to Mr. J. M. Hills, and a modification of it is now used by the New York Gas Light Company.

Professor Chandler remarks of the mixture employed by the latter company that

it was invented by Messrs. St. John and Cartwright, and has been in use nearly two years, giving entire satisfaction. As the bog iron ores of this neighborhood are not sufficiently pulverulent to act promptly on the gas, Messrs. St. John and Cartwright add to the ore a quantity of iron borings or turnings, which they then convert into an artificial hydrated sesquioxide of iron by moistening the whole with ammoniacal liquor and exposing it to the air. The resulting mixture of natural and artificial oxide receives an addition of coarsely pulverized charcoal. This mixture is always sprinkled with ammoniacal water before it is placed in the purifier.

The material now in daily use at the works of the New York Gas Light Company was introduced in April, 1868. Occasional additions of iron borings have been made to it; otherwise the material is the same. When last tested it contained thirty per cent of sulphur. In Germany several varieties of sesquioxide of iron are now in use, prominent among which are "the Oberuseler mixture," an iron ore containing some oxide of manganese; the "Manheim oxide," and "Deicke's oxide," very pure artificial oxides of iron.

The wet-lime process is only used so far as is known in a single establishment in Ireland, where it is preceded by another process which, removing the ammonia, renders the lime, when taken from the purifiers, quite inoffensive. The dry-lime process has also been almost universally abandoned in Europe, the iron process having been found to be not only cheaper, but free from the offensiveness of the lime processes. The iron process has also gained a foothold in America, being used not only by the New York Gas Light Company, but by two or three companies in Massachusetts.

We have not space to follow Professor Chandler through his discussion of the relative merits of the methods enumerated. He, however, effectually disposes of the objections raised against the iron process, and emphatically indorses it as being far superior to any other process of purification known to gas engineers.

The report next reviews the history of the complaints made against the several gas light works of New York, on account of the offensive gases emanating from them, and the proceedings of the Board of Health in the matter. On the 30th April, 1866, a meeting of the Sanitary committee, and a committee of the Citizens' Association was held to consider means for abating the nuisance, the gas companies being also represented. The result of the conference was the prompt institution of experiments on the part of the Manhattan and New York companies, which have resulted in the less objectionable processes above specified, and a great improvement in the purity of the air in their vicinity was at once noticed. On the contrary, the Metropolitan Company refused to heed the demands of the citizens, and obstinately held out against them.

The Board of Health at sundry times attempted to compel this company to adopt a less objectionable process of purification. But while the company refused to accede to the requirements of the Board, they expressed their willingness to adopt a better process than the one employed, if shown that it was better and that it could be advantageously adopted. The conduct of the company has, however, shown that they were indisposed to make any change calculated to improve the sanitary condition of the atmosphere of the neighborhood about their works. Professor Chandler sums up the case against this company in the subjoined extract, which must complete our notice of his able report. Our readers will see that it places the refractory corporation in not a very enviable light in reference to their respect for the rights of citizens, the more so as it is also shown in another part of the report, that the changes necessary to adapt their works to an improved process of purification would be very slight, and inexpensive.

This company has probably spent nearly $10,000 for expert fees, counsel fees, sending to Europe the man whose evidence was suppressed and whose advice was not followed, time of employees, printing 200 pages of evidence, etc., all apparently with the design, not of suppressing the nuisance, but of defeating the honest efforts of the Board of Health in behalf of the citizens of New York. Suppose the officers of this company were really acting in good faith, with a sincere desire to obviate the nuisance, they could at once introduce a better process of purification, a cheaper process, by which they could save $10,000 per annum, or they could retain their present process and ventilate the foul lime. Let them follow the example of either of the neighboring companies, use the iron process of the New York Company or the ventilating process of the Manhattan Company, or they may select any one of the improved iron processes now used in Europe. All that is asked of them is that they manifest the same willingness to direct their efforts to the management of their business in a manner most conducive to the health and comfort of the city, as was so promptly manifested by the other companies.

BENT, STAINED, AND ORNAMENTAL WINDOW GLASS.

Though a great deal of ornamental window glass is used in this country, and the demand is slowly but steadily growing, there are only a few establishments in the country where all kinds of ornamental glass for windows is produced. The largest and most constant demand at the present time is stained glass for churches. As work of this kind can be cheaply done, and as it obviates the necessity for blinds or shades, the cost in the end is but little more than the expense of plain glass.

In going through an establishment where ornamental window glass is produced, one of the first operations to be noticed is the production of what is known to the trade as "plain obscure," or plain ground glass. This is ordinarily done by placing the sheets of glass on the bottom of a large box, fastening them down, and then covering them with sand, gravel, and water to the depth of from one half inch to two inches. The box has a vibrating motion given to it by means of a crank and connecting rod. In about two hours the sand and gravel have cut the face of the glass to the required degree of obscurity. The breakage in this operation varies from five per cent, upward, as the glass is thin and crooked or straight and thick. The effect of obscure may be obtained by covering the glass with a thin coat of white enamel.

"Laying a ground" is one of the most essential of all the operations in producing ornamental glass. It is simply covering the glass with an even coat of the color. The color, which is ground up in proper vehicles like a thin paint, is first spread upon the glass with a broad soft brush; while the color dries, which is at once, it is smoothed and spread about with blenders until perfectly even and uniform. This is a trade by itself, and requires great steadiness of the hand and care in manipulation. The white enamels require the most care, as they are usually in situations at no great distance from the eye, and any imperfection in them shows more plainly than in any other color. The beauty of stained work depends in a great measure upon the care and skill with which the grounds are laid. If the glass is to have no pattern upon it, it goes at once from this room to the kiln where the enamel is burnt in. Usually, however, it passes to a room where the "brushing out" is done. The color is upon the glass—an even coat over the whole surface—the figures are produced by brushing away all the color except where the figures are to be. This is done by putting a stencil plate upon the glass and brushing the color out through it, which of course leaves a figure upon the glass of exactly the same shape as the plate. The stencil plates used for this kind of work are the finest that are made. As they are reversed from those in which the paint or ink is brushed through them, they have the advantage that the lines do not have to be broken but only supported by cross lines or lace work, as it is called. When a design is to be shaded by transparent lines like those used on vestibule doors, the stencil plate has only the leading lines and outline. The details are put in afterward with a fine point that removes the ground; this is called stippling. Almost all patterns on enameled glass are produced by stencil plates or some modification of them. In most elaborate designs the artist has much to do after the glass has been under the stencil plate, the details and shading have to be put in, and, it may be, lines to be erased that were put into the pattern simply to give support to the metal.

The glass is now ready for the fire; for, in its present state, the color is easily rubbed off. The enamels must be melted upon its surface in order to make them stick. When they are once subjected to the action of the fire they become so incorporated with the substance of the glass that they cannot be removed except by grinding.

The kilns in which the colors are burned in, are arranged so that the flame from the [illegible] plays upon the surface of the glass. As [illegible] the c[illegible] are melt[illegible] the [illegible] of the kiln upon which the glass [illegible] pushed back to a cooler part where another furnace prevents too rapid cooling. The glass is then removed from the slab forming the floor and set up on the edge till the kiln is ready to cool.

For some kinds of work what is known as a box kiln is used. This is a cast iron box, measuring some two and a half feet each way. It is set in fire brick so that the heat from a furnace beneath may play all around it. This is chiefly for small work, such as the borders for church windows, etc. After the box is filled with glass the front is closed except a small hole through which the inside is observed. The fire is then started and the whole brought to nearly a bright red heat after which it is allowed to cool slowly.

The patterns of which mention has been made are an interesting study by themselves. For the more important kinds of work where there are many copies to be made they are of thin sheet brass. Others less often used are of zinc or block tin, while for single orders paper is used. Some of the designs for white enamel for office windows, etc., are so delicate as to seem like lace or woven work rather than a design punched from a sheet of metal. Their number and variety seem almost infinite. Men are constantly employed in producing new ones, and so high a reputation have American designs attained that European manufacturers are constantly copying them as they appear.

The glazing room is one of the most important points in a large establishment of this kind. A church window may consist of hundreds of small bits of glass. These are brought to the glazing room and united by leads when they are ready to be put into the sashes. The cross section of one of these leads is like a letter ⌶ laid upon its side. They are inserted between each bit of glass, in fact each piece, no matter how small, is surrounded by them, and in that way joined to the rest of the window.

The colors and their preparation require more scientific knowledge and skill than any other department of the business. The colors themselves are, as a rule, metallic oxides that remain unchanged by a red heat, or else some preparation which, at a red heat, takes on the proper color.

Iron, cobalt, copper, chromium, silver, gold, and platinum, are the chief sources of color; the more costly metals furnishing the most brilliant tints. These substances will not by themselves, adhere to the glass, it is therefore necessary to mix them with a "flux," that is something which shall act as a cement. In many cases these oxides are so refractory that they will not melt at a red heat; then some substance must be found that will reduce the melting point without changing the color—no very easy thing to do in some instances. Usually the action of the fire produces a change in the enamels; thus black, when it is put upon the glass, is of a dark olive green, the heat turning it to the proper tint. In glass bearing figures in transparent colors, as ruby, blue, green, etc., the glass used is colored, and all but the figure is covered with an opaque enamel.

There is another kind of glass used for vestibule doors, and ornamental work in general, which is very beautiful and extremely costly, namely, etched glass. The glass is covered with a varnish that resists acid, the pattern is then cut through the varnish to the glass. Hydrofluoric acid is then employed to "bite" the design in. Usually, in this kind of work, the ground is obscured so at to leave the figures transparent. The process is dangerous to the workman, and, at the same time, demands a great deal of skill and artistic talent.

Bent glass for windows, carriage fronts, and corner panels is coming more and more in vogue, and, where there is a great number of pieces required to have the same curve, is not very expensive. A piece of boiler plate or heavy sheet iron is bent to the required curve. This is called the mold, and the chief expense is in making it. The glass is laid on this mold, which is rubbed over with calcined plaster to prevent the glass from sticking when it becomes [illegible]. Mold and glass are then put into the kiln. The heat softens the glass till it sinks down and takes the shape of the mold.

One other variety of ornamental glass in general use is that having white figures on a colored ground. This is really cut glass. The colored portion of the glass being very thin, it is only necessary to cut through it to leave a white or transparent mark. The cutting is done with small wheels and stones of various kinds. An examination of a piece of work of this kind will show at once the marks of the wheels and explain the peculiarities of the patterns used.

WHAT IS CHEMISTRY?

If we open a dictionary, an encyclopedia, or a school book, we shall find a definition of chemistry, tracing the word back to the Arabs and utterly confounding us with the profound knowledge of the learned pundits who have endeavored to enlighten the world on the subject. Somehow, after reading all their wisdom we are about as much in the dark as we were before. We therefore propose to let the Arabs alone this time, and also to say nothing about Albertus Magnus, Paracelsus, and the rest of them, but to speak of chemistry as it appears to us in this year of grace 1870. It is a very different science from what it was fifty years ago; it is not the same thing it was ten years ago; and, if it keeps on growing at the same rate for the next fifty years, it appears destined to absorb a host of other sciences and to become master of the situation. The popular notion is that creating a few unsavory smells, producing loud explosions, effecting marvelous changes in color, and amusing small children, is what we call chemistry. Hence in the minds of such people it is unworthy a place in a school of public instruction. It is about time that more correct information on the subject should be promulgated, and on this account we have selected it as a text for a few editorial remarks.

We used to say that it was the business of the chemist to investigate everything under the sun; but this statement no longer holds good, as the sun itself and all of the heavenly bodies, have been brought down to earth by means of the spectroscope and are made objects of study in the chemical laboratory.

We must now amend the saying by stating that everything in the universe is a fair object for the study of the chemist This would appear to afford ample occupation for the most ambitious person, and it would seem at first glance to be a hopeless task. It is not, however, so difficult as it appears upon first presentation. The number of compounds in the world is large, but the number of simple elements composing them is small. There are a great many words in our language, but these are made up of twenty-five letters. If we are instructed how to handle these letters we know how to spell, and as soon as we can spell we try to attach the words together to make sentences, and if we are skillful in forming sentences we may write a book.

The world, to the chemist, is a big book made up of sentences and words written in sixty-five characters which he calls elements. As soon as we are able to recognize these characters on all occasions, we can read the work of nature and understand it. We shall find that certain elements are rarely used—that, in fact, the number of letters in nature's alphabet is not greater than we constantly employ in ours. This view of the case materially lessens our task and we can go courageously to work to study the composition of the globe. What is, therefore, chemistry?

It is the science of forces that act at insensible distances between the atoms of different kinds of matter. All of the forces of chemistry act in contact and the result is a new body. In physics the forces operate at great distances, often without any permanent change in the body acted upon. For instance, a current of electricity around a piece of soft iron converts that iron into a magnet; but the iron weighs no more, nor is it any longer or broader than before; and as soon as the electricity ceases to pass, the iron is no longer a magnet. This is called a physical operation, but if the same bar of iron be heated in contact with sulphur, it unites with the sulphur and produces a body very different from either of its constituents, this is called chemical action. The chemist studies contact forces. He splits up everything into its elements, and then observes the behavior of these elements when they are brought in contact with each other. By exchanging one element for another, a new and different compound is formed, just as moving letters about will give us different words and sentences.

It is only by experiment that we can derive any knowledge of the kind of compound the bringing together of elements will produce, and hence chemistry is an experimental science. The more we study the behavior of elementary bodies, the more we are struck with the fact that nearly all of the phe