacity: 5,400,000
Process: 12 round and rectangular down draft kilns.
Fuel: Coal; 2 net tons per 1000 brick.
No. of employees: 50

**SPROUL PLANT, SPROUL**
Supt., H. D. Stare
Capacity: 85,000 per day
Process: 22 round down draft kilns, 75 to 80M capacity.
Fuel: Coal; 1.5 tons per 1000 brick.
No. of employees: 100

**WEST DECATOR PLANT, WEST DECATOR**
Supt., Ed. Ratliff
Capacity: 15,000,000
Process: 21 rectangular down draft kilns, 55,000 capacity.
Fuel: Bituminous coal; 1.18 tons per 1000 brick.
No. of employees: 142

**HARRISON-WALKER REFRACTORIES CO., FARMERS BANK BLDG., PITTSTON**
Works—Blandburg (2), Chester, Clearfield (2), Downingtown, Grantville, Havasu (3), Mill Hall (2), Monument, Mt. Union (2), Powelton, Templeton, Wallacetown, Woodland (2).
Pres., J. E. Lewis
Secy., P. H. Hilleman
Treas., W. Foreman Hicken
Gen. Sales Mgr., W. B. Coallie
No. of employees: 2732

**HAWK REFRACTORIES CO., FARMING TRUST AND MORTGAGE BLDG., JOHNSTOWN**
Works—Hawetone, Mifflin County, Johnstown
Pres., E. L. Prouschick
Secy., Campbell Patch
No. of employees: 282

**HYZER AND LEWELLIN, SOUTHAMPTON**
Works—Southampton
Product: Special linings, brick, and magnesite.
J. Wesley Lowell
Process: One up draft kiln, 8000 brick capacity.
Fuel: Oil for burning; 14,456 lbs. annual value: 
274 gal. oil for 1000 brick.
Electricity purchased, 25 HP, annual value: 
No. of employees: 10
Annual wages: $14,456.10

**JACKSON MILLS EMERY CO., 14TH AND FRANKLIN STS., EASTON**
Works—Easton
Pres., C. A. Smit
Secy., E. L. Oertelstick
No. of employees: 22

**KEYSTONE EMERY MILLS, FRANKFORD, PHILADELPHIA**
Works—Frankford
Product: Abrasives.
Capital: $100,000
No. of employees: 27
REFRACTORIES (Continued)

KIER FIRE BRICK CO., THE, 1844 Oliver Bldg., Pittsburgh
Works—Childs, Hogue, Sulin.
Pres., S. M. Kier
Capital: $1,000,000
No. of employees: 201

KOLB, GEORGE AND WILLIAM, MEADOW AND JACKSON STS., PHILADELPHIA
Works—Philadelphia
Product: Fire brick, High temperature cement, Ground fire clay.
Partnership.
No. of employees: 27

LASTIK PRODUCTS CORP., 826 Oliver Bldg., Pittsburgh
Works—Wampum
Pres., J. deS. Freund
Gen. Mgr., D. S. Steinfirst
Capital: $50,000
No. of employees: 10

LAVA CRUCIBLE CO. OF PITTSBURGH, Warash Bldg., Pittsburgh
Product: Alumina bricks, Crucibles, Refractories.
Pres., F. M. South, Jr.
Treas., Allee Mitchell
Secy., C. R. Roy
Capital: Stock, $50,000
Process: Muffle and open fires kilns.
Fuel: Coal and gas.
No. of employees: 55; one ceramic engineer.

LAVINO REFRACTORIES CO., Bullitt Bldg., Philadelphia
Product: Silica, magnesite, and chrome brick, Clays.
Pres., E. M. Lavino
V. Pres., C. T. Kline
Secy., C. W. Rodman
No. of employees: 200

MCCORMICK CO., J. S., 5TH ST. AND A. V. R., PITTSBURGH
Works—Mauch Chuck, Pittsburgh
Pres., J. S. McCormick
Treas., F. J. Bauser
Secy., G. J. Bauser
No. of employees: 43

MCCULLOUGH-DALZELL CRUCIBLE CO., 36TH ST. AND A. V. RY., PITTSBURGH
Works—Pittsburgh
Pres., E. E. Arensberg
Secy., C. F. Dils
Capital: Stock, $150,000
Process: Open and muffle kilns.
Fuel: Coal for burning.
No. of employees: 25.

MCFEELY BRICK CO., Latrobe
Works—Latrobe
Pres., F. B. McFeely
Gen. Mgr., J. M. Seedo
No. of employees: 105

CERAMIC INDUSTRIES OF PENNSYLVANIA

MCLAINE FIRE BRICK CO., 1208 Fulton Bldg., Pittsburgh
Works—Merrill, Beaver County.
Pres., H. E. McLaing
Secy., J. E. Rehmler
No. of employees: 242

MCNALLY CEMENT CO., Cedar Ave. and Orchard St., Scranton
Product: High temperature cement.
Pres., N. T. Spruks
Secy., W. A. Hegeler
No. of employees: 5

NEW CASTLE REFRACTORIES CO., Box 193, New Castle
Product: Refractories, Terra cotta slabs.
Pres., Roger W. Rowland
V. Pres., George D. Morris
Secy. and Treas., Ralph E. Whittaker
Process: Special refractory shapes made by casting, ramming and machine press methods.
Fuel: Gas and oil.
No. of employees: 72; 3 ceramic engineers.

NORTHERN AMERICAN REFRACTORIES CO., National City Bank Bldg., Cleveland, Ohio
Works—Crescent Refractories Co., Fire Brick Co.
Pres., F. E. Gilbert
Gen. Mgr., M. C. Vollmer
No. of employees: 10

OSCEOLA SILICA AND FIRE BRICK CO., Osceola Mills
Product: Fire brick.
Pres., H. W. Todd
Treas., E. C. Blawn
Secy., C. W. Blasford
Capital: Stock, $100,000
Process: Steam press; hand molding and pressing.
Fuel: Coal; 31,477 tons fire clay fired annually by Company.
No. of employees: 210

OSCEOLA SILICA AND FIRE BRICK CO., Osceola Mills
Product: Fire brick.
Pres., H. W. Todd
Treas., E. C. Blawn
Secy., C. W. Blasford
Capital: Stock, $100,000
Process: Steam press; hand molding and pressing.
Fuel: Coal; 31,477 tons fire clay fired annually by Company.
No. of employees: 210

PEGORA PAINT CO., 4TH AND SEDGWICK AVE., PHILADELPHIA
Works—Philadelphia
Product: Stove roofing, plastic cement.
Pres., J. H. Bowen
Secy., J. E. Johnson
No. of employees: 50

PITTSBURGH CLAY POT CO., 1247 Reservoir St., Pittsburgh
Product: Fire brick, clay.
Pres., D. Taylor
Secy., J. E. McKelvy
No. of employees: 122

PITTSBURGH CLAY POT CO., 1247 Reservoir St., Pittsburgh
Product: Fire brick, clay.
Pres., D. Taylor
Secy., J. E. McKelvy
No. of employees: 122
REFRACTORIES (Continued)

PITTSBURGH GRINDING WHEEL CO., ROCHESTER
Works—Rochester

Pres., P. W. Gilbert
Seyc., M. E. Vollmer
No. of employees: 32

Product: Emery and other abrasive wheels.

PRECISION GRINDING WHEEL CO., INC., 3301 TOWNEVILLE AVE.
PHILADELPHIA
Works—Philadelphia
Pres., A. S. Vane
V. Pres., H. E. Kohn
Seyc., and Treas., H. A. Plush
Capital: Stock, $350,000
Process: 9 pottery kilns, 11½ x 16½.
Fuel: Bituminous coal; power capacity of plant, 300 HP.
No. of employees: 150; two ceramic engineers.

Product: Grinding wheels.

READING FIRE BRICK WORKS, (McHose and Co.)*, READING
Works—Reading

Pres., J. Heber Parker
Gen. Mgr., William McHose Boyer
No. of employees: 40.

Product: Fire brick, standard and special shapes.

REMMEY SON CO., RICHARD G., BROOKLYN ST. AND DELAWARE RIVER.
PHILADELPHIA
Works—Philadelphia
Pres. and Treas., R. H. Remmy
Asst. Treas., John G. Remmy
Capital: Stock, $125,000
Process: 9 round clay kilns, 55,000 capacity.
Fuel: Gas; ½ ton per 1000 brick.
Electricity purchased, annual value: $3,500.00
No. of employees: 86
Annual wages: $100,000.00
One ceramic engineer.

Product: Fire brick, special shapes.

ROGERS AND CO., FIRST AVE., ROYERSPORT
Works—Royersford
Pres., W. L. Latshaw
Treas., George Mayer
Seyc., J. Rogers
Capital: Stock, $36,000
Process: 4 round clay kilns, 12½ x 12½ feet.
Fuel: Anthracite coal; 500 tons annually.
Bituminous coal for power, 500 tons, value: $650.00
No. of employees: 13
Annual wages: $22,500.00

Product: Stove linings, Fire brick, Stove and fire clay.

ROSS-TACONY CRUCIBLE CO., TACONY, PHILADELPHIA
Works—Tacony
Pres., F. B. Davenport
Capital: Stock, $100,000
No. of employees: 47

Product: Graphite crucibles, Graphite stopper heads for pouring steel.

ST. MARYS CLAY PRODUCTS CO., ST. MARYS
(See Heavy Clay Products.)

SINTERBAS MFG. CO., WYOMING
Works—Wyoming
Pres., C. G. Carlestrom
No. of employees: 4

Product: Fire brick, refractories.

CERAMIC INDUSTRIES OF PENNSYLVANIA

REFRACTORIES (Continued)

SOISSON BRICK CO., CONNELLSVILLE
(See Heavy Clay Products.)

Product: Fire brick.

SOUTH FORK FIRE BRICK CO., SOUTH FORK
Works—South Fork, Cambria County
Product: Fire brick, Bottom tile, Tungen.

Pres., D. Barry
Seyc., E. H. Barry
No. of employees: 44

STOWE-FULLER REFRactories CO., 2003 UNION Trust BLDG., CLEVELAND, OHIO
Works—Alexandria,

Product: Silica brick, Fire clay brick, Fire clay.

Pres., C. E. Kapitzky
Seyc., C. J. Steitz
No. of employees: 131

STUPAKOFF LABORATORIES, INC., 3317 HAMILTON AVE., PITTSBURGH
Works—Pittsburgh
Product: Magnesia, Alumina, Zirconia and Porcelain refractories.

Pres., Simon H. Stupakoff
Capital: $50,000
No. of employees: 15 to 40

SUPERIOR BASIC BRICK CO., 517 BESSEMER BLDG., PITTSBURGH
Works—Bakerstown, Allegheny County
Product: Gunite brick, Magnesite fire brick.

Pres., H. B. Graninger
Seyc., J. M. Dixon
No. of employees: 12

SUPERIOR SILICA BRICK CO., LATROBE
Works—Port, Matilda

Product: Silica brick.

Pres., F. B. McFadden
Gen. Mgr., J. M. Steel
No. of employees: 122

SWANK'S SONS, INC., HIRAM, P. O. Box L, JOHNSTOWN
Works—Clymer,

Product: Fire brick.

Pres., Ralph L. Swank
V. Pres., A. M. Swank
Seyc., and Treas., Frank D. Phillips
Capital: Stock, $170,600
Bonds, $65,000

JOHNSTOWN PLANT, JOHNSTOWN
Production: 6,242,944 brick

Process: Stiff mud, special equipment. 15 down draft kilns, 22 x 30 ft.
19,970 tons clay purchased annually.
Fuel: Coal; 32,698 tons; annual value: $32,698.18
1½ tons coal per 1000 brick.
Electricity purchased, 38 HP capacity: $12,559.99
No. of employees: 124
Annual wages: $202,915.20

IVONIA PLANT, IVONIA
Production: 10,362,920 (9½ equiv.)

Process: Hand made and dry press; standard equipment.
24 down draft kilns, 22 x 35 ft.
All clay mined by Company.
Fuel: Coal; 33,285 net tons; annual value: $51,169.63
1½ tons coal per 1000 brick.
6,427 tons coal for power, annual value: $14,212.33
Electricity purchased, 712½ HP capacity: $1,394.00
No. of employees: 148
Annual wages: $191,957.99
REFRACTORIES (Continued)

Clymer Plant, Clymer
Production: 6,404,114 (9" equiv.) 1,282 tons radial chimney block

Process: Stiff mud; special equipment.
13 down draft kilns, 22 x 45 ft.
All clay mined by Company.

Fuel:
Coal: 17,685 net tons; annual value: $27,717.02
1 4/3 tons coal per 1000 brick.
1,225 net tons coal for power, value: $1,019.15
Electricity purchased, 455 HP capacity: $15,781.24
No. of employees: 90
Annual wages: $140,117.90

TANITE COMPANY, Stroudsburg
Works—Stroudsburg
Pres., J. R. Feinleid
Sec., J. M. Austin
No. of employees: 8

Product: Abrasive materials.

UNITED STATES REFRACTORIES CORP., Mount Union
Works—Mount Union,
Barrett Sta. Clearfield County
(Savage Mt. Fire Brick Co., Frostburg, Maryland.)

Pres., Thomas W. Lunt
V. Pres., C. W. Houseman
Secy. and Treas., E. L. Wallett
Capital: Common stock, $500,000
Preferred, $50,000
Bonds, $250,000

Process: Dry clay brick made by stiff mud, hand made and dry press.
Silica brick, hand and machine made.
Mt. Union: 20 kilns, rectangular and round, down and up draft.
Barrett: 12 kilns, (as above)

Fuel: Bituminous coal; 39,550 tons annually.
Power capacity, Mt. Union: 500 HP, Barrett: 400 HP.
No. of employees: 535
Annual wages: $442,616.50

REFRactories (Continued)

WELCH-BRIGHT CO., Monaca
Works—Monaca
Product: Fire brick, Fire clay.
Pres. and Gen. Mgr., C. S. Marshall
Capital: $125,000
Annual wages: $43,120.83
No. of employees: 34

WESTMORELAND BRICK CO., 906 Federal Reserve Bldg., Pittsburgh
Works—Hunkers, New Brighton
Pres. A. H. Leitch Secy. J. C. Leitch
No. of employees: 100

WILLET'S COMPANY, S. 10th St., Pittsburgh
Works—Pittsburgh
Pres., E. Ingold Secy., H. G. Willetts
No. of employees: 40

WOODS-LLOYD CO., 30th and Jane St., Pittsburgh
Works—Pittsburgh
Product: Tank blocks,
Glasshouse supplies, Refractories, Fire clay mortar.
Pres., J. W. Lloyd
Treas. and Gen. Mgr., A. T. Houser
Secy., C. H. Higgins
Capital: Stock, $100,000
Capacity: 5000 tons tank blocks
Process: 12 rectangular down draft kilns, 12 x 14 in.
Fuel: Natural gas, annual value: $10,000.00
No. of employees: 10
Annual wages: $89,000.00

WHITE WARE
AMISSON AND SONS POTTERY CO., L. 2421 Wilson Ave., Bristol
Works—Bristol
Product: Plumbers' sanitary earthenware, Vitreous china.
Pres. and Gen. Mgr., Josiah Amisson
Purchasing Agent, Joseph Gsatter
Process: 2 periodic kilns.
No. of employees: 24

BEAVER REFRIGERATOR AND POTTERIES CO., Allegheny St., New Brighton
Works—New Brighton
Product: Sanitary ware.
Pres., W. C. McKee
Secy., A. R. Mitchell
No. of employees: 47

BELMONTe COMPANY, INC., Newtowm
Works—Newtown
Product: Pottery
No. of employees: 9

CANoNSBURG POTTERY CO., Canonsburg
Works—Canonsburg
Product: Bisque and g lost semi-porcelain ivory ware.
Pres., W. C. George
V. Pres., F. C. George
Secy. and Treas., M. C. George
Capital: Stock, $600,000
Capacity: 350 glost kilns
Process: 11 upright periodic kilns, 16½ ft. diam., 18½ ft. diam.
19½ ft. diam., one tunnel kiln
Fuel: Gas and coal; annual value: $55,000.00
Cost to fire each kiln: $126.00
Electricity purchased, monthly cost: $250.00

VesuviUs Crucible CO., Swissvale
Works—Swissvale
Product: Graphite crucibles and stoppers.
Pres., F. L. Arensberg
Secy., A. J. Jackman
No. of employees: 41
WHITE WARE  (Continued)

No. of employees: 315
One ceramic engineer.

CURTIS POTTERY STUDIO, E. de. F., WAYNE
Works—Conestoga Road, Stroudsburg
(Mr. Curtis operates individually.)

Product: Art pottery.

ELDER COMPANY, FORD CITY
Works—Ford City

Product: Vitreous china plumbing fixtures.

Pres., R. E. Crane
Secy., D. E. Guilek
Supt., P. D. Helser
Process: 8 periodic kilns; 2 tunnel kilns.
No. of employees: 226; 1 ceramic engineer.

ENFIELD POTTERY AND TILE WORKS, ENFIELD
(See Terra Cotta.)

FRANKLIN POTTERY, INC., LANSDALE
Works—Lansdale

Product: Tile, (floor and wall), Bathroom accessories, Lighting fixtures.

Pres., Malcolm Schweiker
Mgr., Roy A. Schueker
Capital: $1,250,000
Process: All clay products; 2 tunnel kilns.
No. of employees: 402
Annual wages: $405,000.00

GEORGE POTTERY CO., W. S., EAST PALATINE, OHIO
Works—Caronb, Kittanning

Product: White and ivory dinnerware.

Pres. and Gen. Mgr., W. C. George
Supt. (Caronb), A. C. Ward
Supt. (Kittanning), E. C. George
Process: 8 periodic kilns; one tunnel kiln.
No. of employees: 361; one ceramic engineer.

JACKSON VITRIFIED CHINA CO., INC., FALLS CREEK
Works—Falls Creek

Product: Vitrified hotel china. Restaurant ware.

Pres., W. H. Cannon
Gen. Mgr., and Treas., E. A. Fischel
Capital: $272,000
Process: 5 periodic kilns.
No. of employees: 156
Annual wages: $190,343.51

McDANIEL REFRACTORY PORCELAIN CO., 6TH ST. AND 9TH AVE., BEAVER FALLS
Works—Beaver Falls

Product: Electrical porcelain, Porcelain insulators, Pyrometer tubes, etc.

Pres., J. D. Brum
Secy., W. W. McDonald
No. of employees: 20

MAYER CHINA CO., BEAVER FALLS
Works—Beaver Falls

Product: Vitrified hotel china.

Pres., Author E. Mayer
V. Pres., Walter S. Mayer
Supt., Ben D. Hardesty
Capacity: 350,000 doz.
Process: 2 Harrop tunnel kilns; bisque, 282 ft. long; glaze, 174 ft. long; 4 periodic kilns.
Fuel: Natural gas.
No. of employees: 250; 3 ceramic engineers.

CERAMIC INDUSTRIES OF PENNSYLVANIA

MOHICAN POTTERY CO., TULLIP AND WESTMORELAND STS., PHILADELPHIA
Works—Philadelphia
Product: Vitreous china, sanitary ware.

Pres., John G. Fleck
Gen. Mgr., Walter A. Taylor
Capital: $90,000
Process: Casting method; 5% hand pressed, sagger made by hand.
5 periodic up draft kilns; one 10 ft.; four 18 ft.
Raw materials purchased, annual value: $6,600.00
Fuel: High grade bituminous coal; 1150 tons: $3,265.00
Electricity purchased, 48 HP capacity: $1,174.39
No. of employees: 25
Annual wages: $38,800.00

MORAVIAN POTTERY AND TILE WKS., DOYLESTOWN
Works—Doylestown
Product: Mosaic floor and wall tiles.

Owner, Henry C. Mercer
Gen. Mgr., F. K. Swan
Process: 6 periodic kilns.
No. of employees: 13

NEW KENSINGTON SANITARY POTTERY, INC., 1340 FIFTH AVENUE,
NEW KENSINGTON
Works—New Kensington
Product: Sanitary ware.

Pres., R. A. Siedle
V. Pres. and Supt., W. R. Siedle
Capital: Stock, $50,000
Capacity: 18,000 pieces
Process: Casting in plaster molds, two fired.
2 down and up draft kilns, 16 ft. round.
Raw materials purchased, annual cost: $15,000.00
Fuel: Gas; annual value: $8,000.00
Electricity purchased, 33 HP capacity: $80,000.00
No. of employees: 21
Annual wages: $31,600.00

PENN TILE WORKS CO., Aspers
Works—Aspers, Adams County
Product: Ceramic glazed floor tile.

Pres., Donald C. Asper
V. Pres., Charles Asper
Treas., W. W. Lower
Secy., D. E. Lower
Capital: Stock, $50,000
Capacity: 1,500,000 sq. ft.
Process: Pressed through filter press.
2 up draft kilns, 12½ dia., one down draft, 14½ dia.
2205 tons raw materials purchased, annual value: $25,251.37
Fuel: Bituminous coal; 1778 tons annually, value: $5,911.89
Electricity purchased, 135 HP capacity: $10,147.50
Annual wages: $75,499.63
2 ceramic engineers.

ROBERTSON ART TILE CO., P. O. BOX 848, TRENTON, N. J.
Works—Moorville
Product: White and colored marble floor tile.

Pres. and Gen. Mgr., D. P. Forst
V. Pres., A. D. Forst
Secy., E. O. Lovett
Treas., T. E. Chemey
Capital: Stock, $1,400,000
Capacity: 4,000,000 sq. ft.
Process: Bright and dull finish colors on same tile; 16 colors in floor tile; part encaustic and part vitreous.
20 round down draft periodic kilns; one 10 ft., four 12 ft., fifteen 14 ft.
2 electric glazed tunnel kilns, 5000 sq. ft. tile per 24 hours.
Fuel: Coal; oil and electricity.
One ton coal or 200 gal. oil per 1000 sq. ft. tile.
No. of employees: 433
Annual wages: $513,170.00
WHITE WARE (Continued)

ROSSMAN CORPORATION, Reeves Bldg., Beaver Falls
Works—Beaver Falls
Pres., W. W. Walker, Jr.
Secy., William Waldorf
Supt. (Beaver Falls), R. E. Lorence
No. of employees: 439

SAXOBURG POTTERIES, Saxonburg
Works—Saxonburg
Product: Toy pottery maker sets,
Experimental burning cement,
Other commercial products.
Partnership (Corp.-owned)
Ceramic engineer, G. H. Ascherl
Purchasing Agent, F. H. Morrison
Process: Produces cast and extruded; one periodic kiln.
Experimental work, technical used ware.
Fuel: Kiln gas; 500–1000 cu. ft. per hour.
No. of employees: 3 or 4 part time.

SHENANGO POTTERY CO., W. Grant St., New Castle
Works—New Castle
Product: Vitrified hotel china.
Pres. and Gen. Mgr., James M. Smith
Secy., J. L. Leonher
Supt., Fred W. Sontum
Process: 19 periodic kilns; one tunnel kiln.
No. of employees: 895; one ceramic engineer.

UNIVERSAL SANITARY MFG. CO., Box 823, New Castle
Works—Lawrence Township, Lawrence
Product: Sanitary ware, Plumbing fixtures
Pres. and Gen. Mgr., W. Keith Meafee
V. Pres., R. K. McKeen
Secy. and Treas., C. M. Whitaker
Mfr., F. A. Glenn
Capital: Stock, $550,913.57
Bonds, $62,300.00
Feldspathic cone 12 glazed applied by dipping and spraying.
2 Dresser muffle tunnel kilns; No. 1, 490 units per 24 hrs.
No. 2, 760 units per 24 hrs.
Fuel: Natural gas; 42,329 M ft. annually, value: $19,006.94
Coal for power; 2818 tons annually, value: $8,536.97
Electricity purchased; annual value: $8,382.19
115,000 cu. ft. gas burned per 24 hrs.
No. of employees: 165.
Annual wages: $289,904.80
One ceramic engineer.

WESTINGHOUSE ELECTRIC AND MFG. CO., East Pittsburgh
Works—Derry
Product: Porcelain insulators.
Pres., F. S. Merrick
Works Mgr., C. D. Byers
Asst. Works Mgr., E. H. Fritz
Supt., H. N. Van Wey
Capital: Stock, $120,000,000
Process: Wet plastic; casting; dry.
16 direct draft periodic kilns, 15′ inside diam.
1 Harrop tunnel kiln, 40′ long.
Fuel: Natural gas; 100,000,000 cu. ft.; annual value: $69,900.00
Fuel: Natural gas; 100,000,000 cu. ft.; annual value: $69,900.00
Coal for power; 2741 tons annually, value: $44,722.83
Electricity purchased; annual value: $18,275.75
85,000 cu. ft. gas per $1000 finished product.
No. of employees: 286
Annual wages: $487,269.71
2 ceramic engineers.

CERAMIC INDUSTRIES OF PENNSYLVANIA

TERRA COTTA

CONKLING-ARMSTRONG TERRA COTTA CO., Wissahickon Ave. and Juncta St., Philadelphia
Works—Philadelphia
Product: Architectural terra cotta.
Pres. and Gen. Mgr., Thomas F. Armstrong
Treas., S. O. Conkling
Secy., Joseph J. Frederickson
V. Pres., A. G. Taylor
Capital: Stock, $250,000
Capacity: 7,500 tons annually
Production: 3,557 tons.
Process: 10 down draft kilns, 16 ft. (inside), 28 tons capacity.
One kiln, 24 ft., 100 tons capacity.
Raw materials purchased; annual value: $21,142.00
Fuel: Bituminous coal; $17,445.42
Electricity purchased; annual value: $13,518.44
Power capacity of plant, 200 HP.
No. of employees: 170
Annual wages: $272,340.54
One ceramic engineer.

ENFIELD POTTERY AND TILE WORKS, Enfield
Works—Enfield
Product: Terra cotta plaques, Faience tile.
Pres. and Gen. Mgr., J. H. Dullas Allen
Secy. and Treas., Joseph P. Miller
Process: Work mainly special design.
4 down draft periodic kilns, 8′ diam. x 9′ high.
2 ventilation No. 6 decorating kilns, gas fired.
8 cars per year of raw materials purchased.
Fuel: Gas; coal; 720 tons coal annually.
Electricity purchased; annual value: $8,100.00
No. of employees: 30
Annual wages: $39,289.12
One ceramic engineer.

GALLOWAY TERRA COTTA CO., 22nd and Walnut Sts., Philadelphia
Works—Philadelphia
Product: Garden and decorative pottery.
Pres. and Gen. Mgr., Walter B. Galloway
V. Pres., M. E. Galloway
Secy. and Treas., O. Galloway
Capital: $75,000
Process: 4 periodic kilns.
No. of employees: 20

KETCHAM, O. W., 121-125 N. 18th St., Philadelphia
Works—Crum Lynne
Product: Architectural terra cotta.
O. W. Ketcham, owner
Gen. Mgr., W. J. Stephanci
Production: 1521 tons annually
Process: 4 periodic muffle kilns; one 20 ft. diam., 26 ft. diam.,
one 40 ft. diam.
Fuel: Gas coal; 1472 tons annually.
700 tons for power; 23 HP capacity.
No. of employees: 72
One ceramic engineer.

CEMENT

ALLENTOWN PORTLAND CEMENT CO., INC., Fuller Bldg., Catawba
Works—Evanston
Product: Portland cement.
Pres., R. W. Weaver
V. Pres. and Gen. Mgr., C. H. Brearwood
Secy. and Treas., F. A. Weibel
CEMENT (Continued)

Supt., D. C. Morgan
Capital: Stock, $843,375
Bonds, $278,000
Capacity: 1,000,000 bbls.

Process: Dry; 4 rotary kilns, 8' x 120', 950 bbls. capacity.
Cement rock quarried by Company.
42,654 tons raw materials purchased, annually: $121,274.22
Pulverized bituminous coal; 43,383 tons, value: $186,620.02
Fuel: 90.58 lbs. coal per bbl. cement.
Electricity purchased, 6,474 HP capacity, value: $165,782.20
No. of employees: 225
Annual wages: $431,963.88
5 chemists and helpers.

ALPHA PORTLAND CEMENT CO., EASTON
Pres., G. S. Brown
Secy., R. S. Gersell
Capital: $3,500,000

Process: Dry and wet; Edge Moor waste heat boilers.
Production: 2,838,940 bbls.
No. of employees: 483
Annual wages: $765,682.35

ATLANTIC GYPSUM PRODUCTS CO., DELAWARE AVE. AND JEFFREY ST., CRICKET
Pres., Chester (Penna. Gypsum Co.)
No. of employees: 1796

ATLAS PORTLAND CEMENT CO., 25 BROADWAY, N. Y. C.
Pres., John R. Moree
Gen. Supt., A. G. Croll

BESEMER CEMENT CORP., 1106 CITY BANK BLVD., YOUNGSTOWN, OHIO
Pres., A. A. Bessemer
Y. Pres., W. E. Bles and C. Schmutz
Seey., W. H. Killasway
Capacity: 1,750,000 bbls.
Process: Wet; 3 rotary kilns; 10' x 120' with 8' x 60' extensions.
11,654 tons raw materials purchased.
Fuel: Coal; 100 lbs. per bbl. cement.
Electricity purchased.
No. of employees: 583

CAMBRIA PLASTER AND BUILDERS' SUPPLY CO., BAUMER ST., JOHNSTOWN
Secy. and Treas., Lee H. Burton
Mfr., D. J. Ukle
Capital: Stock, $2,000,000
Bonds, $400,000
Capacity: 2,400,000 bbls.
Process: Dry; 25 - 42' kiln mills.

COPLAY CEMENT MFG. CO., COPLAY
Pres., H. J. Steiner
Secy. and Treas., C. D. Young
Mfr., D. J. Uhle
Capital: Stock, $2,000,000
Bonds, $400,000
Capacity: 2,400,000 bbls.

CERAMIC INDUSTRIES OF PENNSYLVANIA

CRESCENT PORTLAND CEMENT CO., 1007 ENGINEERS BLVD., CLEVELAND, OHIO
Pres., James Heidenkamp
Gen. Mfr., J. A. Wilson
Capital: $1,184,000
Production: $1,051,824 bbls.
No. of employees: 944

ERIE BUILDERS' SUPPLY CO., 19TH AND CRANBERRY STS., ERIE
Pres., C. K. Christensen
Gen. Mfr., Louis H. Breiter
Capital: $50,000
Annual wages: $12,903.50
No. of employees: 8

GIANT PORTLAND CEMENT CO., 603-610 PENN. BLVD., PHILADELPHIA
Pres., Charles F. Conn
V. Pres., Walter L. Harbin
Treas., J. J. Jiggins
Secy., J. R. Lennig
Capital: Stock, $2,900,000
Bonds, $157,000
Capital: 1,299,072.54
Production: $2,900,000 bbls.
Process: Dry; Central Mill: 8 rotary kilns, 60' x 60'; 311,363 tons raw materials purchased annually: $354,923.87
Fuel: Bituminous coal; 33,330 tons annually: $230,812.50
Electricity purchased, annually: $151,334.66
1,100 HP capacity, Central Mill, 243 HP; Rain Mill, 688 HP
No. of employees: 281
Annual wages: $495,246.51

GRANITE WALL PLASTER CO., 7TH AND GUILFORD STS., PHILADELPHIA
Pres., B. F. Patshaw
Gen. Mfr., M. Luther Patshaw
Supt., Warren W. Leary
No. of employees: 11

HERCULES CEMENT CORP., 1700 WALNUT ST., PHILADELPHIA
Pres., Morris Kind
Secy. and Treas., Linor G. Powers
Supt., J. Stanley Downs
Process: Dry; 9 kilns, 7.5' x 125', 6' high steam; 10' x 120', 6' high steam-electric power, 1,100 HP
Capacity: 6000 bbls. per day
No. of employees: 2,000

KEYSTONE PORTLAND CEMENT CO., EASTON
Pres., John Barnes
Secy., E. L. Clarke
No. of employees: 189

KEYSTONE STUCCO MFG. CO., LLOYD AND PASCAL AVE., PHILADELPHIA
Pres., G. C. Merrywell
No. of employees: 9

Product: "Hercules" Cement.
Product: Wall plaster (Builders' supplies).
CEMENT (Continued)

**KNICKERBOCKER LIME CO.,** Park Ave at 24th St., Philadelphia
Works—Malvern, Chester County  
Pres., G. D. Van Seiver  
Secy., V. C. Trout  
No. of employees: 146
Product: Neat plaster, (Lime, Crushed stone).

**LAWRENCE PORTLAND CEMENT CO., INC.,** Northampton
Works—Northampton  
Pres., Frank H. Smith  
V. Pres., Marion S. Ackerman  
Secy., J. S. Van Middlesworth  
Treas., Edgar F. Sheppard
Capital: Stock, $7,500,000  
Bonds, $2,000,000  
Capacity: 3,400,000 bbls.  
Production: 2,550,320 bbls.
Process: Dry; Hercules and tube mills;  
13 rotary kilns, vertical kilns for “Hy-Test”.  
67,294 tons raw materials used annually, value: $494,016.85
Fuel: Coal; 110,734 tons annually;  
Anthracite and coke for burning in “Hy-Test”  
96 bbl. coal per bbl. cement.
Electricity purchased, 41,355,323 KWH: $499,411.33
Power capacity of plant, 14,300 HP.  
Annual wages: $695,768.89
No. of employees: 396

**LEHIGH PORTLAND CEMENT CO.,** Young Hwy., Allentown
Works—Bath, Easton, Kempton,  
New Castle, Nesquehoning,  
Sandia Eddy, West Coplay
Pres., E. M. Young  
V. Pres. and Gen. Mgr., Daniel F. Ritter  
Secy.-Treas., A. F. Walter
Capital: $86,000,000  
Process: Wet and Dry; Edge Moor waste heat boilers.  
Annual wages: $785,253.00
No. of employees: 891

**LONE STAR CEMENT CO. OF PENNA.,** 123 S. Broad St., Philadelphia
Works—Nazareth  
Pres., H. Streckmann  
V. Pres., Charles L. Hogan  
V. Pres. and Mgr., D. S. MacBride
Capital: Stock, 100,000 shares, no par.  
Production: 1,042,137 bbls.
Process: Dry; 6 rotary kilns, one 10 x 175, four 8 x 100.  
940 tons gypsum quarried by Co., annually: $43,500.00  
Electricity purchased, annually: $219,000.00
No. of employees: 266  
Annual wages: $510,000.00

**MEDUSA PORTLAND CEMENT CO.,** 1002 Engineers Bldg., Cleveland, Ohio  
Works—York  
Pres. and Gen. Mgr., J. B. John  
Capital: $7,751,141.99  
Production: 417,729 bbls.
Process: Wet; One kiln, 10 x 175 ft., three 8 x 100 ft.  
Fuel: Coal for burning;  
Power capacity of plant, 6000 KW.
No. of employees: 240  
Annual wages: $396,253.00

**CERAMIC INDUSTRIES OF PENNSYLVANIA**

**CEMENT (Continued)**

**NAZARETH CEMENT CO., Nazareth**  
Pres., M. J. Warner  
Treas., G. F. Coffin
Capital: Stock, $7,000,000  
Process: Dry; 7 rotary kilns, 71' x 120', one 9' x 120'.  
587,000 tons cement rock and gypsum quarried: $206,000.00  
Fuel: High vol. bituminous coal; 20,000 tons, value: $406,000.00  
Electricity purchased, 35,000 KWH, value: $306,000.00
No. of employees: 280  
Annual wages: $446,000.00

**PENNSYLVANIA DIXIE CEMENT CORP., Nazareth**  
Product: Cement.  
Pres., B. S. Smith  
Secy., George Killian
No. of employees: 710

**PHILADELPHIA MINERAL FLOORING AND PRODUCTS CO., Tioga and Wabuneco Ave., Philadelphia**  
Works—Philadelphia  
Product: Limestone, Composition flooring.
Pres., F. H. Kelly  
Secy., J. B. Kelly
No. of employees: 23

**PITTSBURGH PLASTER AND SUPPLY CO., Catherine and Chambers Sts., McKees Rocks**  
Works—McKees Rocks  
Product: Sanded prepared wall plaster.
Pres., W. B. Holmes  
Gen. Mgr., D. J. Morgan
No. of employees: 6

**POMPEIAN MFG. CO., 420 William St., Williamsport**  
Works—Williamsport  
Product: Stucco, Stucco dash, etc.
Pres., T. D. Miller  
Secy., J. A. Offen
No. of employees: 4

**TECHNICAL PRODUCTS CO., 2308 Main St., Sharpsburg Station, Pittsburgh**  
Works—Sharpsburg Station  
Product: Liquid porcelain adhesive cement.  
Annual wages: $10,000.00
Pres., Fred Sauereisen  
Supt., Charles Stewart  
Asst. Mgr., E. G. Gruber
Capital: $20,000  
No. of employees: 10

**UNIVERSAL PORTLAND CEMENT CO., 210 S. LaSalle St., Chicago, Ill.**  
Works—Universal  
Pres., B. F. Affleck  
Secy., E. B. Harkness  
Treas., A. W. Carlisle
No. of employees: 725

**VALLEY FORGE CEMENT CO., Fuller Bldg., Catasauqua**  
Works—W. Conshohocken  
Product: Cement.
Pres., R. S. Weaver  
V. Pres. and Gen. Mgr., C. H. Breckwood  
Supt., G. E. Newhard
CEMENT (Continued)

Capital: Stock, $2,341,736
Process: Wet; 2 rotary kilns, 8' 10" x 9' 10" and 11' 10" x 22'.
All limestone quarried by Company.

Fuel: Pulverized bituminous coal, 85,785 tons annually; $162,379.69
97 coal per bbl. cement.
Electricity purchased, 6814 HP capacity, value: $135,816.75
No. of employees: 265
Annual wage: $389,908.36
6 chemists and helpers.

(Westerns only operate; product distributed by another company.)

WEST PENN CEMENT CO., BUTLER
Works—West Winfield
Pres., B. D. Phillips
Secy.-Treas., C. A. Wilcox
No. of employees: 140

WHITEHALL CEMENT MFG. CO., 1127 LAND TERR., PHILADELPHIA
Works—Cementon, Lehgh County
Pres., Otis Mower
Secy., Louis Anderson
No. of employees: 201

LIME

AMERICAN LIME AND STONE CO., BELLEFONTE
Works—Bellefonte,
Pres., Charles Walker
V. Pres., A. D. Warner, Jr.
Y. Pres., Gen. Mgr., Samuel M. Shafter
Capital: Stock, $700,000 preferred, $500,000 common,
Bond, $1,119,500 outstanding
Process: High calcium ground, lump, and hydrated lime.
2 rotary kilns, 8' x 175; 36 shaft kilns.
Fuel: Soft coal; 30,000 net tons annually.
3,000,000 KWH electricity purchased annually.
No. of employees: 256

ANDREAS QUARRY CO., 963 TILGHMAN ST., ALLENTOWN
Works—Andreas, Schuylkill County
Partnership: George W. Gosser
Capacity: 1000 tons
Annual wage: $4,000.00
No. of employees: 8

ANNVILLE LIME CO., ANNISTON
Works—Annville
Pres., C. S. Detacher
Gen. Mgr., Arthur G. Deitzler
Capital: $50,000
Production: 5000 tons
Process: 6 pot kilns, 8' x 26'; 1 Clyde hydrator.
Fuel: Coal and coke for burning; electric and water power.
No. of employees: 15
Annual wage: $15,000

Baker, Berger Co., New Enterprise
(Reported as small lime producer.)

BARNHART AND SONS, F. D., Mt. PLEASANT
Works—Mt. Pleasant
Pres., W. D. Dickley
Secy.-Treas., F. S. Hoyt
Capital: $50,000
Production: 5000 tons lime
Process: One Clyde hydrator; 2 Gates' crushers.
2 vertical kilns, 10' x 15'.

LIME (Continued)

BAUGHMAN, C. S., MARTINSBURG
Works—Martinsburg, Blair County
Owner, C. S. Baughman.
No. of employees: 2

BLUE ROCK LIME PLANT, R. F. D. No. 1, STROUDSBURG
Works—Stroudsburg
Proprietor, Charles H. Haney
Process: One large kiln; coal for burning.

BONNYMEADE FARMS, HARRISBURG, R. F. D. No. 1
Works—Near Pautang
Gen. Mgr., Herman Billett
Capital: $12,550
Process: Lime
Annual wage: $6,970.00

BOYER, JAMES E., LEWISBURG, R. F. D. No. 1
(Reported as small lime producer.)

BOYER, IRVIN, MR. PURSANT MILLS
Works—Fremont
Owner, Irvin Boyer
Production: 6,400 bu.

CANNON, JOHN J., WILLOW GROVE
Works—W. Glenside, Willow Grove
Owner, Ed. W. Walker
No. of employees: 60

CHEMICAL LIME CO., N. THOMAS ST., BELLEFONTE
Works—Bellefonte
Pres., A. R. McNabb
Secy., J. S. Walker
No. of employees: 86

CLUGSTON, J. S., EAST WATERFORD
Works—Waterloo, Juniata County
Gen. Mgr. and owner, J. S. Clugston
No. of employees: 2
Annual wage: $250.00

CONEMAUGH VALLEY LIME AND COAL CO., JOHNSTOWN
Works—Conemaugh Twp., Cambria Co.
Product: Agricultural lime
Pres. and Gen. Mgr., C. S. Bondabush
Production: 650 tons lime.

CONSOLIDATED STONE AND MINING CO., NEW CASTLE
Works—Rock Point
P.O. Ellwood City
Product: Limestone
Annual wage: $7,200.00
LIME (Continued)

CORSON, G. AND W. H., PLYMOUTH MEETING
Works—Plymouth Meeting
Product: Lime for agricultural, chemical and construction purposes. (Dolomite.)

Pres., Walter H. Corson
Treas., Bolton L. Corson
Secy., George Corson
No. of employees: 70

COX LIME, STONE AND LIME PRODUCTS CORP., PLYMOUTH MEETING
Works—Cold Point, Montgomery County
Product: High magnesium lime, for agricultural, chemical and construction purposes.

Pres., Charles C. Cox
Secy., Charles G. Gurling
Treas. and Gen. Mgr., F. W. Biddle
No. of employees: 50

CROSSLEY, D. C., DANVILLE
(Reported as small lime producer.)

CURFMAN AND BROTHER, R. J., THREE SPRINGS, HUNTINGDON COUNTY
(Reported as small lime producer.)

CUSSINS, JOHN R., BEDFORD
(Reported as small lime producer.)

DAVIS, E. M., MUNDER
Works—Munder
(Small operations.)

DEFFIBAUGH, J. CALVIN, OSTERBURG
Works—Osterburg, Bedford County
Product: Lime.
Process: Burned; one fire brick kiln, 225 bu. capacity.
Fuel: Coal; 450 bu., annual value: $72.00
No. of employees: 2
Annual wages: $120.00

DENNIS, J. W., CLOVER TOP, FAYETTE COUNTY
(Reported as small lime producer.)

DIETRICK LIME AND SUPPLY CO., 329 N. SIXTH ST., READING
Works—Temple
Mgr., W. W. Dietrick

Product: Hydrated lime.

DOBSON, MCKINLEY, CLAYSBURG, BLAIR COUNTY
(Reported as small lime producer.)

DUNCANSVILLE LIME AND STONE CO., DUNCANSVILLE
Works—Duncansville
Pres. and Gen. Mgr., J. C. Diehl
Secy., Ashton Gardner
Treas., A. O. Diehl
No. of employees: 17

EDELMAN, JOHN, MYERSTOWN
Works—Myerstown
Product: Hydrate and lump lime, (Crushed stone).

Pres. and Gen. Mgr., John Ebling
Capital: $45,000
Production: 6,306 tons lime
Annual wages: $15,438.19

EDMISTON, WILLIAM, ACOZA, SOMERSET COUNTY
(Reported as small lime producer.)

EMIG LIME CO., HELLMAN
Product: High calcium and Hydrate lime for agricultural and construction purposes.

Pres., and Gen. Mgr., D. M. Gilbert
Secy., E. E. Smith
No. of employees: 3

ENTERPRISE LIME AND BALLAST CO., HYNDMAN, BEDFORD COUNTY
Works—Hyndman Boro.
Product: Lime. (Crushed stone).
Pres., E. W. Light
Capital: $35,000
Production: Lime kilns not operated in 1928 and 1929
No. of employees: 12

ERB, THOMAS H., LITITZ, LANCASTER COUNTY
(Reported as small lime producer.)

ERFORD, JOSEPH, FAIRFIELD, CUMBERLAND COUNTY
(Reported as small lime producer.)

FAIRFIELD LIME AND STONE CO., FAIRFIELD
Works—Fairfield
Product: Lump and ground burned lime. (Crushed stone).
Capital: $10,000
Process: Burned; 2 draw kilns, 400 bu. capacity.
Fuel: Coke; 80 tons, annual value: $500.00
Coal and gasoline for power, value: $250.00
Electricity purchased, 40 HP capacity: $800.00
No. of employees: 5
Annual wages: $5,000.00

FERRY, JOHN W., Ligonier, R. F. D., No. 2
(Reported as small lime producer.)

FREIDLIN AND BRANT, BOX 88, QUECREEK
(Reported as small lime producers.)

FULKROAD, JACOB, MIFFLINTOWN
Works—Mifflintown
Product: Burned lime. (Crushed stone).
Owner, Jacob Fulkroad
Capacity: 1000 tons lime and stone
Process: Burned; 2 draw kilns, old type.
Fuel: Coal for burning; 30 ton per 3 tons lime
No. of employees: one part time
Annual wages: $250.00

GARLIN, SAMUEL T., NEW BLOOMFIELD, PERRY COUNTY
(Reported as small lime producer.)

(Reported as small lime producer.)

GOLDEN, G. EDWARD, WARFORDSBURG
Works—Warfordsburg
Product: Burned and ground lime.
Process: 2 draw kilns, 22' x 7'; 225 bu. capacity.
Fuel: Coal for burning; gasoline for grinding.

GOODYEAR BROTHERS, CARLISLE
Works—Carlisle
Product: Burned lime.

GROVE CITY LIMESTONE CO., SHARON
Works—Osborne
Product: Agricultural lime. (Ground limestone).
Pres., Harry J. Filer
Secy., R. A. Knapp
Process: 7 kilns; coal for burning.
No. of employees: 27
LIME (Continued)

GUMMO, G. B., Port Matilda
Works—Port Matilda
Product: Burned lime.

HAGENBACH, PERCY, MELTON
(Reported as small lime producer.)

HAMILL, J. S., Ligonier
(Reported as small lime producer.)

HAMMOND, MARTIN F., Spring Run, Franklin County
(Reported as small lime producer.)

HANER, BENJAMIN J., Arkville, R. F. D. No. 3
Works: Harpers, East Hanover
Process: 2 draw kilns, 300 bu. capacity, drift cool for burning.
1 1/2 tons coal per 100 bu. lime
No. of employees: 2
Annual wages: $290.16

HARROLD, S. L., Irwin
(Reported as small lime producer.)

HAYS, J. M., Mammoth
(Reported as small lime producer.)

HESS, A. M., Almeda
Works—Almeda
No. of employees: 2.

HESS, BRADLEY W., Almeda
(Reported as small lime producer.)

INTERCOURSE LIME QUARRIES, INTERCOURSE
Works—Intercourse
Owner: J. S. Smucker
Capital: $2,000
Capacity: 162 tons annually
Process: Burned; 2 tunnel shaped kilns, 6' x 14'. Jeffrey pyrometer.
Fuel: Buckwheat coal; 60 tons annually.
No. of employees: 1

KAUFFMAN, DAVID R., Manheim
(Reported as small lime producer.)

KELLER CO., LUTHER, 813 W. Lackawanna Ave, Scranton
Works—Portland
Pres., Luther Keller
Treas., H. A. vanHorn
No. of employees: 12
Product: Burned lump lime.

KEYSTONE LIME CO., Salisbury
Works—Niverton
No. of employees: 4
Product: Agricultural lime.

KILGUS LIME KILNS, Muncy, R. F. D. No. 5
Works—Muncy
Owner, Henry Kilgus
Process: Burned; 6 pot kilns, 7' x 24', 3 tons capacity.
Fuel: Buckwheat coal and coke; 222 tons, annual value: $1,760.69
No. of employees: 3
Annual wages: $1,760.91

KING, H. L., New Enterprise
(Reported as small lime producer.)

KNICKERBOCKER LIME CO., Parkway at 24th St., Philadelphia
Works—Malvern, Chester County
Product: Building lime, Hydrate agricultural lime, (Plaster, crushed stone.

Pres., G. D. Van Seiver
Secy., V. C. Trout
No. of employees: 146

CERAMIC INDUSTRIES OF PENNSYLVANIA

LIME (Continued)

KNOOTZ, JOHN G., New Enterprise
(Reported as small lime producer.)

KOUGH, E. E., Newville, Cumberland County
Works—Newville
Product: Pulverized lime,
Owner, E. E. Kough
No. of employees: 2

LANDIS STONE MEAL CO., RHEEMS
Works—Rheems
Product: Pulverized limestone,
Pres., P. K. Landis
Gen. Mgr., H. K. Landis
Capital: $30,000
No. of employees: 7
Annual wages: $8,500.00

LAVINO AND CO., E. J., Bulletin Bldg., Philadelphia
Works—Howellville
Product: Pulverized limestone,
Pres., E. M. Lavino
Treas., C. T. Kline
Secy., C. W. Rodman
No. of employees: 43

LEOPOLD AND McHENRY, DAYTON, ARMSTRONG COUNTY
(Reported as small lime producers.)

LOW BROTHER AND CO., LIME RIDGE
(Sold in 1929 to Dr. Frank Baker, Bloomburg.)

LOWRY, CHARLES W., CHAMBERSBURG
(Reported as small lime producer.)

LUKENS AND YERKES, STEPHEN GIRARD BLDG., PHILADELPHIA
Works—Norristown
Product: Agricultural and construction lime.

McClure, HARRY, Ford City
(Reported as small lime producer.)

McClure, A. M., ELYSBURG
(Reported as small lime producer.)

McConnell, W. E., Muncy
Works—Muncy Twp., Lycoming Co.
Gen. Mgr., W. E. McConnell
Capital: $5,000
Production: 500 net tons
Annual wages: $690.00

MARTINSBURG QUARRY, Martinsburg
Works—N. Woodbury Twp., Blair County
Capital: $5,000
Production: 3000 bu. lime
No. of employees: 1
Annual wages: $1,357.00

MAUSER'S CO., ALONZO, Danville, R. F. D. No. 5
Works—Danville
Product: Burned lime.
Pres. and Gen. Mgr., A. Mauser
No. of employees: 1
Annual wages: $1,300.00

MERION LIME AND STONE CO., Norristown
Works—Norristown
Product: Dolomitic lime,
Pres. and Gen. Mgr., H. A. Gawthrop
Secy., J. M. Detra
No. of employees: 33

(Continued)
LIME (Continued)

MILLER, FRANK H., EVERETT
(Reported as small lime producer.)

MURPHY, ROBERT W., Ligonier
(Reported as small lime producer.)

NATIONAL LIMESTONE CO., NAGINEY
Works—Naginey, Ormshin, Williamsturg
Pres. and Gen. Mgr., J. D. Shearer
Process: One Schultess hydrator; 5 pot kilns, 5' x 20'.
Production: 3,000 tons lime per yr.
No. of employees: 30
Annual wages: $40,000.00

NEW CASTLE LIME AND STONE CO.
New Castle, New Castle, Pa.
Pres., H. W. Healy
Secy., Ellwood Gilbert
No. of employees: 17

NEW ENTERPRISE STONE AND LIME CO., NEW ENTERPRISE
Works—Everett, Roaring Spring, Waterline
Pres., J. S. Detwiler
Gen. Mgr., F. L. Detwiler
Capital: $35,000
Production: 1,000 tons lime per yr.
No. of employees: 10
Annual wages: $8,800.00

PARAGON PLASTER AND SUPPLY CO., GREEN RIDGE ST., SCRANTON
Works—Lidge Ridge
Pres., F. E. Lynett
Gen. Mgr., E. L. Marvin
Mgr., A. B. Haub
Capacity: 30 tons daily
Production: 2,000 tons lime per yr.
No. of employees: 6
Annual wages: $5,000.00

PEERLESS LIME CO., HYNDMAN
Works—Hyndman, PA.
Capital: $1,000
No. of employees: 3

PEEPER, J. W., 48 N. SIXTH ST., LEBANON
Works—Myerstown
Capital: $10,353.25
Process: Burned; 4 pot kilns, 14' x 22', 8 tons capacity.
Fuel: Coke; 14,750 tons annually, value $7,116.64
One ton coke per 4 tons lime.
Electricity purchased, annual value: $244.40
No. of employees: 18
Annual wages: $15,206.90

PINE GORC LIME AND STONE CO., JERSEY SHORE
Works—R. D. No. 3, Jersey Shore
Pres., Warren Shank
Secy. and Treas., C. R. Peterson
Capital: $20,000
Capacity: 600 bu. per day
Production: 2,055 tons annually
Process: One Schultess hydrator; 6 pot kilns, 7' x 30'.
Fuel: Coke; 360 tons annually, value $1,000.00
Electricity purchased, 100 HP: $3,000.00
No. of employees: 18
Annual wages: $23,820.27

CERAMIC INDUSTRIES OF PENNSYLVANIA

QUARRYVILLE LIME AND STONE CO., QUARRYVILLE
Works—Quarryville
Product: Lime, (Crushed stone).
Owner, A. H. Burkholder
Process: 4 set kilns, 1,200 bu. capacity.
Fuel: Anthracite coal for burning; 10 HP capacity.
No. of employees: 10

RAMOTH LIME AND STONE CO., 48 N. NINTH ST., LEBANON
Works—Lime Rock
Product: Lime, (Crushed stone).
Ownership: Partnership
Capacity: 60 tons daily

REEDER LIME AND STONE CO., MONTON
Works—Chippewa
Product: Agricultural lime, (Crushed stone).
Pres., M. E. Reeder
Gen. Mgr., C. Wilbert Reeder
Capital: $50,000
Production: 2,111 tons lime annually.

REINHARD LIME WORKS, 825 WALNUT ST., LEBANON
Works—Swatara, PA.
Product: Chemical lime.
Owner, W. T. Reinhard
Process: Burned; 4 pot kilns, 22' x 7'.
Fuel: 48 hr. furnace coke, 2,000 tons, annual value $31,000.00
No. of employees: 12
Annual wages: $25,000.00

REYNOLDSVILLE LIME CO., REYNOLDSVILLE
Works—Poncaq. Point
Product: Hydrate, ground and agricultural lime.
Pres., W. T. Girt
Secy., S. M. McCrystal
No. of employees: 9

RIGBY AND SON, S., CHADDS FORD
(Not operating in 1928.)
Product: Lime.

ROARING SPRING LIME AND STONE CO., ROARING SPRING
Works—Roaring Spring
McGee and Shooper
Product: Lime.

ROBINSON, CHARLES J., GAP, LANCASTER COUNTY
(Reported as small lime producer.)

ROSE POINT STONE AND LIME CO., NEW CASTLE
Works—Rose Point
Product: Agricultural lime.
Pres. and Gen. Mgr., John W. Norris
Capital: $50,000
Production: 7,000 tons
Process: 1 pot kiln, 10' x 50'; coal for burning.
No. of employees: 25

RUPP, W. W., NEW BETHLEHEM
(Reported as small lime producer.)

SHILLING AND SON, C. E., MANNS CHOICE
Works—Eggell Kiln, Man's Choice
Product: Agricultural lime.
Process: One brick kiln, 28' x 8'; capacity: 65 bu. per day
Fuel: Coal for burning; 10 bu. per 65 bu. lime.

SHUMAKER, HARRY W., BRADLEY
(Reported as small lime producer.)
LIME (Continued)

SMITH, RUSSELL, Saxton
(Reported as small lime producer.)

SNYDER, SAMUEL, Hurdon, Northumberland County
(Reported as small lime producer.)

STEACY AND WILTON CO., Wrightsville
Works—Battinger, Wrightsville
Pres., R. P. Wilton
No. of employees: 2
Production: 105,889 tons lime
Annual wages: $111,369.28

STUMP, ADAM G., ROBBINSIA
(Reported as small lime producer.)

SUMMERS, JOHN T., Danville, R. F. D. No. 5
Works—Danville
Owner, J. T. Summers
No. of employees: 2
Production: 7,350 bu.
Annual wages: $130.90

SUNNYSIDE LIME KILNS, Lebanon
G. M. Stanley, (Reported as small lime producer.)

SWITZER, IRVING E., Fairmount City
Works—Near Limestone
Pres., Irvin E. Switzer
Gen. Mgr., C. V. Switzer
No. of employees: 3
Production: 2,200,000 tons lime
Annual wages: $5,192.89

THOMASVILLE STONE AND LIME CO., Thomasville
Pres., J. C. Gittings
V. Pres. and Gen. Mgr., R. K. Forsyth
Secy. and Treasurer, D. List Warner
No. of employees: 109
Production: 3,200,000 tons lime
Annual wages: $10,741.77

TRECEB, B. F., Ashton, Huntington County
(Reported as small lime producer.)

TROUP, CALVIN W., Mt. Pleasant Mills
(Reported as small lime producer.)

TURE, EDWARD, Muncy
Works—Lime Bluff
Pres., Arthur V. Vanneman
Secy. and Treasurer, Belle Bookhamer
Supt., D. G. Miller
Capital: Stock, $10,000
Bonds, $30,000
Production: 9,000 tons lime
Annual wages: $25,197.37

TYRONE LIME AND STONE CO., 364 Pennsylvania Ave, Tyrone
Works—Stover, Huntington County
Pres., Charles Warner
Secy. and Treasurer, J. W. Wilson
Supt., D. G. Miller
Capital: Stock, $10,000
Bonds, $30,000
Process: Hardinge continuous ball mill for pulverizing.
Fuel: Electrically purchased, 425 HP capacity, value: $3,248.71
No. of employees: 47
Annual wages: $25,197.37

UNIVERSAL GYPSUM AND LIME CO., 111 W. Washington St., Chicago, Ill.
Pres., Eugene Holland
Secy. and Treasurer, Frank G. Krumholz
Supt., B. W. Sidwell
Capital: Stock, $5,731,817
Bonds: $1,754,800
Production: 57,689 tons lime
Process: Lump and hydrated; one Krizer continuous hydrator.
One Schaefer continuous hydrator;
10 upright kilns, 400 tons capacity;
2 gas kilns.
Raymond import pulverizers and separators;
210,020 tons limestone quarried annually by Company.
Fuel: Bituminous coal; 10,384 tons annually, value: $71,077.74
Electricity purchased, annual value: $38,098.35
No. of employees: 190
Annual wages: $265,250.13

VALLEY VIEW LIME CO., Bellefonte
Pres., Martin J. Miller
Supt., T. S. Koith
Capital: Stock, $60,000
Production: 2,200,000 tons lime
Process: Hydrated; one Schulte hydrator.
2 perpendicular shaft kilns, 6’ x 40’, 7 tons per 24 hrs.
Fuel: Bituminous coal; 600 tons annually, value: $3,510.75
One ton coal per 324 tons lime.
Gas for power; 2,000 cu. ft.
Annual wages: $10,341.62
No. of employees: 12

WAGNER, THOMAS A., Lebanon, R. D. No. 1
(See Heavty Clay Products.)
Product: Burned lime.

WALKER, F. J., Garret, R. D. No. 1
Works—Near Pine Hill
(Plant idle.)
Product: Lime.

WALKER, J. M., Salina
Works—Salina
No. of employees: 2

WARNER COMPANY, 1518 Walnut St., Philadelphia
Pres., Charles Warner
Gen. Supt., J. W. Wilson
Capital: Stock, $10,085,571
Bonds, $2,084,050
Process: Lump, hydrated, inoculated, ground burned lime.
Pulverized limestone, Crushed stone.

CERAMIC INDUSTRIES OF PENNSYLVANIA

Cedar Hollow and Knickerbocker Plants, Cedar Hollow
Asst. Supt.,
Wayne deHaven (Cedar Hollow),
R. H. Williams (Knickerbocker)
Process: Hydrated; modified Clyde hydrator with seasoning tanks.
One rotary kiln, 150’ x 8’ for calcination of stone;
27 shaft kilns; Fuller-Lehigh mills for pulverizing.
Fuel: Coal and producer gas; 38,429 tons coal; value: $145,680.30
4.55 tons coal per ton lime (shaft kiln);
2.6 tons coal per ton lime (rotary kiln).
Electricity purchased, 3677 HP (connected), value: $45,156.41
Annual wages: $53,335.84
No. of employees: 385
3 ceramic engineers.
LIME (Continued)

McCoy and Mertox Plants, Swedeland
Supt., John B. Kelly
Capacity: 160 tons lime per 24 hrs.
Production: 30,304 tons lime
Process: 9 shaft kilns; Kritzer hydrator with Bates packer.
Fuel: Bituminous coal; 6870 tons; annual value: $30,703.29
Electricity purchased, 1250 HP (connected), value: $14,703.92
No. of employees: 99
Annual wages: $198,469.59

WEIDMAN AND SON, A., 908 E. Lehman St., Lebanon
Works—Lebanon
Process: 2 draw kilns; 10 tons capacity.
Fuel: Coal for burning; 150 tons annually, value: $600.00
1/2 ton coal per ton lime.

WEIGLE, DAVID, Shanksville, Somerset County
(Reported as small lime producer.)

WERNERSVILLE LIME AND STONE CO., Wernersville
Works—Wernersville
Pres., H. D. Winters
Gen. Mgr., A. E. Hehler
Capacity: 5,000 tons lime
Process: One hydrator; 3 shaft kilns, 10' x 35' (Crushed limestone).
Fuel: Anthracite coal and coke; 300 tons annually, value: $2,022.00
Electricity purchased, 50 HP capacity, value: $475.00
No. of employees: 5
Annual wages: $6,289.00

WHITMAN, E. W., Myersdale, Clarion County
Works—Myersdale
Capacity: 300 tons lime
Production: 1400 tons annually
Process: Bin hydration
Fuel: Anthracite coal and coke; 300 tons annually, value: $2,022.00
Electricity purchased, 50 HP capacity, value: $475.00
No. of employees: 6
Annual wages: $6,289.00

WHITE ROCK QUARRIES, Bellefonte
Works—Bellefonte, Centre County
Pres., W. F. Reynolds
Secy., L. A. Schaefer
Gen. Mgr., R. C. Noll
No. of employees: 235

WILLIAMS’ LIME KILN, Stroudsburg
Owner, Theodore Williams
Production: Agricultural lime
Process: 3,000 bu.

WOLF, FRED W., Milton
(Reported as small lime producer.)

WYNKOOP, H. S., Marion Center, Indiana County
(Reported as small lime producer.)

YORK VALLEY LIME AND STONE CO., Box 495, York
Works—York
Capacity: 200 tons per day
Production: 8,528 tons lime
Process: Burned and hydrated; 12 patent steel kilns, 8 ft. diam.
Fuel: Gas coal; 4,000 tons annually, value: $6,536.59
Electricity purchased, 340 HP capacity, value: $8,981.00
No. of employees: 47
Annual wages: $54,070.14

GLASS

AMERICAN PLATE GLASS CORP., Kane
Works—DuBois City
Pres., A. H. Gaffney
Sales Mgr., M. L. Peterson
Pur. Agent, A. B. Dickmann
Capital: Bonds, $1,500,000
Process: Cast; 7 furnaces, 20 pots
Fuel: Natural and producer gas
Power capacity: 9,000 HP
No. of employees: 474
Annual wages: $540,419.51

AMERICAN RESEARCH GLASSWARE CO., 928 S. 8th St., Philadelphia
Works—Philadelphia
Product: Experimental glassware.
Partnership: Bernhardt and Hawkins
No. of employees: 5

AMERICAN WINDOW GLASS CO., 1618 Farmers Bank Bldg., Pittsburgh
Works—Arnold, Belle Vernon,
Product: Window glass,
Jeannette, Kane,
Picture glass,
Monongahela City,
Ground and chipped glass.
Secy. and Treas., W. M. Bongard
Supt., W. A. Kurts
Process: Machine made; 110 machines, 13 continuous tanks.
No. of employees: 1,458

ATLANTIC BOTTLE CO., 90 W. Broadway, N. Y. C.
Works—Brackenridge
Product: Milk bottles,
Cheese jars,
Tobacco jars, etc.
Capital: $500,000
Process: Automatic machine made; 12 machines, 2 continuous tanks.
Annual wages: $279,864.00
No. of employees: 191

BECK CO., ALBERT H., 1914-24 N. 15th St., Philadelphia
Product: Homeopathic vials,
Works—Philadelphia
Eye pippets,
Miscellaneous products.
Secy., M. W. Beck
No. of employees: 19

BERNEY-BOND GLASS CO., Clarion
Works—Clarion,
Product: Glass bottles.
Huntehurst, McKean County
Pres., Ben F. Halterman, Jr.
Treas., Frank F. Hunsen
Secy., S. M. Casoloski
Process: Machine made; 5 continuous tanks.
No. of employees: 234
GLASS (Continued)

BRIDGEVILLE GLASS WKS., (GENERAL ELECTRIC CO.), 1 RIVER ROAD, Schenectady, N. Y.
Product: Glass tubing for incandescent lamps, Glass rods.
Pres., Gerard Swope
Gen. Mgr., W. W. French
No. of employees: 110

BROCKWAY MACHINE BOTTLE CO., BROCKWAY
Product: Glass bottles.
Pres., P. J. Spindler
V. Pres., J. W. Harding
Treas. and Gen. Mgr., A. A. McFadden
Secy., W. D. Dugan
Process: Machine made; 2 continuous tanks, 10 rings.
No. of employees: 221

BRYCE BROTHERS CO., Mt. PLEASANT
Product: Plain blown tumblers, Stem ware.
Pres., S. A. Bryce
Secy., K. R. Bryce
Process: 3 furnaces; 28 pots.
No. of employees: 336

CAPSTAN GLASS CO., CONNELSVILLE
Product: Glass food containers for packers use.
Pres., G. F. Riemer
V. Pres., H. J. Carr
Treas., C. C. Steens
Secy., S. B. Darmell
Capital: Stock, 100 shares, no par.
Capacity: 180 tons per 24 hrs. Production: 717,006 gross
3 H. L. Dixon furnaces, 60 tons capacity. Raw materials purchased, annual value: $895,044.00
Fuel: Gas; purchased and manufactured, annual value: $129,908.66
Electricity purchased, 1788 HP capacity, annual value: $52,020.28
No. of employees: 479
Annual wages: $783,445.70

CONROY-PRUCH GLASS CO., 1430 WESTERN AVE., N. S. PITTSBURGH
Product: Window glass, Decorated glass, Plate glass, mirrors.
Pres., George Lung
Gen. Mgr., H. J. Nesbit
No. of employees: 143

CONSOLIDATED LAMP AND GLASS CO., CORAOPOLIS
Product: Illuminating glassware, Novelties and glassware.
Pres., J. M. Lewis
V. Pres., W. P. Barker
Secy. and Treas., R. J. Watson
No. of employees: 237

CO-OPERATIVE FLINT GLASS CO., FIRST AVE. AND 15TH ST., BEAVER FALLS
Product: Pressed and blown glass, Tableware, Novelty glassware in crystal and colors.
Pres., Robert Morris
V. Pres., Jacob House
Secy. and Treas., C. W. Klein
Process: 32 pots.
No. of employees: 136

GLASS (Continued)

CERAMIC INDUSTRIES OF PENNSYLVANIA

CORNING GLASS WORKS, CORNING, N. Y.
Product: Pyrex ware, Special technical ware, Glass bulbs for incandescent lamps.
Pres., Eugene C. Sullivan
Secy., W. M. Sinclair
Treas., John L. Thomas
Process: 2 tanks.
No. of employees: 100

CUNNINGHAM GLASS CO., D. O., S. 22ND AND JANE STS., PITTSBURGH
Product: Beverage bottles.
Pres., E. S. Cunningham, Sr.
L. S. Cunningham, Jr.
H. V. Cunningham
Capital: Stock, $225,000 Capacity: 180,000 gross
Process: 3 continuous glass furnaces, 100 to 120 tons capacity.
2 O'Neill bottle blowing machines;
4 Hartford-Empire feeders.
Fuel: Natural gas; 6,149,488 cu. ft. annually; $27,106.45
Electricity purchased, 560,384 KWH, value; $8,652.16
No. of employees: 120
Annual wages: $124,078.50

DIAMOND GLASS CO., FIRST AVE., ROYERSFORD
Product: Glass bottles.
Pres. and Supt., F. L. Peterman
V. Pres., H. B. Kastie
Secy., J. K. Steinmetz
Treas., M. L. Lotshaw
Process: Automatic machine; 4 continuous tanks, 32 rings.
No. of employees: 118

DIAMOND GLASS WARE CO., P. O. BOX 130, INDIANA
Product: Tableware, Fancy art ware.
Pres., J. R. Richards
Secy., Treas. and Gen. Mgr., H. W. Thomas
Process: One furnace, 10 pots; one regenerating tank, 6 rings;
One day tank, 2 rings.
No. of employees: 254

DUNCAN AND MILLER GLASS CO., JEFFERSON AVE., WASHINGTON
Product: Tableware.
Pres. and Secy., J. E. Duncan, Jr.
Process: 2 furnaces, 30 pots.
No. of employees: 140

FORD MOTOR CO., DEARBORN, MICHIGAN
Product: Polished plate glass.
Pres. and Treas., Edsel B. Ford
V. Pres., E. E. Martin
Secy., B. J. Craig
Mgr., J. C. Ogle
Capacity: 7,500,000 sq. ft.
Process: One plate glass lehr; 9 regenerative furnaces, 144 pots; one muffle pot kiln.
176,985,235 lbs. grinding and quarried annually by Company.
Bituminous coal; 14,566 tons annually.
Electricity purchased; 6,036,200 KWH annually.
No. of employees: 681
Annual wages: $1,064,159.40

FORT PITT-JEANETTE GLASS CO., JEANETTE
Product: Tableware, Electrical ware, Opal ware.
(Reported idle)
GLASS (Continued)

FREAS GLASS WKS., FRANCIS L., INC., 140-46 E. 9TH AVE.,
Conshohocken  
Pres. and Trea., Francis L. Freas  
Gen. Mgr., Perry F. Ramey  
Capital: $40,000  
No. of employees: 25  
Product: Hydrometers, Thermometers, etc., Chemical Glassware.

FRY GLASS CO., H. G., NEW YORK ST., ROCHESTER  
Works—Rochester  
Receiver, E. T. Davis  
Sales Mgr., G. K. Fry  
Process: 4 furnaces, 64 pots; 2 tanks.  
No. of employees: 449  
Product: Tableware, Oven glass, Industrial glassware.

GILL GLASS AND FIXTURE CO., INC., PHILADELPHIA  
Works—Philadelphia  
Pres., F. D. Gill  
V. Pres., M. A. Gill  
Product: Illuminating glassware, Lighting fixtures.

GILLANDER AND SONS, INC., STATE ROAD AND DEVREUX ST., TACOY, PHILADELPHIA  
Works—Taco  
Pres., R. R. Gillander  
Gen. Mgr., John J. Beattie  
Capital: $945,087.00  
Process: 26 pots; One day tank.  
No. of employees: 225  
Annual wages: $205,000.00  
Product: Illuminating glassware, Advertising pump, globes and balls, Special mold work.

GLENSHAW GLASS CO., INC., GLENSHAW  
Works—Glenshaw  
Pres., J. J. Beck  
Sey., and Trea., S. B. Meyer  
Gen. Mgr., G. W. Meyer  
Capital: $300,000  
Process: Machine made; 6 Lynch full automatic blowing machines.  
3 continuous glass furnaces: 12" x 27" x 30", 12" x 24" x 42".  
9420 tons raw materials purchased annually.  
Fuel: Natural gas; 7 internal combustion engines.  
162,859,999 cu. ft. gas annually: $58,628.78  
25,570,000 cu. ft. for power: $10,641.92  
Power capacity, 760 HP; 10 electric motors.

No. of employees: 82  
Annual wages: $101,937.80  
Product: Glass bottles.

GREENSBURG GLASS WKS., (SUBSIDIARY OF L. E. SMITH GLASS CO.), GREENSBURG  
Works—Greensburg  
Pres., W. S. Wible  
Gen. Mgr., C. L. Spence  
Process: 2 continuous tanks, 17 rings.  
No. of employees: 197  
Product: Pressed ware, Specialties.

HAMILTON CO., J. T. AND A., 26TH ST. AND A. V. R. R., PITTSBURGH  
Works—Pittsburgh  
Pres. and Gen. Mgr., James W. Hamilton  
Treas., A. G. Hamilton  
V. Pres. and Sey., James H. Grahm  
Capital: $190,000  
Process: Machine made, one continuous tank, 10 rings.  
No. of employees: 175  
Production: 290,000 gross  
Annual wages: $222,251.00  
Product: Flint glass bottles.

HAWLEY GLASS CO., HAWLEY  
Works—Hawley  
Pres., L. P. Cocke  
Sey., Treas., and Gen. Mgr., LeRoy E. Sands  
Process: One continuous tank, 6 rings.

HAZEL-ATLAS GLASS CO., WHEELING, W. VA.  
Works—Washington (Plants No. 1, and No. 2)  
Pres. J. Harrison McNab  
V. Pres. and Gen. Sales Mgr., W. H. McClure  
Sey., C. S. Quay  
Treas., A. L. Metzner  
No. of employees: 1,581  
Product: Fruit jars, Packers, Preservers, Bottles, Tumblers, etc.

HEINZ CO., H., 1062 PROGRESS AV., S. F., PITTSBURGH  
Works—Sharpsburg  
Supt., John Johnson  
Purchasing Agent, W. A. Kober  
Process: Machine made; Owens machines.  
3 continuous tanks.  
No. of employees: 107  
Product: Flint packers and preservers.

HIGHLAND-WESTERN GLASS CO., WASHINGTON  
Works—Washington (2 plants)  
Pres., R. M. Paxton  
Sey., S. J. Hug  
No. of employees: 725  
Product: Rough rolled glass, Polished glass (Wired and Figured).

HOZE CONVEX GLASS CO., L. J., POINT MARION  
Works—Point Marion  
Pres. and Gen. Mgr., Leon J. Houze  
Sey., and Treas., Roger J. Houze  
Capital: $900,000  
Process: Pressed glass specialties, private mould work.  
No. of employees: 250  
Annual wages: $400,000.00  
Product: Goggle and special glass, Technical glassware, Sheet glass, colored and white.

INTERSTATE WINDOW GLASS CORP., KANE  
Works—Kane (Plant No. 1); Mt. Jewett (Plant No. 2)  
Pres., R. A. Hill  
Sey., and Treas., J. B. Anglec  
Capital: $350,000 shares, no par, common  
15,000 shares, $100 par preferred.  
Production: 506,030 boxes, (50 sq. ft. each)  
Annual wages: $501,936.00  
Product: Common window glass.

JEANETTE GLASS CO., 4TH ST. AND CHAMBERS AVE., JEANETTE  
Works—Jeannette  
Pres., C. H. Paschall  
V. Pres., C. P. Mills  
Sey., and Treas., Carl T. Sloan  
Process: Machine made; 5 continuous tanks, 20 rings.  
One day tank, 2 rings.  
No. of employees: 232  
Product: Pressed and blown glassware in crystal and colored glasses.
JEANNETTE SHADE AND NOVELTY CO., N. FOURTH ST., JEANNETTE

Product: Commercial units, Table and boudoir lamps, Hand decorated shades.

KNOX GLASS BOTTLE CO., KNOX

Product: Glass bottles.

KOPP GLASS, INC., SWISSEVALE SWISSEVALE

Product: Pressed and blown glass, Colored fancy glass, Technical glass, Signal glass, etc.

MCKEE GLASS CO., JEANNETTE


MacBEETH-EVANS GLASS CO., CHARLOTTESVILLE

Product: Technical illuminating and table glassware.

MARIENVILLE GLASS CO., MARIENVILLE

Product: Amber glass bottles.

MARSDEN GLASS WKs., INC., J. E. AMBLER

Product: Special crystal, Battery-jars, Kitchen glass, Discs, special molds.
GLASS (Continued)

PITTSBURGH PLATE GLASS CO., 2200 GRANT BLDG., PITTSBURGH
Works—Charleroi
Creightons
Ford City.
Pres.: R. S. Wherrett
Secy.: C. S. Lamb
Treas., Edwin Pitsaim
Capital: $65,000,000
No. of employees: 3,380
Product: Rough and polished plate,
Tapestry glass,
Carrara (Black and White),
Optical glass.
Production: 49,493,575 sq. ft.
Annual wages: $5,270,144.00

PITTSBURGH REFLECTOR CO., 402 BOWMAN BLDG., PITTSBURGH
Works—Irwin
Pres. and Gen. Mgr., E. S. Simons
V. Pres., E. W. Simons
Secy. and Treas., B. B. Hurlst
Process: 3 furnaces.
No. of employees: 147

QUERTINMONT GLASS CO., FAIRCHANCE
Works—Fairchance,
Point Marion
Pres., Jules J. Quertinmont, Sr.
Capital: $1,000,000
No. of employees: 140
Annual wages: $2,274,117.00
Product: Flat drawn window glass.

RUTH GLASS CO., 10TH AVE. AND HALLOWELL ST., CONSHOHOCKEN
Works—Conshohocken
Pres., Joseph A. Ruth
No. of employees: 105

SERGEANT GLASS CO., SERGEANT
Works—Sergeant
Pres., Eben Russ
Secy. and Treas., W. L. Heim
Mgr. and Pur. Agent, Clement Jungers
Process: One continuous tank, 35 tons daily capacity.
No. of employees: 46

SMITH GLASS CO., L. E., P. O. BOX 1, MT. PLEASANT
Works—Greenburg,
Mt. Pleasant
Pres., W. S. Wible
V. Pres., J. S. Hall
Treas. and Gen. Mgr., C. M. Wible
Secy., C. L. Spence
No. of employees: 251

STANDARD PLATE GLASS CO., FIRST NATIONAL BANK BLDG., PITTSBURGH
Works—Butler
Springdale, N. S. Pittsburgh
Pres., R. B. Teeter
V. Pres., J. D. Watson
Treas., J. R. Eckler
Secy., Joseph Hadenkamp, Jr.
No. of employees: 24
Product: Polished plate glass,
Mirrors.

CERAMIC INDUSTRIES OF PENNSYLVANIA

GLASS (Continued)

STANDARD SHEET GLASS CO., PUNXSUTAWNEY
Works—Punxsutawney
Product: Window glass.
Pres., D. L. Dennis
Capital: $150,000
(Reported idle)

STEELE GLASS CO., 622 S. WASHINGTON SQ., PHILADELPHIA
Works—Philadelphia
Product: Mfg. of glass for scientific purposes and laboratories.
Proprietor, Harris Conner
No. of employees: 15

TIBBY-BRAWNER GLASS CO., PUNXSUTAWNEY
Works—Jefferson County
Product: Glass bottles,
Glass stoppers.
Pres. and Gen. Mgr., W. C. Tibby
Capital: $20,000
Process: Hand blown; one continuous 10-rung tank.
No. of employees: 150
Annual wages: $93,711.34

TYGART VALLEY GLASS CO., WASHINGTON
Works—Washington
Product: Glass bottles.
Pres., Edward C. Stewart
Gen. Mgr. O. C. Noble
Capital: $400,000
Process: 2 continuous tanks, 14 rings.
No. of employees: 325
Annual wages: $300,000

UNITED STATES GLASS CO., 8. 9TH AND BINGHAM STS., PITTSBURGH
Works—Glassport (3 plants),
Pittsburgh (6 plants)
Product: Tableware,
Industrial glassware,
Glass bottles, etc.,
Specialties.
Pres., E. E. Slick
Secy. and Treas., William R. Nickel
Capital: $5,000,000
No. of employees: 3,000

VICTORY GLASS CO., JEANNETTE
Works—Jeannette
Product: Glass toys,
Corrugated cartons.
Pres., Joseph T. Buehler
Gen. Mgr., James Edge
Secy., C. Rachel Edge
Capital: $400,000
Process: One continuous tank.
No. of employees: 185

WESTMORELAND GLASS CO., GRAPEVILLE
Works—Grapeville
Product: Plain crystal,
Tableware,
Decorated and cut glass,
etc.
Pres., C. H. West
Gen. Mgr., J. J. Brainard
Secy., S. Brainard
Process: 32 pots; one day tank.
No. of employees: 241

WIGHTMAN BOTTLE AND GLASS MFG. CO., PARKERS LANDING
Works—Parkers Landing
Product: Glass bottles.
Pres. and Gen. Mgr., R. R. Underwood
Capital: $301,500
Production: 44,000 gross
Process: One continuous tank, 3 feeders.
No. of employees: 80
Annual wages: $40,531.44
ENAMELS AND CHEMICALS

AMERICAN SPECIALTY STAMPING CO., Oak and Murdock Sts.,
Johnstown
Works—Johnstown
Product: Enamed ware.

CERAMIC COLOR AND CHEMICAL MFG. CO., P. O. Box 81,
New Brighton
Works—New Brighton
Product: Ceramic colors, Chemicals.

CONEMAUGH IRON WORKS, LARAMIE
Works—Blairsville
Pres., F. B. McFeely
Vice and Treas., C. C. Adams
Secy. and Treas., W. W. Palmer
Capital: $440,000
Bonds, $255,000
Process: Dry process enameling;
9 gas fired enamel furnaces.
Fuel: Natural gas; 150,000,000 cu. ft. annually.
Electricity purchased, 700 HP capacity.
No. of employees: 555
Annual wages: $330,000.00
One ceramic engineer.

CROWN CHEMICAL CO., Farmers Bank Bldg., Pittsburgh
Works—Shadyside Station
Pres., Gen. Mgr., I. A. Simon
Secy., H. A. Stobus
Supt., J. P. Groves, Jr.
Capital: $15,000,000
Capacity: 4,000,000 lb.
No. of employees: 20; one ceramic engineer.

DANVILLE STOVE AND MFG. CO., 215 Railroad St., Danville
Works—Danville
Pres., W. S. Chamberlin
Gen. Mgr., G. M. Richards
No. of employees: 106

DUNLAP CO., JOHN, P. O. Box 1023, Carnegie
Works—Carnegie
Pres., W. A. Dunlap
Gen. Mgr., J. W. Wallis
No. of employees: 40

ENDURO PORCELAIN ENAMELING Co., MIDDLETOWN
Works—Middletown
Pres., E. M. Colquhoun
Secy. and Treas., E. W. Snook
Supt., George L. Dally, Jr.
Capital: $60,000
Process: White and colored enamels.
5 muffle type furnaces, 5 x 12 ft.
Fuel: Fuel oil; 25,000 gal. annually.
Electricity purchased, 250 HP capacity.
No. of employees: 70
Annual wages: $79,762.89
One ceramic engineer.
ENAMELS AND CHEMICALS (Continued)

Pres. and Gen. Mgr., J. W. Russel
Treas., H. S. Rich
Secy., R. J. Myers
Capacity: 2500 gross tons.
Process: Wet and dry coat enamel on cast iron.
5 kils., 9' x 6', 2 tons daily capacity.
Fuel: Fuel oil; 61,278 gal. annually; value: $2,357.75
Electricity purchased, 200 HP capacity, value: $2,572.75
No. of employees: 53
Annual wages: $35,227.65

PENNSYLVANIA SALT MFG. CO., Widmer Block, Philadelphia

Works—Greenwich Point, Natrona
Commercial chemicals.
Pres., L. T. Beale
Secy., J. A. Smith
No. of employees: 44

PHILADELPHIA ELECTRICAL AND MFG. CO., Philadelphia

Works—Philadelphia

Product: Street lighting fixtures and appliances.
No. of employees: 31
Annual wages: $46,000.00

PHILADELPHIA QUARTZ CO., 121 S. Third St., Philadelphia

Works—Philadelphia

Product: Soda products.
Pres., W. T. Ellington Secy., J. G. Vall
No. of employees: 55

PITTSBURGH LAMP, BRASS AND GLASS CO., Swissvale

Works—Swissvale

Product: Lamp manufacturing, Electroplating.
Pres., A. E. Blumenthal
No. of employees: 13
Annual wages: $15,955.43

PITTSBURGH VITREOUS ENAMELING CO., Corliss Station, Pittsburgh

Works—Pittsburgh

Product: Job enamelng of cast iron parts.
No. of employees: 10

PRIZER-PAINTER STOVE WORKS, Reading

Works—Reading

Product: Enameling on cast iron, (Stoves and ranges).
Pres. and Gen. Mgr., S. F. Blatt
Secy., W. B. White
No. of employees: 118

QUAKERTOWN STOVE WORKS, Quakertown

Works—Quakertown

Product: Vitreous enameling of stoves.
Pres., N. J. Roberts
Secy. Joseph Cavanaugh
Treas., N. H. Moyer
Capital: Stock, $300,000
Process: Wet process enameling on sheet steel and cast iron in conjunction with stove foundry.
One muffle kiln, 42' x 10 ft.
Fuel: Oil; 15,000 gal. annually; 4 gal. per hour.
No. of employees: 91
Annual wages: $94,700.00

CERAMIC INDUSTRIES OF PENNSYLVANIA

ENAMELS AND CHEMICALS (Continued)

RICHMOND RADIATOR CO., 1480 Broadway, N. Y. C.
Works—Uniontown
Product: Cast iron enameled sanitary ware.
Pres., W. G. Langford
No. of employees: 551

ROBERTS AND MANDER STOVE CO., 11th and Washington Ave., Philadelphia
Works—Hathorne
Product: Enamelled stoves.
Capital: Stock, $1,500,000
Process: 3 enamel smelters, 5' x 6' pot size; 2 electric enameling furnaces, 8' x 11'; 2 oil fired enameling furnaces, 8' x 12', one furnace, 4' x 10'.
Fuel: Oil, gas, electricity. All power purchased.
No. of employees: 484
Annual wages: $901,800.00
One ceramic engineer.

SCRANTON ENAMELING CO., Jefferson Ave. and New York St., Scranton
Works—Scranton
Product: Vallender clay, Enamel frit, Coloring oxides.
Pres., Heineck Turk
Secy. and Trea., Thyne Smith
Supt., J. Albert Freidel
Capital: Stock, $25,000
Production: 800,000 lbs.
Bonds, $150
Process: Interested in enameling all cast iron parts.
Fuel: Bituminous coal; 10 ears annually.
Electricity purchased; annual value: $3,600.00
No. of employees: 14
Annual wages: $20,500.00

SEASHOLTZ AND SONS, J. M., Front and Spruce Sts., Reading
Works—Reading
Product: Enameling of coal and gas stoves.
Pres. and Trea., J. M. Seasholtz
Secy., Edwin L. Seasholtz
Capital: $75,000
Process: All enamels purchased smelted but not milled.
3 kils., brick with carbahurnium muffles, 42' x 108'.
One electric kiln, 60' x 144'.
Fuel: Gas coal; 300 tons annually.
Electricity purchased; annual value: $9,860.00
No. of employees: 33
Annual wages: $46,000.00

STANDARD SANITARY MFG. CO., Bessemer Block, Pittsburgh
Works—Erie, New Brighton, Pittsburgh (2 plants)
Purchasing Agent, L. C. Corbus
No. of employees: 2,455

UNION MFG. CO., Boyertown
Works—Boyertown
Product: Enamelled and plain stoves and ranges.
Pres., J. Z. Hurmer
Secy., J. Clifford Leavengood
No. of employees: 83

UNITED STATES SANITARY MFG. CO., Monaca
Works—Monaca
Product: Enamed iron sanitary ware.
Pres., C. F. Arritt
No. of employees: 542
ENAMELS AND CHEMICALS (Continued)

VITRO MFG. CO., CORLISS STATION, PITTSBURGH
Works—Pittsburgh
Pres., Josef Vollkommer
Gen. Mgr., George Blumenthal
Capital: $250,000
No. of employees: 57

WILLIAMS AND CO., C. K., EASTON
Works—Easton
Pres., C. K. Williams
Secy., James B. Neal
No. of employees: 272

Product: Enamels,
Opacifiers, oxides,
Chemicals,
Glass colors, etc.

Product: Dry colors,
Fillers.

CHAPTER VI

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