

boasted what their system would do if fairly tried—what peace and purity would reign in their “New Moral World.” John held his peace for a long time, till at last “the fire kindled,” and lifting up his voice, he turned upon them and said feelingly, but firmly: “Well, I am a plain-dealing man, and I like to judge of the tree by the fruits which it bears. Come then, let us look at what your principles do. I suppose they will do in a little way what they would do in a great. Now there,” said he, pointing at the two apostates, “there are Tom and Jem, on whom you have tried your system. What, then, has it done for them? When they professed to be Christians, they were civil, sober, good-tempered; kind husbands and fond fathers. They were cheerful, hard-working, and ready to oblige. What are they now? What have you made them? Look at them. How changed they are! But not for the better. They seem downcast and surly; they cannot give one a civil word; their mouths are full of cursing and filthiness; they are drunk every week; their children are nearly naked; their wives broken-hearted, and their houses desolate. *There* is what your principles have done. This is the ‘*New Moral World*’ they have made.

“Now I have tried Christianity, and what has it done for me? I need not tell you what I was before; you all too well know. There was not one of you that could drink so deeply, or swear so desperately, or fight so fiercely; I was always out of humour, discontented, and unhappy. My wife was starved and ill-used; I had no money, nor could I get anything upon trust; I was hateful and hating. What am I now? What has religion made me? Thank God, I am not afraid to put it to you. He has helped me to walk carefully amongst you. Am I not a happier man than I was? Can you deny that I am a better servant to my master, and a kinder companion to you? Would I once have put up with what I daily bear from you? I could beat any one of you as easily as ever: why don’t I do it? Do you ever hear a foul word come out of my mouth? Do you ever catch me in the public house? Is there any one that has got a score against me? Go and ask my neighbours if I am not altered for the better. Go and ask my wife; she can tell you. Go and see my house; let that bear witness. God be praised for it: *here* is what Christianity has done for me; *there* is what Socialism has done for Tom and Jem.”

He stopped. The appeal was not to be withstood. For that time, at least, the scoffers had not a word to answer. *They were overpowered by the eloquence of example.*

BIRMINGHAM AND HER MANUFACTURES.

IV.—GLASS WORKS OF MESSRS. CHANCE, AT SPON-LANE.

THE reader will now accompany us back to the Smethwick railway station, whence a ride of a few minutes only, transports us to Spon-lane, the next station on the route. Here, having been furnished with an introduction to the works of Messrs. Chance, we shall have an opportunity of

witnessing the operations carried on at their extensive glass factory.

Glass, as most persons know, is produced from silicious sand fused in the fire by means of alkali; but were it nothing else than this, it would obtain little admiration from mankind, and might be fitly described, in the words of Dr. Johnson, as a “shapeless” commodity, “rugged with excrescences and clouded with impurities;” but since the hour when the “first fortuitous liquefaction” taught mankind to combine its component materials, countless experiments have led to perfection in the manufacture, and so far as the purity of the product is concerned nothing now remains to be wished for. The glass in ordinary use is of three kinds—crown glass, plate glass, and flint glass; the base of all being the silicious sand which is found in great abundance at Alum Bay, in the Isle of Wight, as well as at Aylesbury, in Buckinghamshire, and Lynn, in Norfolk. The materials for flint glass are three parts of sand, two of oxide of lead, and one of alkali, with some admixture of manganese and arsenic; the components of crown and plate glass differ somewhat from these, and variously in different manufactories. The quality of the glass is dependent on the proportions of the above elements, on the temperature to which they are exposed, and the skill and judgment brought to bear in combining them in the furnace.

The glass works of Messrs. Chance, at Spon-lane, occupy an immense space of ground; there is many a market town in England, with its marketplace and town-hall, its parish church and burial-ground, that stands upon a less area. It will be in the recollection of the reader that the Crystal Palace was glazed with glass from this establishment; it was of the kind called sheet glass, manufactured by a process originally French, but which has been long practised and brought to perfection at Spon-lane. On arriving at the works we are consigned to the care of a guide, whom we follow forthwith to the furnaces, where a number of men are engaged in the manufacture of crown glass; this is the glass generally used by glaziers, the appearance of which is familiar to every one, from the great lump or bull’s eye in the centre of the large disc, and which unsightly lump is occasionally visible in kitchen windows. One of these large circles or “tables,” as they are called, though it passes through the hands of many workmen, occupies but a very short time in the making; it requires, however, the services of a great many men, the principle of the division of labour being necessarily carried out in this process. The reader must suppose the materials of which crown glass is made to have been already mixed in the melting-pots, fused by an intense heat into a liquid state, and freed from all impurities by skimming them off the surface of the fluid “metal.” But as glass in a fluid state cannot be worked, the heat of the furnace has to be slackened in order that it may coagulate to such a consistency as to render it manageable. This being done, the business proceeds, somewhat in the following manner: a man armed with an iron tube seven or eight feet in length dips this into the molten mass, and turning it slowly round, collects as much as will adhere to the end of his rod; he then withdraws what he

has gathered, and allows it to cool for a moment or two, while, revolving the tube, he swings it a few turns in the air. When sufficiently cooled, though it is still red-hot, he again plunges it into the molten metal, from which it now takes up another pound or two; and this ceremony he repeats until he has gathered at the end of his rod a lump bigger than a man's head, and weighing probably ten or a dozen pounds. He is obliged to keep the tube continually revolving to save the pliant mass from dropping on the floor, and at the same time he swings it aloft and whirls it about to give it an elongated pear-shaped form, finally completing the desired shape by rolling it rapidly about on a flat steel slab. A gallon or so of air is now blown into it from the lungs of an assistant, and the glass, swollen to a large cylindrical bulb, is taken possession of by another operator, who carries it to the mouth of a furnace, where it is reheated several times, and blown between each heating, still kept in rapid revolution all the while, until it assumes the shape of a globe some twenty inches or more in diameter. The globe is then depressed by flattening against an iron plate. Another workman now comes forward, bearing an iron rod tipped with a small portion of white-hot glass, which he instantly applies to the flattened centre of the globe, which is now comparatively cool. The globe is no sooner cemented by the hot glass to the rod of the new operator, than it is detached from the original tube by the touch of an instrument dipped in cold water, and applied to the point of junction. The glass has now entirely changed its position relatively to the rod, the opposite pole of the globe being attached to the iron. The globe, having a small orifice at the point where it was severed from the tube of the first operator, has next to be transformed into the flat disc or "table" of the glazier. This process, which would strike a stranger to the art as one of extreme difficulty, is managed in the simplest manner imaginable. It is the rapid revolution of the globe in the dexterous hands of the workman that does it all: the same law which depresses the poles of the solid earth, and expands her circumference at the equator—the law of centrifugal force—flattens the disc for the glazier, and helps us to cheap glass. The workman carries the globe to the wide mouth of a glowing furnace, where, resting his rod upon a fulcrum, he turns it rapidly round. In a few moments, the glass, yielding to the intense heat, begins to change its form, the small orifice in the centre of the globe expanding momentarily; and now the globe is changed into a deep vessel—now it is a large vase—now a huge saucer—now a shallow dish—and now it is the flat circular table, which as it is drawn gradually from the fire hardens into consistency, and is carried to a flat bed of sand, where it is summarily detached from the rod of the "bull's eye" in the centre. It is now lifted by means of a long fork, and carried immediately to the annealing furnace, where it cools by slow degrees, without which precaution it would be too brittle for use.

The whole of the various processes above described are carried on with such marvellous rapidity and certainty, that a spectator had need make good use of his eyes to understand what is going on. The description we have attempted to

give would probably take as much time to read as would be consumed in the several operations. The crown glass, having remained a sufficient time in the annealing oven, is removed to the cutting-room, where it is cut by the diamond into semi-circles of unequal dimensions, and packed for purposes of commerce.

We are now conducted to another department of the works, where the manufacture of sheet glass by the French process is carried on. Before we describe the process, it will be as well to allude briefly to its history, its adoption by the Messrs. Chance, and the perfection to which they have carried it out in their establishment. It will be obvious to every one that there are two very serious defects in the results of the crown glass manufacture above described; these are the circular shape of the glass "table," which necessitates loss in the cutting up into squares, and the presence of the "bull's eye" in the centre, entailing further loss, or the tolerance of an unsightly nuisance; besides these, there is the further disadvantage of limited size, as no very large square of glass can be cut from the half circle. More than twenty years ago, Messrs. Chance and Hartley visited the glass works of M. Bontemps, near Paris, and witnessed a process of manufacture by which the whole weight of metal, manageable by a single workman, was formed into a sheet of glass, square in shape, and without the knot in the centre. Impressed with these evident advantages, they resolved to attempt the same mode of operation. With this view they secured the co-operation of M. Bontemps, and began their experiments in the latter part of 1832. They had, however, many difficulties to contend with; and among the rest, a duty of 300 per cent. upon the cost of the material. In 1836, Mr. Hartley withdrew from the firm, which has since consisted of Messrs. Chance Brothers, and Co. By 1838 the difficulties of the manufacture appear to have been surmounted, a substantial and serviceable kind of glass from these works being then produced. From that time to the present, improvements have been continually effected; the manufacture of sheet glass has been taken up by other houses, and since the abolition of the excise duty, has increased to such an extent, that it is a question at this moment, whether the weight of sheet glass annually made is not greater than that made by the old process. In the year 1840, the Messrs. Chance introduced, under the name of patent plate, a new variety of window-glass; it is made from an improved sheet glass, ground and polished by a new process, the invention of Mr. James Chance; the surface of this glass is, with very trifling exceptions, perfectly true, while in colour and brilliancy it is not surpassed by the best cast plate. As might be expected, the demand for it is large and continuous, and we have heard it said, that extensive as are the factories of this firm, were they twice as large they might be fully employed. In the new villas and suburban residences everywhere rising in the neighbourhood of London, we recognise this patent plate glass, which passes for cast plate, and can only be distinguished from it by a close scrutiny. Let us glance now at the mode of its manufacture.

The molten glass, at apparently the same con-

sistency as that used for the circular "tables," is gathered by the workman at the end of his tube in the way already described. When he has gathered sufficient for his purpose, however, instead of moulding it to a convenient shape on a flat iron slab, he makes use of a bed of sand and water, as more suitable for his purpose. The glass which he is thus moulding is almost at a white heat, and, *because it is so hot*, it neither cracks nor hisses upon contact with moisture; were it some hundred degrees cooler it would fly into a thousand fragments, perhaps to the fatal injury of the busy operatives around him. This species of work is plainly more laborious than that of the crown-glass maker. The men appear to have heavier masses of the fiery metal to deal with, and to exercise more strength in their management. The mass of metal at the end of the tube, instead of being blown into a globe, has to be drawn out by means of inflation by the breath, whirling aloft and swinging in a cavity in the ground, into the form of a cylinder some four feet in length and near a foot in diameter. The skill of the artificer of course consists in his ability to do this in such a manner that there shall be an equal thickness of glass on every square inch of the long cylinder. He presents a very curious spectacle to a stranger while thus occupied. Standing at the mouth of a glowing furnace, and upon the edge of a deep pit in the floor, he now blows into the revolving tube, now brandishes it aloft, grimly watching it the while, as though he were going to balance it on his chin, now pokes it into the fire, withdraws it again and dangles it in the pit, then whirls it round half-a-dozen times in the air. Thus tormented, the mass grows longer and bigger and more and more transparent, until, at length, having been tossed and whirled, and roasted and toasted, and blown and balanced, and dangled into the precise shape and substance upon which the workman had set his mind, it is allowed to cool, and is deposited upon a tressel standing a few yards from the furnace. The pyramidal end next the blow-pipe has now to be cut off; this is done by a lad, who twists a snaky ribbon of the glowing metal from the furnace round that part of the cylinder which he wishes to detach, and then touches the spot with a little cold water. The cylinder, now about forty-five or fifty inches in length, is first allowed to cool; a lad then pokes with one end of it a straight-edge and a crooked instrument armed with a diamond, and with a stroke slits it from end to end. The cylinder has now to be changed into a flat plate. For this purpose, it is carried to another furnace, in an oven at one side of which it is gradually re-heated. When it has acquired the right temperature, it is removed to a flat smooth slab in the centre of the fire, where, by the action of intense heat, it soon shows symptoms of melting. It is laid on the slab with the slit uppermost: as the glass softens in the fire, the workman, with his long iron rod, carefully turns back the overlapping sides, and lays the sheet flat on the stone; he now changes his rod for a long hoe-shaped instrument, with which he in a manner kneads it to a perfect level. This accomplished, the slab, which runs upon a tramway at the bottom of the furnace, is drawn away in the rear, and the glass, becoming in a few moments sufficiently hard to be

removed, is stacked up in the annealing oven, after which it is ready for the purposes of the glazier. It was with glass thus made, weighing sixteen ounces to the square foot, and measuring forty-nine inches each pane, that the Crystal Palace was glazed.

But supposing that the sheet of glass, whose fiery birth we have thus described, is intended to be patent plate, it has yet further and more protracted processes to undergo. To witness these, we must quit this part of Chancetown, as it ought to be called, and, descending a hill and crossing a bridge, make our way to a different part of the works, where the grinding and polishing and the artistic ornamentation of glass are carried on upon a most extensive scale. To become "patent plate," the sheets of glass, supposing them to be of the proper quality and thickness, have to be ground and polished. The grinding is performed in an immense apartment, some considerable proportion of an acre in extent, upon approaching which the ear is saluted by such a strange and portentous combination of sounds as cannot be heard elsewhere, and which we can compare to nothing but an imaginary tempest in a sea, the billows of which should be crags of rock and blocks of timber instead of salt sea-waves. The spectacle within is very much in keeping with the unearthly din. The whole floor is one congeries of heavy machinery in violent agitation, under the impetus of steam-power. Hundreds of sheets of glass, pressed beneath weighty slabs, are grinding one another's faces with sand and water. In order to insure an equal friction upon every portion of the surfaces, a strange eccentric motion is imparted to the beds between which they are packed, which gives them the air of creatures struggling to get free from a position in which they are anything but comfortable. We know not how long this ceremony of grinding endures; but when the plates are relieved they are turned over to gentler treatment, which they receive in another large apartment, at the hands of young girls, whose duty it is to examine each plate, and to finish by hand those few portions of its surface left untouched or imperfectly ground by the machines. A sheet of glass thus ground is a most beautiful object, and a market might be found, and most probably is found, for a considerable quantity in that state. By far the greater portion, however, has to undergo the final process of polishing, which takes place in another enormous room, fitted up with machines in all respects, so far as we could observe, similar to those in the grinding-room, with the exception that the slabs are covered with felt or leather rubbers, and fed with red oxide of iron instead of sand and water. The polish imparted by this means is considered equal to any that can be attained. The whole of these machines, as well for polishing as grinding, are driven by an enormous steam-engine, suckled by five boilers, each of which would serve for a palace for an Irish family. The engine lives in three floors at once, and we had to climb two flights of stairs to get, by instalments, a view of his entire proportions.

The ornamental department of this establishment is situated in the neighbourhood of the grinding and polishing rooms. We can enter less into detail on this subject, for reasons which the

reader will naturally conceive, the processes of painting and staining glass being but partially intelligible by a casual visitor, even when he is allowed to witness them, which is not always the case. Among the many beautiful specimens we saw were some capital imitations of the old mediæval church windows. There is, it is said, a considerable demand for these at the present time; but it strikes us as absurd, that the artists who produce them should be bound down to copy the defects and deficiencies of the old style as well as its merits. So it is, however; and it appears to be the rule, that whenever a coloured window is erected in a church or chapel, the outline of the design must needs be traced by an ungraceful line of dark lead, a resource to which the old artists were driven by want of better materials to work with—a want which no longer exists. Designs purely artistic are here in course of execution. We had the pleasure of seeing several finished portions of a transparent ceiling, intended for Chatsworth house, which will consist of a series of paintings from allegorical designs of a high order of merit, by a French artist. We saw enough of these performances to assure us that all that is wanting to complete success in the art of painting on glass, in our own country, is that its practice should be taken up by men capable of drawing with fidelity and breadth, and well versed in the difficult science of colour. Even an artist, however, thus qualified would have to revise all his previous knowledge and experience, inasmuch as the colours used in glass-painting assume new tints under the action of the heat of the kiln, to which the pictures must be subjected. The expense of getting up these pictures must be very great, partly from the slow and laborious nature of the process, and partly from the risk of breakage, which may destroy the work of months in an instant.

A plainer variety of ornamentation, for domestic and decorative purposes, is also here carried out to a great extent by means comparatively simple. The sheet of glass upon which the designs are to be impressed is brushed over with a whitish vitreous mixture, so combined as to melt at a certain temperature which would not affect the glass. When this is dry, it presents a surface sufficiently hard for the pencil of the artist, who, first drawing his design upon it, then easily scrapes away with the graving tool such portions of the cloudy surface as he wishes to remove. The drawings being finished, the sheets or plates of glass are carried to the kiln, the heat of which unites the whole in one mass, without injuring the design, which glimmers in clear crystal forms upon a kind of frosted ground. At the time of our visit, several young artists were employed in transferring designs upon sheets of glass thus prepared. But we witnessed a more remarkable adaptation of the same process in a room below. Here stood what appeared at first sight a strange, nondescript, and complicated engine, but which proved to be a kind of engraving-machine, combining, as it appeared to us, the properties of the lathe and the pentagraph. It was manufactured by the late Mr. Holtzapfell, of Long Acre, whose extraordinary mechanical talent was well known throughout the country; and it is questionable whether, since his death, any one could be found to produce its fellow.

It does its work in the following manner: the sheet of glass to be ornamented is laid upon a flat slab, the cloudy surface uppermost; the slab being adjusted in its proper position, under the graving tool, the operator has nothing to do but to turn a handle, and in a very few minutes an exquisite pattern is engraved in the centre of the glass. The patterns thus produced appear not to be limited to any particular species of lines or curves, the tool working rapidly in all directions—waving, circular, curvilinear, angular, or in straight lines, and occasionally with a rapidity which the eye cannot follow. By this masterly contrivance an immense saving of time is effected—the work of a day under the pencil of an artist being done, with a precision which an artist could hardly accomplish, in a few minutes.

We are at the verge of our narrow limits, and must refrain from remarking on various other ornamental processes, which had their origin at Spon-house, and upon the experiments still carrying on having for their object the introduction of real art into the operations of manufacture. We have probably omitted all mention of many of the products of this vast factory, but we make no pretensions even to a knowledge of the whole of them, and our restricted space will not allow us to add much to what is already written. One thing, however, we cannot suffer to pass unrecorded, and that is, the humane and truly philanthropic spirit of the proprietors, which has led them to provide for the education of the children of their workmen, who are educated under their superintendence, at a cost little more than nominal to the parents. The schools and buildings necessary for this purpose were erected at an expense of several thousand pounds, defrayed by the Messrs. Chance; and hundreds of the children are there educated under the charge of qualified tutors, the books, papers, etc. being provided by the proprietors.

THE BLOOD PARASITE.

It is well ascertained that the peculiar colours exhibited by lakes and other pieces of water, under certain conditions, are in general due to the presence of minute vegetable and sometimes animal productions. Such simple organisms as the lowest tribes of freshwater algæ, which represent the zero of vegetable life, are found in every situation suitable for their development; even the rain and the dust of the atmosphere are thickly impregnated with such microscopic beings. One of these minute productions—*Protococcus nivalis*—is developed in the snow of northern regions, to which it communicates the colour of blood, and is hence called "red" or "bloody snow." This simple plant, consisting only of a single cell, which propagates itself by division into a number of separate cells, has been long known by botanists; but another production allied to it, or at least presenting a resemblance in general appearance, and certainly not less remarkable, has just been brought into notice by M. Montagne, in a paper published in the "Comptes Rendus," (xxxv. p. 145), and the "Annals of Natural History" for October, 1852. M. Montagne observes:—"An extraordinary phenomenon has just passed under my eyes, to