

THE MARBLE INDUSTRY OF EAST TENNESSEE

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History

The first marble quarry and mill in East Tennessee were opened in Hawkins County in 1838. This operation, known as the Rogersville Marble Company, produced on a limited scale for several years with most of its production being distributed in East Tennessee; however, in 1848 two large blocks were sent to Washington, at the invitation of the Federal Government, for use in the Washington Monument. These blocks were floated down the Holston and Tennessee Rivers to Chattanooga and sent from there to Washington by rail.

Hawkins County marble continued to enjoy a good market for several years, being used in the Baltimore City Hall and other notable buildings. Shortly after the turn of the century the demand for dark variegated marble, the principal variety Hawkins County produced, declined due to a change in public taste. This change caused a decline of the marble industry of Hawkins County, but promoted the demand for the lighter grays and pinks of the Knoxville area.

The first marble quarry in the vicinity of Knoxville, the present center of the East Tennessee marble industry, was opened in 1852. This quarry was located two miles north of the city and supplied most of the marble for the State Capitol at Nashville.

The period from 1852 to 1900 witnessed the establishment of several other marble companies in the Knoxville area. Some of these enterprises were very successful while others were failures. The industry did not prosper during the period of World War I but increased activity followed the return of peace. The depression years of the 1930's were also difficult ones for the industry.

At the present time (1958) four companies fabricate marble in Knoxville. They are: Appalachian Marble Company, Candoro Marble Company, Gray Knox Marble Company, and Tennessee Marble Company. All of these concerns except Candoro Marble Company are also engaged in quarrying marble. Endsley Marble Company has one quarry and a small fabricating plant in Friendsville, Tennessee, a rural community about eighteen miles south of Knoxville. John J. Craig Company which quarries marble, but does not fabricate it beyond "gang sawing", is located about two and one-half miles northeast of Friendsville.

Imperial Black Marble Company, a quarrying company only, operates its only opening about two miles northwest of Thorn Hill, Tennessee.

Geology

The marble deposits of East Tennessee are found in eight parallel belts extending in a northeast-southwest direction from Hawkins County to the northwestern part of Monroe County (see Figure 1). This is a distance of about 125 miles in which individual belts vary from less than a mile to seventy-five miles in length; however, none of them exceeds one-fourth mile in width. The beds have been folded and faulted and subsequent erosion has resulted in repetition of their outcrops.

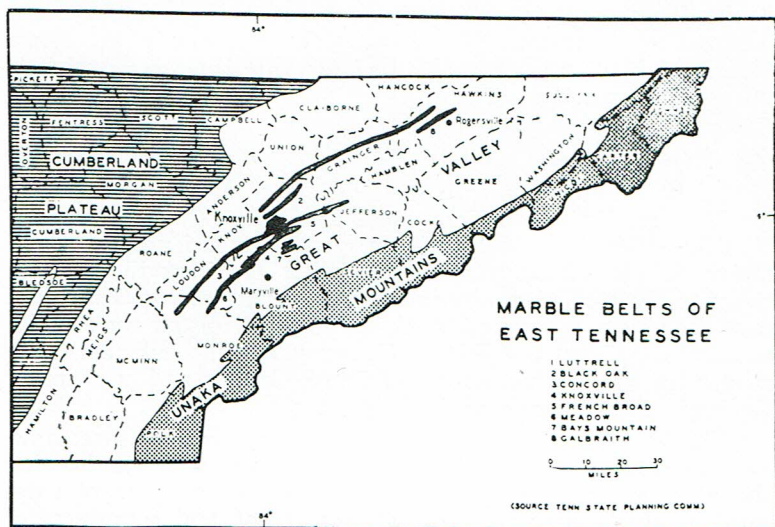


Fig. 1. Location of the commercial marble deposits of East Tennessee.

Chemical analysis shows that Tennessee marble is composed mainly of calcium carbonate with small amounts of magnesia, manganous oxide, ferric oxide, alumina, silica, and sulfur. Naturally the amount of each varies according to the location from which a given sample is taken. Tennessee marble has an average weight per cubic foot of approximately 180 pounds, and a crushing strength of about 17,000 pounds per square inch.

It should be pointed out that most Tennessee marble has not been completely recrystallized and fossil remains are often found in it. However, it is very definitely "marble" in a com-

mercial sense because it is capable of taking a polish and has the approval of the buying public. Fossils most often found in Tennessee marble are bryozoans, crinoids, brachiopods, and cephalopods.

With one exception, all of the active marble quarries in East Tennessee today are in the Holston formation which is of middle Ordovician age. This formation is usually overlain by the Tellico sandstone, although in places it may be overlain by thin shaley limestone. The lighter shades of marble such as gray and light pink are found in the lower portions of the Holston formation while the deeper pinks and chocolate colors are found nearer the top. The formation is 400 feet thick in places, but the workable beds usually do not exceed sixty to eighty feet.

The one active marble quarry not in the Holston formation is the Imperial Black opening about two miles northwest of Thorn Hill, Tennessee. This quarry, the only one in Tennessee yielding a black marble, is in the Maryville limestone which is of middle Cambrian age.

Quarries and Quarrying Methods

At the time of this writing (1958) there are fourteen active marble quarries in East Tennessee. The greatest concentration—eight quarries—is in Blount County near the Friendsville Community about eighteen miles southwest of Knoxville. Three quarries are located approximately five miles east of Knoxville near the point where the French Broad and Holston rivers unite to form the Tennessee River. One is near the Bluegrass Community in the southwest part of Knox County and two are in Grainger and Union counties respectively.

The location of a marble belt is determined by nature; however, some of the factors which man must consider when choosing the exact site of a quarry are dip, amount and type of overburden, availability of transportation, color and soundness of the stone, reserves, and the presence of ground water. The quarries in East Tennessee which are presently operating are favorably located, by chance or by plan, in respect to the factors just mentioned; the fact that many abandoned marble quarries are present is evidence that some were started without careful study.

Few, if any, accurate studies have been made concerning reserves of marble in East Tennessee because the various companies evidently do not consider this to be a problem at the present time. When asked about reserves, most company officials and foreman usually spoke of them as being "unlimited" or stated that their company has made no studies in regard to this matter either in terms of tons, cubic feet, or number of years production. Only one company gave a quantitative estimate in stating that it has enough stone to last for seventy-five years at the present rate of production.

The methods used in quarrying marble in East Tennessee have remained largely unchanged for the past several years; however, one notable development has taken place. This is the almost complete replacement of channeling machines by large pneumatic drills, many of which are mounted on adjustable bars (see Figure 2). The purpose of a channeling machine is to cut a continuous narrow trench or channel in the stone as it moves back and forth on a small steel track. Only four of these machines are being used in East Tennessee at this time, but they were used in much larger numbers before World War II.



Fig. 2 A pneumatic drill mounted on an adjustable bar.

After the pneumatic drills have been used to outline the block to be removed, the narrow bands of stone between the drill holes must be broken. This is accomplished by either "wedging" or "broaching". Wedging refers to driving tapered steel rods, between two narrow pieces of steel called feathers, into the drill holes, thereby causing the marble still intact between them to crack and break. This is always done by hand. Wedging is a critical operation in the quarrying of marble. In order to obtain a uniform break, it is important to have an equal amount of stress. If the wedges at one end of the block are driven harder than those at the other end, an irregular break may occur. The wedging of a particular block is usually done by only one man who must try to strike his blows with equal force, and, by avoiding haste, give the stone adequate time to fracture.

Broaching is the method of removing the connecting bands of stone between the drill holes by the chopping or cutting action of the end of a long thin steel blade. This tool, attached to the same pneumatic machine that operates the drill rods, frees the block from the main body of the quarry. Broachers are used where unquarried stone is opposite the side to be cut, while wedges are used where there is no stone opposite the side to be cut. Wedges are ordinarily used to free the underside of a block.

Marble is removed from all East Tennessee quarries by electrically powered derricks consisting of a steel mast and one or more steel booms. The booms are commonly ninety feet in length giving them a reaching ability of approximately 180 feet. Derricks are usually powered by 440 volt fifty horsepower motors and have a lifting capacity of thirty to fifty tons.

Mills and Fabrication

At present there are five marble companies operating fabricating mills in East Tennessee. They are: Gray Knox Marble Company, Candora Marble Company, Tennessee Marble Company, Appalachian Marble Company, and Endsley Marble Company. The first four named are located in Knoxville, while the last is at Friendsville, Tennessee.

Almost all of the marble blocks from East Tennessee quarries are fabricated in the mill of the producing company. This does not mean, however, that all of the marble fabricated in the area is of local origin. Three companies reported that they use a large amount of foreign marble, 25 per cent, 20 per cent, and 40 per cent, for fabrication into dimension stone. The remaining two companies reported using 100 per cent domestic marble. It is almost impossible to calculate the composite percentage of foreign marble used in the area due to insufficient information concerning local quarry production and mill waste. On the basis of percentage per company the average amount of foreign marble used is approximately 17 per cent.

The use of wire saws is a comparatively new innovation in fabricating in East Tennessee. These are expensive machines costing at least \$7,500.00, but their proper use can save a great deal of money. The most outstanding use of wire saws is to remove the end or side of a block in order to determine the extent of a fracture or crack (see Figure 3). They can also be used to remove the rough or uneven portion of a block and thus reduce transportation costs. The installation of more wire saws would undoubtedly result in greater profits, but their high initial cost seems to limit the number being used at present.

Gang sawing is the first operation through which marble destined for use as dimension stone must pass. A gang saw consists of a number of steel blades set parallel to each other in

a frame at distances corresponding to the thickness of the slabs to be sawed. The abrasive sand is fed to the saws by a continuous stream of water applied from above. These saws are capable of cutting through a block of marble at the rate of about one inch per hour.

After slabs have been sawed from a block of marble, they must then be "coped" or cut to specific sizes. This is performed by the use of a diamond saw which is highly complex and expensive. The saw is mounted on a device permitting movement in any direction. The cutting edge is impregnated with diamonds which saw rapidly.

Rubbing is the next phase of fabrication through which a slab of marble ordinarily passes. This is done by a machine composed of a round horizontal bed of cast iron that is turned

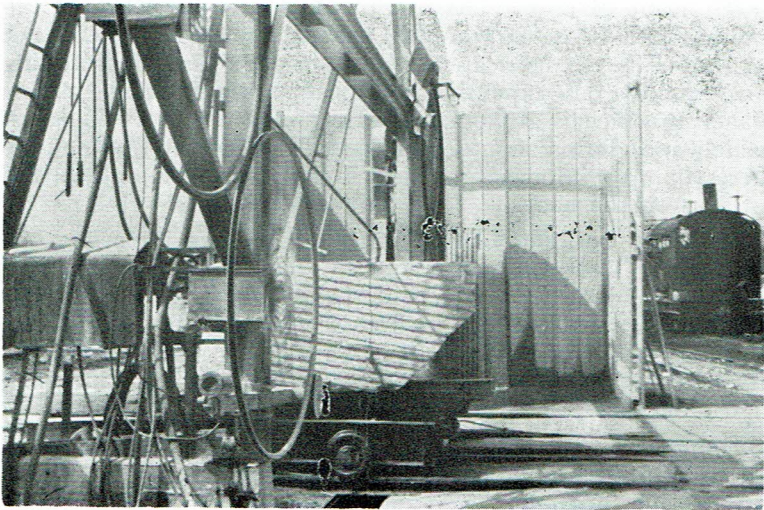


Fig. 3. A single strand wire saw being used near a quarry to shape a block of marble.

by a steel shaft. The machine is used to remove the rough surface of a slab before it receives its final finish. Sand is the most common abrasive used on rubbing beds and it must be pure and of uniform size.

Most interior dimension marble must be highly polished. This is accomplished by buffing with felt or some other soft material. The abrasive used for "gritting," which gives marble a dull finish, is emery powder. Polishing requires a finer abrasive so a substance called "putty powder," composed of chromium oxide, or tin oxide, together with oxalic acid, is used.

Uses

The uses of marble, almost too numerous to mention, range from the less spectacular ones such as industrial lime and turkey grit, to monuments, statues, and great works of art. Its use in great dignified buildings has remained almost unchallenged through the ages, but in less permanent structures it must compete with other materials. However, no other material is so well suited for combining prestige, dignity, and beauty in a large building with utility, endurance, and strength.

The marble industry of East Tennessee is fortunate in being able to produce a great variety of products. Many of these differ from each other so extensively that they should be discussed separately.

Dimension stone is composed of two classifications of marble, interior and exterior. The first of these is by far the most important and is the outstanding product of all East Tennessee marble mills. Its fabrication requires a great deal of processing and the use of expensive machinery. Wainscoting, marble paneling which is affixed to interior walls, is one of the most widely used forms of interior dimension stone. It is sometimes necessary to reinforce this material by placing aluminum rods in slots on the back.

Exterior building blocks constitute another important use of marble. They can be cut into any reasonable size, and their production does not ordinarily require the use of polishing machines because they are used with a dull finish. Other items included under dimension stone are window stools, flagstones, floor tile, drain boards, base boards, toilet partitions, molding, and table tops.

The reputation of marble as a material for sculpturing is of long standing. The mills of East Tennessee employ artisans who are capable of producing sculptured work for churches, public buildings, or any individual who may desire it. Blocks of sawed but unfinished marble are sold to monument companies which make monuments and memorials.

Split face marble is produced from slabs that are not suited for use as dimension stone. It is produced by a powerful machine called a "guillotine" which uses a steel blade to cut or break the slabs into various sizes. Used mainly for the construction of small buildings and residences, split face stone is a comparatively new marble product and often receives direct competition from sandstone for use in fireplaces, fences, and trimmings of buildings. The current price of split face is from \$27.50 to about \$40.00 a ton, varying with color, color combination, size, and producer. It is produced by three companies in East Tennessee.

Among the products derived from marble waste, both quarry and mill, terrazzo chips is one of the most important. These small pieces of crushed marble, sometimes mixed with chips of other material to produce a blend of colors, are placed in freshly poured concrete to form terrazzo flooring. After the concrete has hardened, a grinding machine is used to wear the entire surface down to a uniform level. The use of this product has become very important in Florida, where the damp climate demands a type of flooring capable of resisting termites and decay.

Turkey grit is another product derived from waste. The material used for this purpose should be of uniform size. Marble mills have been able to supply an excellent grit.

Other products derived from waste are crushed stone, agricultural lime, road metal, and riprap. To a large degree the utilization of waste material depends on transportation costs because waste products have a low unit value and cannot be shipped long distances.

Quick lime is not produced by any of the marble companies of East Tennessee, but two lime companies use marble as a source of raw material. Both of these companies calcine marble, producing quick lime which is sold largely to chemical and paper companies. The states of Kentucky, North Carolina, New York, and Tennessee receive the largest number of shipments.

Economic Contribution

No single marble company in East Tennessee is large enough to be called a giant industry, but considered together they approach this designation. A grand total of 956 people are employed; 619 in the mills and 337 in the quarries. If the two lime companies mentioned are included, a total of 1,067 people are employed. The average hourly wage for quarry workers is \$1.28 and for mill workers about \$1.35. The companies have a combined payroll of about \$2,302,312 annually. Their combined sales amount to about \$5,672,000 a year, most of which is "new money" brought in from other places.

In 1956 the value of dimension marble produced in Tennessee was \$3,508,648. This far less than the value of coal for that year which was \$35,608,736, but it should be remembered that coal is produced over a wider area than marble. In 1955 Tennessee produced \$12,610,302 worth of zine, most of which was mined in or near the marble producing area. Marble is therefore a major natural resource of East Tennessee.

There are many less obvious ways in which the marble industry contributes to the economy of East Tennessee. One of these is in transportation. Of the total shipments made from the mills, about 19 per cent is transported by rail while approximately 81 per cent goes by truck. It is not known exactly

how many transportation workers are involved indirectly in the movement of marble, but the industry is an important contributor to the support of this service activity.

The marble industry also contributes to the economic well-being of the region through the purchase of such necessities as machine parts, sand, office supplies and equipment, and a host of miscellaneous items and services too numerous to mention.

Outlook

In spite of competition from other materials, often low quality substitutes, marble will undoubtedly continue to be in demand as a building material. But the industry does have definite problems and the companies of East Tennessee have not been spared from these. When asked about the most important problems facing the American marble industry today, company officials reported these most often: (1) competition with foreign producers, especially those of Italy, and (2) difficulty of advertising marble to the general public. It is easy to see why the first of these problems is important because the average wage for an Italian marble quarry worker is about \$0.28 per hour, whereas, an American quarry worker receives about \$1.28 per hour. Italian producers can often undersell American producers on the American market. The United States tariff, as established by the Tariff Act of 1930, places an import duty on marble of \$0.65 per cubic foot on rough blocks and \$1.00 per cubic foot on sawed or dressed slabs over two inches thick. This is not great enough to give American producers adequate protection. The other major problem is related to the fact that most marble is not sold directly to the consuming public but is bought or specified by architects, building committees, and other groups. For this reason the public often has an indifferent attitude toward marble. Company officials feel that the stone would be more widely used if the general public was more aware of its many good qualities. Such an effort would involve extensive advertising and expenditures that no single company, or the industry as a whole, is prepared to bear.

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