WOOD MOSAIC.

Mosaic work in a variety of forms is always pleasing when well done. Although its origin is obscure, yet for centuries it has been one of the most favored mediums of decoration. In one of the southern counties of England there is still plied a quaint inlaid wood industry which is a modern example of this art. This inlaid woodwork, known as "Tonbridge ware"—a name suggestive of pottery—consists of views, flowers, borders, and so forth, in all their natural colors, with minute pieces of variously colored woods, each measuring about a twentieth of an inch square. So accurately are these pieces of wood cut, even at these minute dimensions, and so neatly and closely are they glued together, that they resemble one solid piece of wood with the design painted upon it. Curiously enough it was painted drawings upon white wood that originally suggested and subsequently evolved into the present craft.

The principal woods employed in the art are American birch, mahogany, fustic, walnut—American and Spanish—plum tree, tulip—with its beautiful fruit—red grain, cocus, snake wood, nutmeg, rosewood, mulberry, laburnum, box, peach, acacia, maple and Hungarian ash, with its charming silky luster and moiré grain. In short, no wood is useless for the craft so long as it does not contain too great a quantity of sap, although a remedy is found in the case of one or two necessary woods, such as the holly, which is boiled for several hours, an operation not only removing all the sap, but bleaching the wood considerably as well. There is one color, however, which has always puzzled the artist. Up to the present, no tree has been discovered the hue of whose wood is gray, and to supply this deficiency birds' eye maple and Hungarian ash are steeped for several weeks in the indigenous chalybeate waters, which convert the yellowish whiteness of these two woods into a soft steel-gray.

When it is proposed to inlay a certain view, border, or collocation of flowers in wood, a colored design is first of all prepared upon a piece of paper divided into squares of about the eighth of an inch in measurement. The design prepared, the workman proceeds to set it up in wood. This entails great labor and care, for in addition to being a skilled mechanic some artistic sense is absolutely essential in the judicious selection and composition of the different colored woods to obtain the necessary realistic effect. On all sides of him, within an arm's length, are ranged little piles of thin narrow slips of wood, each slip measuring about three and a half inches in length by about an inch broad, and varying from a twentieth to a twelfth of an inch in thickness. The workman begins at the bottom left hand corner of the squared design and takes the first set of squares and works across the drawing in a vertical direction. Suppose, for instance, he has to make a bouquet of flowers. He refers to the bottom left hand corner square of the pattern and finds that it forms part of the groundwork of the design; that is to say, no portion of the drawing encroaches upon that square. As the groundwork is invariably white, he selects a slip of white wood from one of the little piles and lays it flat down upon his bench. Then he proceeds to the next square above. This occupies a portion of the design—the end of a petal or a leaf. This is green, and he therefore selects a piece of wood of the correct greenish shade, and places this piece upon the former slip and proceeds to the next square above, and so on until he has worked his way right across the design, taking each square one by one and superposing their corresponding colored slips of wood, in their order of sequence in a little pile by his side. He then glues and presses these little slips tightly together in a little block, three and a half inches long, one inch wide, and two or three inches in thickness, composed of thin little strips of variegated wood. He labels this "number one" and proceeds to set up the second line of squares upon the drawing in a similar manner, which he afterward glues up and consecutively numbers; and so on until he has so constructed the whole design. If the drawing is a very large one, he may have as many as two hundred of these blocks of glued strips of wood. A thin veneer about the twentieth of an inch thick is now longitudinally cut from block number one. As he has now cut the reverse way of the wood, this veneer consists of a number of little frail sticks, three and a half inches in length and about a twentieth of an inch square, firmly held together by the glue. He lays this upon his bench, cuts a similar veneer from each of the other blocks, and glues them together in regular order. This block is now subjected to tremendous pressure to drive out all the superfluous glue and to unite the thin frail pieces of wood firmly together. In this block, the artist has obtained an exact and complete facsimile, square for square, of the drawing. When thoroughly dry, veneers are again longitudinally cut from this block, and each veneer is a replica of the pattern. Out of a block three and a half inches in thickness it is possible to obtain as many as thirty veneers.

Contains 32,600 pieces and over 100 different natural wood colors.

WOOD MOSAIC—THE PICTURE, WITH THE BLOCKS IN THE ROUGH STAGE.

Our illustration of a street conveys a comprehensive idea of the work at this stage. It appears to be an indistinguishable conglomeration of a number of small blocks of wood, and presents a blurred and fuzzy appearance, like a photograph very much out of focus. This particular design only measures six inches by four and a half, yet there are no less than 32,600 pieces of wood, extending over one hundred different colors, utilized in its composition.

THE ASSAYING OF GOLD AND SILVER ORES.

BY WILLIAM B. GAMBLE.

The assayer's first operation consists of a thorough sampling of the ore. The reason is plain. Metal-bearing rocks are not at all homogeneous. Barren quartz is often found next to mineral assaying thousands of dollars to the ton. The amount to be assayed must be made to represent as accurately as possible the average of the whole lot.

The ore is first sampled as it comes from the mine, and later at the smelter, chlorination works, or cyanide plant, as the case may be. When mechanical samplers are not employed, the general practice is to throw aside every fifth shovelful into a conical pile, which is afterward divided vertically into four equal parts—or "quartered" as the operators say. Opposite segments are withdrawn and thoroughly mixed together. This operation is repeated until the sample is of a convenient size, when it must be passed through a small hand crusher. The latter should be thoroughly clean—a safeguard against error, which is possible when rich ore has been previously crushed. The writer knows of several cases in which the ore from a worthless prospect has assayed like that from a dividend-paying mine—a result due to carelessness in this particular.

In many cases the sample is still too large when it comes from the crusher, and it must be further reduced until it can be conveniently handled on the apparatus about to be described. The latter consists of an iron plate two feet square and provided with flanges at the two sides in order that the ore may not be brushed aside. This device is known as the bucking-board. Its complement, called the muller, is a piece of cast iron resembling an ordinary cigar box in size and form. This is manipulated by a long handle parallel to the upper surface. The lower surface is convex, so that a rocking motion may be imparted to the whole.

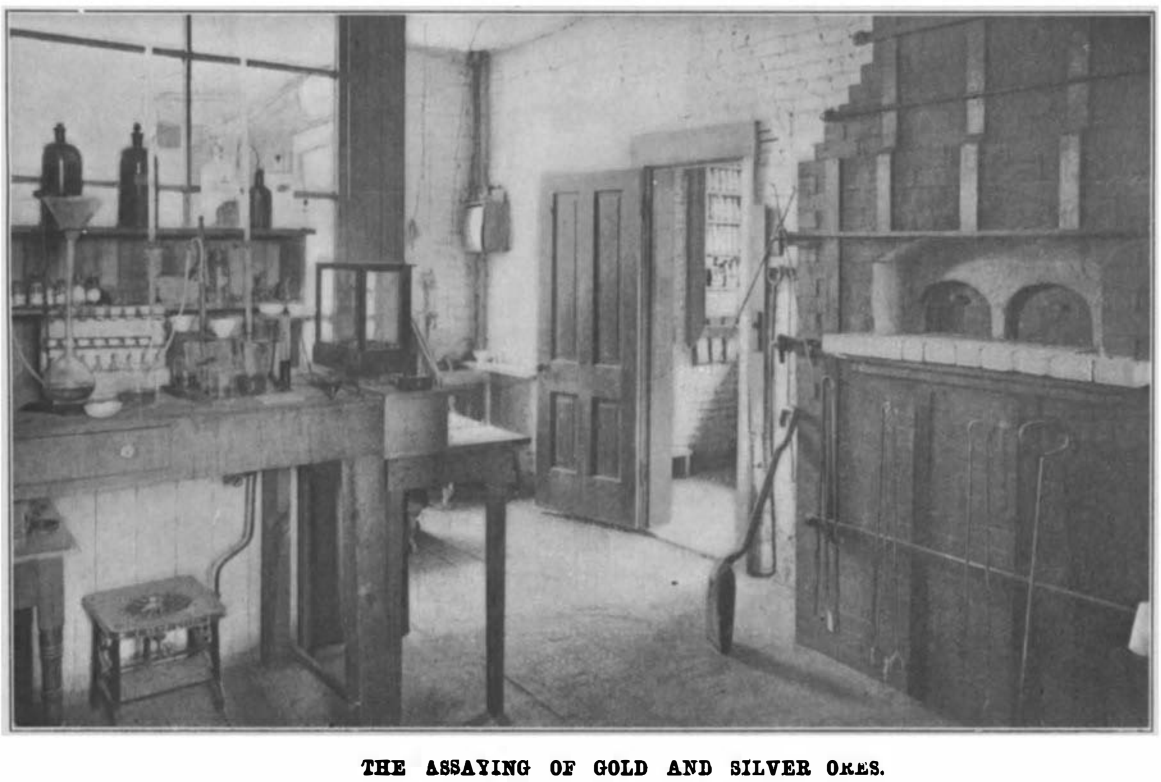
The bucking-board having been cleaned and the sample spread over its surface, the operator, with a backward and forward motion of the muller, grinds the ore to a pulp sufficiently fine to pass through an eighty-mesh screen. When this operation is completed the screen should be examined for any particles of free gold which may have clung to the wires. If any are found they must be weighed and their total value computed in relation to the weight of the whole pulp sample. The value to the ton is very easily calculated—which figure must be included in the final assay result.

After the pulp has been rendered homogeneous by rolling it in a small piece of oilcloth it is spread into a thin layer, from which small portions are taken until an amount known as half of an assay ton is obtained.

Here it is necessary to explain the system of assay weights. As I have before mentioned, gold and silver ores are valued by the amounts of these metals contained in the ton of rock. These amounts are generally expressed in ounces troy. Of course, any system of weights might be used and the final result calculated in ounces to the ton. But the assayer is a busy man who shortens his labors whenever he may do so without a sacrifice of accuracy.

This is a convenient place briefly to mention the scales used in assaying. There are generally two: those for weighing the pulp sample, and the "button scales" for weighing the metals obtained. The latter, which are provided with a rider, or hook, adjustable along the beam, weigh correctly to the one one-hundredth part of a milligramme, or less than two ten thousandths of a grain.

Now the problem in establishing a system of assay weights is to read milligrammes and fractions thereof as so many ounces to the ton directly from the button scales. The matter, of course, is simply one of proportion; it being necessary to weigh out an amount on the pulp scales which shall bear the same relation to a milligramme as a ton does to an ounce. We know that there are 29,166·66 ounces troy in the ton of two thousand pounds. Therefore 29,166 milligrammes is the pro-



THE ASSAYING OF GOLD AND SILVER ORES.

per weight to represent a ton. This is known as the assay ton. As the bulk of this weight of pulp is a trifle large for the ordinary crucible; only one-half of the amount is usually taken, and the gold and silver results multiplied by two. For example: suppose that we have a reading of 2·2 milligrammes for gold and 60·2 milligrammes for silver. These figures signify 4·4 ounces of gold and 120·4 ounces of silver to the ton.

To return to the preparation of the assay. The one-half assay ton of pulp is placed in a small fire-clay crucible, care being taken that the latter is perfectly clean. If the determination is for gold alone and the assayer suspects that the ore carries little or no silver, a small piece of the latter metal (which should be chemically pure) is added to the pulp. This is done for the reason that gold and silver are thrown down together and that the gold, which often appears as a mere speck, might otherwise be difficult to find, or in greater probability lost.

In the succeeding operation the assayer's knowledge of chemistry comes into play. I refer to the fluxing of the charge; that is, the addition of materials which will remove the non-essential ingredients of the ore. Among the various fluxes in common use are the following: Sodium and potassium carbonates, which are used for the decomposition of silicates; lead oxide, otherwise known as litharge, which not only supplies the lead for the mechanical carrying down of the gold and the silver, but which acts as a powerful oxidizing and desulphurizing agent; flour and argol, which, by means of their carbon, act as reducers—that is, they take oxygen from other parts of the ore; niter, which freely supplies oxygen; and, lastly, iron, generally in the form of nails, which acts as a desulphurizing agent. Borax is a most important factor in most assays, both on account of its strong acid reaction and its use in preventing too vigorous a boiling of the crucible's contents. Salt is very often substituted for the latter purpose.

The fluxes, which have been mixed in the proper proportions, are intimately mixed with the pulp. The charge, having been covered either with a layer of borax or salt, the crucible is introduced into the white hot muffle of a reverberatory furnace. It is at this point that many an inexperienced operator fails. Success is due to his ability to keep his furnace at a high uniform heat. If he is unattentive in this respect, he might as well abandon his task at once. A view of a typical furnace, with asbestos doors to prevent the escape of heat from the muffles, is shown in the photograph. Coal is fed into the furnace from the rear.

When all sounds of boiling of the crucible contents have ceased—that is, in about forty-five minutes, if the fire has been favorable—the glowing charge is removed and carefully poured into a mold. The lead (supplied either from the litharge or from the ore itself) sinks to the bottom and carries with it the gold and silver. When the whole has cooled, the slag is broken off and the lump of gold and silver bearing lead pounded with a hammer into a convenient cubical form.

The separation of the precious metals from the lead is the next problem. The procedure is based upon the fact that lead oxides at a temperature not sufficiently great to cause serious losses from the gold and silver by volatilization.

The lead cube just mentioned is placed in a small bone-ash dish called a cupel, which has already been heated in the muffle. The heat should be carefully watched during the process of cupellation. Until the lead is melted, the muffle door should be closed. It is then opened; not only that the temperature may be reduced to the proper degree, but that a current of air, for the purpose of oxidizing the lead, may pass over the cupel and out of a small aperture at the back into the chimney. Thus a portion of the lead is oxidized and carried off as fumes, while the remainder is absorbed by the bone-ash of the cupel.

As the last of the lead disappears, the mass of gold and silver which remains suddenly solidifies and becomes dull, or "blicks"—an action which warns the operator that it is nearly time to remove the cupel from the muffle.

If no silver has been added to the original charge, and it is desirable to obtain the silver result, the button of associated gold and silver, which we will call bullion, is weighed on the button scales. The amount (multiplied by two, as before explained) read off in milligrammes represents the number of ounces of bullion to the ton.

The determination of the gold value is the next step. The bullion button is transferred to a small porcelain dish and covered with dilute nitric acid. It is then gently heated. If the amount of gold is not excessive it takes but a few moments for the silver to dissolve. The residue of nitric acid and nitrate of silver (in solution) is then decanted off, leaving a black spongy mass of gold. After the latter is dried and annealed to its yellow color in the muffle, it is carefully weighed. This amount is substracted from the bullion weight, the difference representing the silver value.

While to some assayers the crucible method is quite satisfactory, others claim that it fails to recover the full amount of silver. In many localities, notably in Colorado, where a close saving of this metal is desired, what is known as the scorification assay generally accompanies the former.

The scorifier is a shallow fire-clay dish, circular in form and about two inches in diameter. In this is usually placed one-tenth of an assay ton of pulp which should be mixed with about twenty grammes of chemically pure test lead. A like amount of the latter is then spread over the mixture and a small quantity of course grained borax added. The charge is placed in the muffle and the asbestos door is closed until the operation is well under way. It is then noticed that the melted metals lie in the center of the scorifier as a glowing mass surrounded by a ring of melted slag. When the latter has completely closed over the metals the assay is poured into a mold. The slag is removed, and as before described, the lead button is cupelled. If the ore is known to run very low in gold the bullion weight is accepted for that of the silver, because the almost inappreciable amount of gold in one-tenth of an assay ton in such a case would scarcely warrant a separation of the two metals. A silver result, correct to one-half an ounce to the ton, is generally regarded as sufficiently close.

It cannot be emphasized too strongly that every step in the operations above described must be taken with the greatest care. If there is an exact art, that of the assayer certainly lays claim to the distinction. The possibilities of error are many and only careful men may hope to retain their business or their positions.

COTTON TRADE SCHOOLS IN THE SOUTH.

BY J. A. STEWART.

The progress which the South has been making in cotton manufacturing augurs well for the future prosperity and advancement of the Southern section. While there were 7,160,000 cotton spindles in Massachusetts at the beginning of 1895, there was no State south of Mason and Dixon's line with a million. Now there are two, North and South Carolina, with over that number, thus exceeding all the New England States excepting Massachusetts, Rhode Island and New Hampshire.

The value of the cotton goods manufactured in the eight Southern States in 1880 was $16,173,222, and in 1890 the returns showed a value of cotton manufactures reaching $40,165,074 or a gain of nearly 250 per cent.

This splendid growth is bringing the South into prominence through the enhancement thus given to national American industries. Its progress is also bringing it into closer relation and a clearer understanding of the development of the manufacturing interests which comprise so large a portion of the life and prosperity of the nation. Furthermore, this grasp of conditions is shown by the growing realization in the South of the need of trained craftsmen and educated workmen to conduct its colossal manufacturing interests.

Like textile manufacturers in foreign countries, manufacturers in the South are recognizing that the system of training workmen in the mill is ineffective, for the textile mill is an establishment whose chief purpose is production and not instruction. Consequently they have been awake to the necessity of establishing textile schools, from which are to come trained workmen and educated engineers for the carrying on of their large and growing textile industrial enterprises.

The first cotton trade school in the South is that started in 1898–1899 in connection with the Georgia School of Technology at Atlanta, Lyman Hall, president. Clemson College, S. C., has also recently opened a textile department in a building especially erected for its use under the direction of J. H. M. Beatty. By the establishment of these two trade teaching institutions, the South has justified its claim to textile educational enterprise.

The Atlanta institution is very complete. It was designed by a Boston architect, and as it stands it embodies the very latest ideas of mill construction, as well as a convenient school department.

The school is the outcome of the legislative act of December, 1897, which appropriated $10,000 for the establishment of the Textile School on condition that its friends contribute $10,000 additional in money and machinery. A wealthy philantropist. Mr. Aaron French, of Pittsburg, became the chief benefactor of the institution. In his honor it has been named "The A. French Textile School." In December, 1898, the legislature appropriated $10.000 for two consecutive years for the support of the school. The building is of brick, 150 by 70 feet and three stories in height. The basement floor contains the laboratory, dye house, receiving and finishing rooms, store and washrooms, the engine room, a ginery and a lecture room. On the first floor one finds the department devoted to preparing the warps and weaving. Here are also the designing room, a room for Jacquard designing, an exhibition department besides the principal's office. The top floor is occupied by the carding and spinning department, where the cotton is brought from its crude state up to a finished yarn ready for weaving.

The equipment of the school is complete. In appreciation of the advantage of having the future mill men of the South familiar with their machinery, the machine manufacturers have donated whatever was required by way of equipment to a valuation of $20.000. The shafting makers, the belting company, the automatic sprinkling company, the ventilating and heating company followed in line, as did the makers of the Drosophore humidifiers—machines very essential to the cotton manufacturing industry in the hot, dry South, where natural atmospheric conditions would otherwise be too unfavorable. Every machine of consequence known to the cotton manufacturing industry is to be found here, and in most cases in considerable variety of makes of manufacture.

The student who has mastered the technicalities of the plant in a school of this sort will have no trouble in manipulating or caring for any machine he may find in any up-to-date mill in actual business. There are four types of cards; a Winship 60 saw cotton gin, gin feeder and condenser; two kinds of drawing frames, a railway head, a ribbon lapper, a comber, five processes of fly frames, three types of ring spinning frames, four spoolers, three winders, and a wet and dry twister. The student learns the process of weaving on about fifteen different kinds of looms, from those making heavy coarse cloth to the finest Jacquard products. Among these looms are Whitin, Mason, Crompton & Knowles, Kilburn, Lincoln, Northrop, Calvin and Jacquard looms.

The curriculum of the school is as broad as its equipment is complete. There are courses in mathematics, English, drawing, mechanics, textile design, chemistry and dyeing, millwork and shopwork to be studied in four years. Special courses of two years in designing and weaving, carding and spinning, chemistry and dyeing are provided. Thus the needs of most of the branches of the textile industry in the South are met. The special feature of the textile course in the Georgia school are the courses given in the different shops synchronously with the work in the cotton mill. Special prominence is given to the elements of practice of every department. Although this is the first year of practical operation of this department one hundred and twenty-five young men have matriculated.

Clemson College Textile School, also inaugurated last fall, provides a similar four year course in which the textile instruction is incorporated in the regular college work, the increasing development of cotton manufacturing in South Carolina having brought about a demand for more complete textile training. At Clemson the purpose is to expand into a broader curriculum of textile industrial art, to include the manufacture of wool, silk and linen products. The textile building at Clemson is a two-story brick structure of modern cotton mill design, lighted by electricity, heated by steam and protected from fire by automatic sprinklers. On the first floor are the recitation rooms, the carding and spinning departments and the office. The dyeing and weaving departments are on the second floor. The equipment is fully as comprehensive as that of the Georgia institution.

It is well held that three years spent wisely in a school are equal to twice that time in a mill. These two schools may be looked on as pioneers in a group that will cover the whole cotton growing requirements of the South; to which learner and manufacturer can turn alike for information and for assistance, and from which trained experts will graduate, whose knowledge and skill will be devoted to the further development of the great textile industry.

Without a doubt, the expansion of textile education in the South will be coincident and contributory to the new era of southern industrial progress. The time has come when the manufacture of those textiles which are now imported from abroad to an extent exceeding one hundred million dollars' worth annually will be conducted in this country; and when the South's vast product of cotton will no longer be chiefly shipped in the bale to be manufactured into cloth in foreign mills, but will be wrought into fabrics in this country, thus giving industrial impetus to a large section greatly in need of it.

On May 12 ended the British tour of the Automobile Club. All the cars which went through the trial traveled a minimum of 1,059 miles, and some of them made a distance of 1,107 miles. There were eleven actual running days since the competing vehicles left London, the balance being made up of Sundays and one-day exhibitions. The longest day's journey was the last, the trip up to London being made from Nottingham, a distance of 123½ miles. The shortest day's trip was the run between Kendal and Carlisle, a distance of 61½ miles. It is impossible to state at present, until the official figures are published, how many cars went through the trial from the start to the finish.

In the harvest of 1899 there were 1.265.601.664 gallons of wine produced in France; 766,107,500 gallons produced in Italy; 594,393,750 gallons produced in Spain, and 158,505,000 produced in Roumania. The total production of the old world is estimated at 3,338,101,704.