[From the St. James Magazine.]

HOW LOOKING-GLASSES ARE MADE.

* * * The essential ingredients for making glass are only two—sand and soda, or sand and potash. Other ingredients are added, but mostly in small quantities, according to the sort or quality of glass required. Thus lime is added to make the mixture melt more easily; manganese and cobalt, to improve its color; lead, to increase the refractive power; arsenic, to make it white. Still, the only essential ingredients are the sand and soda. If the glass is to be good the sand must be pure, *i. e.*, as nearly unmixed silex as possible. Very good sand comes from Lynn, and from Alum Bay; the best of all from the forest of Fontainbleau. Excellent sand, however, good enough for all ordinary purposes, comes from the Medway.

The soda used by the glassmaker was formerly obtained from burnt seaweeds. In this form it was called kelp, and was formerly made on a large scale in the Hebrides, as well as on the western coasts of Ireland and Scotland. It was very expensive, costing latterly in London as much as £20 a ton. For many years however, the kelp trade has become almost extinct. Carbonate of soda, of much better quality, is now obtained by a simple chemical process, in any quantity, and at a very much cheaper rate, from common salt.

There are few transformations in the whole range of the arts more striking and more beautiful than that which gives birth to glass. A heap of sand and soda—it used to be of sand and ashes—to look at like common road dust, is changed by the simple application of heat into solid, transparent, brilliant glass. It is even more wonderful than the transformation of a handful of dirty rags into a sheet of white notepaper.

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We come first into a room (or rather an out-house) in which the raw materials—the sand, the soda, the arsenic, &c., along with broken glass, or "Cullet," are being carefully mixed by hundred weights at a time. The following is said to be a good receipt for making plate-glass:

Fine white sand	lbs. 300
Soda	lbs. 200
Lime	lbs. 30
Oxide of manganese	oxs. 32
Oxide of cobalt	ozs. 3
Cullet	lbs. 300

It does not take long to complete our inspection of this preliminary process; and as it stirs up more dust and dirt than are pleasant to nose or eyes or throat, we may go on to the furnace room. Here the heat is tremendous, coming from vast dome-shaped brick furnaces, twenty feet high, containing four or six earthen pots apiece, in each of which two or three thousand pounds of glass are melting. The flame and heat are intensely fierce, and yet it takes from sixteen to eighteen hours of exposure before the mixture melts, and six or eight more before the glass is workable. These furnaces are often kept burning for weeks together; and we have seen one which had not gone out for eight years.

One might wonder how the pots themselves could stand against so intense a heat; and, in fact, one of the most delicate operations in the whole establishment is the manufacture of these melting-pots. They are made of Stourbridge fire-clay, and are built up entirely by hand (without the help of a wheel or lathe,) much as a swallow builds her nest. It is found necessary that each additional layer of clay, which adds an inch or so to the height of the pot, should be quite dry before the next is added. And as the drying takes place slowly, a large number of pots, in different stages of completion, are always in hand. The workman adds a layer to each, one after another; and by the time he has gone the whole round, the first is dry enough to receive a further addition. The accuracy with which long practice enables the man to work is so great that the pots appear as truly circular as if made on a wheel.

But we must return to the furnace-room. The workmen open a little door in the furnace, and by looking through a smoked glass (as if examining the sun in an eclipse,) find that the melted glass is fit for casting. No easy job is it to get the pots full of the melted glass, (the "metal," as it is called out of the burning fiery furnace;) and still less easy to manage them when they are out. Imagine a gigantic pair of curling tongs, mounted on wheels, brought up to the furnace door, in the blinding glare of which are only just visible the ghostly forms of the white hot melting-pots. In a moment the curling-tongs have caught one of the pots by its middle, and their grip has been made firm by a screw. Then as many of the workman as can stand, sit, or hang on the opposite end of the tongs, by jumping and jerking, at last lift the pot from its fiery bed, and wheel it out in triumph, playing at see-saw with it till it gets close to the casting-table. Here the tongs deposit their burden on the ground so hot that it almost burns your eyes to look at it, and wheel off.

Here we must stop a minute to give a glance at the casting-table. It is long and low, made of iron, and as smooth as iron can be planed. At the upper end, where the lady of the house would sit, were it a dining-table, is a metal roller say a foot or rather more in diameter, and some few inches longer than the table is wide. Along the whole length of the table, and at the distance apart corresponding to the width of the plate to be cast, are clamped two parallel iron bars, of the exact thickness required for the glass. Over these, as on rails, the rollers will run, and they will serve to keep the "metal" within its proper limits.

And now, though without the delay of one-tenth of the time that it has taken to read the last paragraph, the white hot pot with its fiery contents has been clutched by another pair of curling irons which hang by chains from a crane close by. It is then immediately hoisted up and suspended a foot or so above the table and just in front of the roller. The foreman and two or three of the men, some on one side of the table and some on the other, take hold of the long handles of the curling-irons—the pot in this case hanging from the centre—and gently tilt its contents, which look like red-hot treacle, upon the table. The roller is at once set in motion by a windlass, and rolls out the glass—just as the cook rolls out her paste, as lightly and as quickly. In a minute's time the sheet of glass, large enough for the largest shop window on Ludgate Hill, is so far finished; and the roller drops quietly into its bed at the lower end of the table.

Instantly—for success appears to depend as much upon the speed with which it is all done as upon the skill—a flat truck, as large as the table itself is run up, and the sheet of glass, still hot and sparkling, is pushed on to it and carried off to the annealing oven, where it is left for a day or two to cool gradually—otherwise it would be so brittle as to be useless.

We must not imagine that our plate of glass is as yet fit for a looking-glass. If it were, looking-glasses would be a great deal cheaper than they are. No; at this stage of its history our plate is hardly more smooth or clear than common pond ice. We sometimes see glass in this condition used for skylights, and for the roofs of railway stations. It lets in a certain amount of light, but for seeing through is practically opaque. Let us therefore follow it into the large, wet, noisy rooms, where it will be ground and polished.

The first thing done is to bed the plate, which may be as much as ten or a dozen feet long by six or eight wide, on a perfectly level stone table, by means of plaster of Paris. A flat piece of wood the size of a small door-mat, which has flat plates of iron screwed on its under side to make it grind more vigorously, works by steam power, with a circular motion over the glass plate. Sand and water are freely supplied to this grinding apparatus; and, as may be believed, there is no resisting such decided measures. Even the hard, stubborn glass is obliged to yield. Its inequalities, and roughness, and sharp points are all rubbed down; though even when this part of the process is complete, it is still far from presenting the polished, reflecting surface which it gets after a while. When both sides have been smoothed in this rough way, our plate has to submit to several more somewhet similar processes, each less severe than the preceding one. The final degree of smoothness is imparted by making two plates of glass rub together, with the finest emery between them.

Yet still our friend, though no longer rough, is unpolished; he possesses no powers of reflection, and is as dull as a dunce. One further course of discipline, however, rsecues him from all these defects. A long continued brushing by steam power (such a fashionable process now-a-days, though seldom, it is to be feared, attended by such beneficial results) brings him up to the last pitch of polish. And when he has had all his sharp corners and jagged edges trimmed off with a diamond, he is fit for a mirror for the Queen's own drawing-room.

But how does our plate become a mirror? What gives it its wonderful powers of reflection? Strictly speaking, it is not the glass at all that reflects, but the metallic or other surface behind it. That spectral reflection which we may often notice overlapping the true image is the only one due to the glass; and were it as easy to keep the reflector at the back as polished, as free from tarnish, and as well protected, without the glass as with it, the glass would not be needed. The reflecting surface, to form a good mirror, must not only be perfectly even, but must throw back as many of the rays that fall upon it from any object, and absorb as few of them, as possible; otherwise the image will be distorted or dark. Practically it is found that no sort of mirror answers these conditions so nearly as plate-glass, with an amalgam of mercury and tinfoil fixed on the back of it. For certain delicate purposes, as, for the reflectors in astronomical instruments, or even in the beautiful form of the kaleidoscope, the "debuscope," a mirror all of metal is preferred. Though even for telescopes, reflectors of silvered glass are beginning to be preferred to those made of speculum metal. The reflector of the great Foucault telescope is made of glass; and the Abbe Moigno speaks of a drawing representing the double nebula in Canes Venatici, as seen by its means, as "exhibiting incomparably more details than those given by Herschel and Lord Rosse." And yet the diameter of the Foucault telescope is less than half that of its rival at Parsonstown. But for nine hundred and ninety-nine out of every one thousand mirrors, quicksilvered glass is made use of.

We might easily be tempted to digress into the history and mystery of tin, so peculiarly a British product as to have given the most ancient known name to our islands—the Cassiterides. The temptation must be resisted; nor must we say much about the other substance employed in silvering our glass plate, the quicksilver, the living silver, that is, silver that runs about as if alive. It comes to us principally from Almaden in Spain, Idria in Carniola, and from California; and its uses and abuses are numerous. Barometers are made with it, and gold is separated from the crushed ore by means of it; the farmer anoints his sheep with one preparation of it; your butler spoils your plate by cleaning it with another; and your doctor half poisons you with a third. In our present paper we confine ourselves to its employment by the looking-glass manufacturer.

Our old friend, the plate of glass, has been brought to the factory, and is being diligently cleaned with rotten-stone and spirit of wine. Meanwhile, on a flat stone table a sheet of tinfoil is laid, a little larger than the plate, and is surrounded with a low wall made of strips of glass. On this quicksilver is poured till it stands at a uniform depth of half an inch, and is allowed to remain undisturbed for a few minutes, during which time its lower surface is forming an amalgam with the tinfoil. The plate of glass, which probably weighs very many pounds, is now carefully lifted up, and placed with one end of its cleansed face flat on the mercury, and is then gradually pushed onwards, driving before it any impurities that may be floating on the top. When the whole glass is thus laid on its mercury bed, it is covered all over with heavy weights which squeeze out the excess of metal; and in this position things remain undisturbed for twelve hours or more, by which time the bright amalgam has become fixed to the glass. In a few days it may be framed according to its quality, size, the market it is intended for, or the taste of an individual purchaser, and from that time forward may begin making its quiet, faithful reflections, careless whether they are neglected or improved. In common with all other trades in which mercury is largely used, glass-silvering is a very unhealthy business. The workmen become subject to a sort of paralysis, popularly called the trembles, or the shakes. Trembling, more or less violent, accompanies every attempt to use the voluntary muscles. The patient dances rather than walks. He cannot keep his arms quiet, nor direct them at will. His speech is hurried and abrupt; and, in extreme cases, he cannot masticate his food. Sometimes the disease attacks him before he has been more than a few weeks in the manufactory; and it is thought wonderful if he escapes a year or two without a seizure. The patient usually recovers if he can change his employment for a more healthy one.

CENTRAL PACIFIC RAILROAD.—Gov. Low, of California, in his message, says President Stanford reports that the company has ample means at its disposal to push forward the work with great rapidity, and predicts that the road will be finished and in running order to Salt Lake early in the year 1869.

THE NEW SCHOLAR.

A New scholar came to Rackford school at the beginning of the half year. He was a well dressed, fine-looking lad, whose appearance all the boys liked.

There was a set of lads at this school who immediately invited him to join them in their "larks," and I suppose boys know pretty well what that means.

They used to spend their money in eating and drinking, and often run up large bills which their friends often found it hard to pay. They wanted the new scholar to join them, and they always contrived. by laughing at him, or reproaching him, to get almost any boy they wanted into their meshes. The new boys were afraid not to yield to them. This new scholar refused their invitations, they called him mean and stingy—a charge which always makes boys very sore.

"You are real mean not to go with us," they said.

"Mean!" he answered; "where is the meanness in not spending money which is not my own? And where is the stinginess in not chosing to beg money of my friends in order to spend in a way that they would not approve?"

"He talks like a minister," exclaimed one of them.

"After all," he continued, "our money must come from our friends, as we haven't it nor can we earn it. No boys, I do not intend to spend one penny that I should be ashamed to give an account of to my father and mother should they ask me.

"Eh! not out of your leading strings, then?"

"No, nor am I in a hurry to get out of them."

"Afraid of your father, eh! afraid of his whipping you? Afraid of your mother? Won't she give you a sugar plum? What a precious baby!" they cried in mocking terms.

"And yet you are trying to make me afraid of you," said the new scholar, boldly. "You want me to be afraid of not doing as you say. And which, I should like to know, is the best sort of fear—the fear of my school fellows, which would lead me into what is low; or fear of my parents, which will inspire me with things noble and manly? Which fear is the best? It is a very poor service you are doing me, to try to set me against my parents, and to teach me to be ashamed of their authority."

The boys felt that there was no headway to be made against such a new scholar. All they said hurt themselves more than him and they liked better to be out of his way than in it—all bad boys, I mean. The others gathered around him, and never did they work or play with greater relish than while he was their champion and their friend.

"The new scholar is a choice fellow," said the principal, "and carries more influence than any boy in the school. They study better where he is. You can't pull him down. Everything mean and bad sneaks out of his way.—*Children's Prize*,

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HOW LONG PEOPLE WILL LIVE.—We hear much said about the uncertainty of human life, but we are apt to ignore the fact that it is only to man's individual existence that this uncertainty attaches. Nothing is more conclusively established, for example, than that the dread reaper's scythe cuts a clean swarth over the surface of our earth every thirty-three years, garnering into eternity, during every century, so to speak, three full successive crops of humanity. Thus every year, as it wings its flight, takes note of the death-throes of thirty million mortals, who at the rate of one in every second of time, or ninety thousand each day, experience a change of worlds. Their places are supplied by births in equal number, and this new growth springs up to meet its fate from the same sickle's inexorable sweep. One quarter of all who are born die before reaching seven years of age; only one-half pass their seventeenth year. There is, therefore, a natural law of mortality, the operations of which, while they may appear eccentric, uncertain, and irregular, as to individuals, are fixed, systematic, and calculable when applied to masses or communities of men. For instance an English writer has asserted that out of 100,000 persons born at any particular time, a certain number will yield up their life in each year; in other words, the aggregate will be diminished in an increasing but regular proportion till none are left alive. Of the entire number named, only one half will reach forty-five years of age, 60,941 will live to the age of twenty-nine; and out of the survivors exactly one in a hundred will die in the following year. 37,996