AN EXAMINATION OF POMPEIAN GLASS.

BY M. G. BONTEMPS.

Window glass, the utility of which is appreciated chiefly in northern countries, does not seem to have been used in remote antiquity. The silence of ancient Greek and Latin authors on the subject is a sufficient proof that it was unknown in their time; and, in any case, the wonderful expertness evidenced in glass manufacture many years before the Christian era, renders it surprising that no one thought of making glass windows. The first mention of them we find in the first century of the Christian era. Philon, a Jew, in the account of his embassy to the Emperor Caligula, has a passage relating to glass windows. On the other hand, Seneca assures us that glass windows were first adopted in his time. These assertions have long been disputed. Certain commentators argue that these windows were nothing but trellises, or a kind of Venetian blind, made of wood; others maintain that they were made of a fine talc, called specular stone; but since the discoveries at Herculaneum and Pompeii, there can no longer be any uncertainty touching this point. The architect Mazois, in his remarkable work on "The Ruins of Pompeii" (Paris, 1814, 1835, four vols. in folio), expresses himself thns (Vol. ii. p. 77, chapter on "Public Baths"):—

"If the question of the use of window glass among the ancients were still doubtful, we should find in this room evidence adequate to resolve it; for here has been preserved for centuries a bronzed sash filled with glass, showing not only the size and thickness of the panes employed, but also the manner of adjusting them. The figures 4 and 5, which give the appearance and the details of the sashes, show that the glass was fitted into a groove, and secured at certain distances by turning buttons, which pressed upon the pane and fixed it. The panes are 20 inches broad (0.54 millimètres), about 28 inches (0.72 millimètres) high, and more than 2 lines (5 to 6 millimètres) thick."

The employment of window glass at an epoch anterior to the year 79 of our era, the date of the eruptions of Vesuvius which buried Herculaneum and Pompeii being ascertained, glass workers became much interested in finding out how these panes, which are of considerable size, were made—whether they were blown into cylinders or plates, or whether they were cast in the same way as a mirror. I could clear up this point only by inspecting the fragments. These panes, which, from their size, could weigh not less than five kilogrammes, if blown could not have been the product of a single lifting of glass; for in this case we ought to be able to distinguish the glass of the different liftings. Were these panes formed by blowing a cylinder, afterward cut and spread out, the bubbles contained in the glass would be long and parallel with the axis of the cylinder. They would have been concentric if the panes were formed from a globe converted into a plate; and if the panes were molded the bubbles could have no uniform direction, but would be generally round and flat. Uncertain when I could go and personally examine the fragments of window glass found at Pompeii, I begged the Minister of Foreign Affairs to ask the Consul of Naples to entrust me with a few of these fragments; and a few weeks afterward the Minister informed me that the intervention of the Consul M. de Soulanges Bodin had been successful; that, in fact, the Superintendent General of the Museums of Naples, M. le Prince de San Giorgio, appreciating the usefulness of my investigations, would be happy to place at my disposal the fragments of window glass found at Pompeii.

These fragments measured ten centimètres, and after their examination, no doubt could remain of the manner in which the panes were made. The glass was cast free from knots and other imperfections; portions were free from bubbles; while in other parts these were present in great quantities, but not all caused by fusion. The thickness of the glass was unequal, in some places being five millimètres thick, and in others only three. This sign alone wonld not show that the panes were not blown. One surface bore the impression of the floor on which it was laid when hot. This might be the mark of the refractory stone on which the cylinder was spread, but the opposite surface did not resemble blown glass. Moreover, there were other indications yet more reliable showing that this glass was not blown. The bubbles were the result neither of a cylinder nor of a globe spread into a plate. It was evident that each pane had been cast; that this casting had not in some parts been carried sufficiently far; and that in others, on the contrary, the workman having reached the limit in this respect, has returned the glass on itself, and thus led to the interposition of air and the formation of a bed of bubbles. The unequal thickness shows that a metallic cylinder was not used to press upon the glass.

It is, then, probable that a metallic frame of the size of the pane it was desired to obtain—say 0.72 by 0 54 millimètres—was placed on a polished stone, slightly powdered with very fine argil. Into this frame the glass was then poured, taken from the crucible in spoons, probably of bronze, or even with canes, and the glass was pressed with a wooden pallet, so as to make it fill the mold. The ancients then came very near the invention of plate glass, which was not in vogue in France till seventeen centuries later; for they had only to pass a roller over the frames to obtain panes of equal thickness, which would then have required nothing but polishing—an operation familiar to them; for Pliny, in his "History of the World," says that obsidian was used as mirrors, and it is evident that it must have been previously polished.

The Pompeïan window glass is of a bluish green tint, like the common glass fifty years ago. The analysis made for me by M. Fred. Claudet, and of which I can consequently guarantee the exactitude, gave the following result:—

Silica	69·43
Lime	7·24
Soda	17·31
Alumina	3·55
Oxide of iron	1·15
Oxide of manganese	0·39
Oxide of copper	traces
	99·07

This analysis is remarkable, since it coincides exactly with that of the glass now made. In fact, take the analysis of window glass made by M. Dumas, and we find:—

Silica	68·65
Lime	9·65
Soda	17·70
Alumina	4·00

In the latter analysis, perhaps some traces of iron and manganese have been disregarded; but independently of these two elements, it is to be observed that the two analyses are almost identical.

I ought to state that the glass analysed by M. Dumas was not so good as now generally made. The window glass used at present gives on an average the following:—

Silica	72·50
Lime	13·10
Soda	13·00
Alumina	1·00
Oxides of iron and manganese	0·40
	100·00

REFINING PETROLEUM.

The following description of refining petroleum, and crude coal oil is from the *Philadelphia Coal Oil Circular*:—

The crude oils may at once be submitted to chemical treatment; but as a general rule, and especially when they are heavy and contain much tar, they should be first distilled. This distillation is made in a common iron still, protected from the action of the fire by fire brick, which equalizes the heat, consequently the expansion of the metal, and lessens the risk of fracture.

The "change" of oil prepared as above, may be run into the still and distilled without the use of steam. But when it has been "run off" to four-fifths of the whole quantity, or when the part remaining in the still will be a thick pitch when cold, common steam should be gently let into the neck or breast of the still. The steam immediately produces an outward current through the condensing apparatus, and brings over all the remaining part of the oils, leaving a compact coke as the only residuum. Furthermore, it gradually diminishes the heat of the iron and prevents it from breaking. When the steam is thus let in, the fire is to be removed from beneath the still.

Common steam under moderate pressure has been introduced into stills, both above the charge and into it throughout the entire distillation. In the latter instance the steam soon becomes superheated after the lighter oils have been run off. Again, steam previously superheated is driven into the charge during the distillation, and for the distillation of the heavy oils and paraffine this mode has the preference; yet steam is advantageous however applied. When it is superheated the condensing apparatus should be extensive.

In the first distillation of the crude oils, as they come from the retorts, and in subsequent ones, the oils may be slowly admitted into the stills after it has become sufficiently heated and the oils begin to flow freely from the worm or condenser. By the adjustment of a cock, a stream of the crude product may be permitted to flow through an iron tube into the still while it is in operation. The tube should dip beneath the oil in the still, the in-flow of oil into which must not exceed the out-flow from the condenser. A greater amount of heat will be required for this operation than for the common method, as much of it is taken up by the cold oil constantly flowing inward. By this mode a still working 1,000 gallons may be made to run double that quantity without interruption, and steam may be applied in any manner before described.

The first distillate of the crude oil should be separated into two parts, each of which requires somewhat different treatment. The first part is that which distills over from the commencement of the run until the oils in the receiver have a proof of 30° by hydrometer, or a specific gravity of 0.843.

These light hydro-carbons and the eupion they contain, form the lamp oil. The quantity produced will depend upon the quality of the coal, or, whence they have been derived. This part of the distillate being pumped from the receiving tank, the remainder, or second part, is allowed to flow on till it assumes a greenish color at the end of the worm pipe, when steam, if not previously employed, may be let into the still and continued until the whole distillation is completed; the fire in the furnace beneath the still being withdrawn. A quantity of coke will be found to remain, amounting to ten or fifteen per cent of the whole charge. When steam is not employed in the residuum the still must not be run down lower than a thick pitch. Coking in the still without steam is unsafe and hazardous to the iron.

The first part is then to be placed in an iron cistern, and therein thoroughly agitated from one to two hours, with from four to ten per cent of sulphuric acid, the object being to bring every particle of the impurities in contact with the acid. The quantity o acid to be used depends upon the character of the oils.

If two much acid is applied the oils will be partially charred and discolored; if two little, the impurities will not be oxidated, and the oils will change color. After the agitation of the oil and acid is completed, the mixture must remain at rest from six to eight hours, when the acid, with the chief part of the impurities, will have settled to the bottom of the vessel. They are then to be drawn off, and the remaining oil to be washed with ten or twenty per cent of water. The water removes a part of the remaining acid, and carries off the soluble impurities. After the water is withdrawn the charge is to be agitated two hours with from five to ten per cent, by measure, of a solution of caustic potash, or soda of specific gravity 1.400—caustic soda is generally preferred. Like the acid, the strength and quantity of the alkali must be varied according to the quality of the oils. After a repose of six hours or more, the alkali is to be withdrawn from the oil, and further impurities washed out with water. When the water is withdrawn from it, it is to be run into a still for final rectification. During the whole of these operations the oils and the several washes applied to them are to be kept at a temperature not lower than 90° Fah. This is done by means of steam coils fixed at the bottoms of the tanksin which the agitations are made. Finally, the oil is to be carefully distilled, with or without steam. A small quantity of the lightest product or eupion, which comes first from the condensing worm, is usually discolored, and may therefore be transferred to the succeeding charge.

The last distillation should be made slowly and with care, avoiding all fluctuations produced by an unsteady heat. If desired, the eupion may be taken off at the commencement of the distillation. It should be at proof 60°, or specific gravity, 0.733, or it may be allowed to run in with the lamp oil. When the distillate has reached proof 40°, or specific gravity, 0.819, the remainder is to be transferred to the next charge, or the heavy oil, as being too dense for illuminating purposes. The mixed oils intended for lamps have their disagreeable odor chiefly removed by allowing them to remain in flat open cisterns over weak solutions of the alkalies during a period of some days. Exposure to light also improves their color. The alkalies employed in the foregoing treatment may be restored and used in subsequent purifications. The oils of the second or heavy part of the first distillate are purified by the same means as described for the lighter oils, except that they require the application of more acid and stronger alkalies. All the oils distilled from them at proof 40° are to be added to the lamp oils. At the close of each distillation, and as the oils acquire greater density, the color grows darker and changeable, finally they are partially charred, and especially when they have been distilled without steam. These dark-colored oils may always be renovated by the use of acids and alkalies, the permanganates of potash and soda, and, finally, by distillation. The color of the lamp oils should not exceed a tinge of greenish yellow, when viewed in a clear glass flask six inches in diameter. If by accident, carelessness, or negligence, the oils treated by the foregoing method should be impure, they must be submitted to washing and re-distillation.

HONORS TO ENGINEERING GENIUS AND INDUSTRY.

A beautiful marble statue has lately been erected at Islington Green, London, in memory of Sir Hugh Myddelton, the goldsmith, who, in the beginning of the 17th century, carried water by a tunnel a distance of 32 miles, to supply the City of London. On the inauguration of the monument, Mr. Gladstone, the Chancellor of the Exchequer, delivered an eloquent address, from which we make the following extracts:—

It is in some respects a striking and a noval ceremony, for it is a thing completely new in the history of mankind to find statues erected in public places to engineers. If we go back to the very root and beginning of philosophy, we shall find that whatever related to mechanics and to physical forces was associated with the processes of mental inquiry. But they soon came to be divorced one from the other, and thousands of years elapsed before the engineer, as such, came to be recognized as a person having a high title to public distinction. It does not appear that the people of this country in very early times had developed much of that talent for which they are now so remarkable; but in viewing the history of the nation to which we belong we find that at a later period it has exhibited aptitudes of which there was formerly no promise. This, let me say, in passing, is a useful lesson not only for nations but for individuals, for it may teach an individual that there are many things which at present are wholly beyond his power, and for which he cannot even recognize in himself the materials of fitness, and yet to which he may thoroughly and conspicuously attain by assiduous and resolute cultivation of the faculties with which he is endowed. No doubt the engineers who, under the name of architects, erected the cathedrals of this country must have been persons of considerable ability in their profession, profound, accurate, careful and skillful in their knowledge of mechanics, but for much of that education we are indebted to foreign countries. It was, perhaps, rather an imported than an indigenous quality. But in these latter times we have seen a great change, and the engineers of this country now take their place as one of the most distinguished and most important of all classes of the community. They have fairly taken their place among the great men of England, though I do not know whether any commemoration so conspicuous as the erection of a statue to Sir Hugh Myddelton in one of the greatest thoroughfares of this vast metropolis has before been given to them. It is a fact full of meaning, an indication of the movement of the time. It is an indication, indeed, of the development of those faculties and those habits of mind and action by which man has advanced from generation to generation, fitting himself more and more, through the efforts of each successive generation, to contend with those difficulties of outward nature amidst which Providence has placed him for the very purpose of evoking his energies and of making the gifts and bounties of Providence, of which that nature is full, available for his comfort and his happiness. This is the opening, I may say, of another chapter in the history of man. Of course I do not mean that it is the beginning of such efforts, but it is the beginning of them on a new scale, with new systems, new appliances, new means of intercommunication and interchange of knowledge, with new means of carrying it on from the men of to-day to the men of to-morrow; and it marks the fact that in the list of elements that belong to human civilisation, these great operations of art and science applied to the external world must henceforward be included, and must hold a conspicuous place in the record of progress. It will be our own fault if the addition of that new chapter be not a great blessing. There is no reason why it should displace anything which was formerly found there, and held a place of deserved honor. Don't let us see in the existence of a class of engineers, and in the distinctions now so universally bestowed on them, anything that need fill us with fear and apprehension as to the displacement of whatever has heretofore been done by men with respect to religion, art or ancient cultivation. All these things ought to continue, and grow, and thrive, and be added to what we have already achieved or what may yet be accomplished. The principle of the Divine life in man must always continue and rule his whole existence, if he is to exist for any purpose of good to himself or his fellow man. The cultivation of intellect, the study of that which unbounded wisdom has left to us, the cultivation of the beautiful in all its varied spheres—all these should continue to thrive; and we ought to see, without jealousy, the development of new powers of the mind of man, or new applications of its powers, in order to meet the continually unfolding wants and demands of society. It is a work which we may confidently say is acceptable to God as well as to man when water is brought from a distant spot to supply the population of this great city. It is all very well for those of us who could find water for ourselves to make light of this great appliance of modern engineering, and to say that it does not signify whether we are carried five miles or fifty in an hour, whether it costs a pound or a shilling, whether our houses are well or ill drained, or whether water from the country is to feed London or not: it is all very well for us, who have these various comforts, to assume a high and sanctimonious tone and say, "Let us not overvalue these merely temporal advantages." No doubt it is wise that the poorer classes of the community, amid the hard pressure of their daily lives, should be reminded—and I have no doubt the teachers of religion will take care to remind them—that they are not to suffer their minds to be absorbed and dried up with the contemplation of their purely physical and temporal necessitities; but that they are ever to turn an eye to God, who is in Heaven, and to keep it open for the world which is to come. But let us freely and gratfully acknowledge that men like Sir Hugh Myddelton in former times, and others whom I might name in the present day, who have devoted themselves with energy, forethought, care and skill, to the multiplication of appliances which conduce to the comfort of man, and have conquered the forces of nature, and made them subservient to human happiness, have done and are doing a great and good work before the face of Heaven as well as in the face of man; and deserve to be held in grateful honor as among the real and genuine benefactors of mankind.

Distinguished Engineer Gone.

By recent news from Europe, we learn that Alexander M. Ross, C. E., resident engineer and designer of the great Victoria Bridge at Montreal, died in England, on the 8th of August, aged 57 years. He was a native of Cromarty, Scotland, a pupil of old George Stephenson, and the companion of his great son. His engineering abilities were of a very high order, and both the Stephensons put great confidence in all he proposed and undertook to perform. He surveyed the route of the Grand Trunk Railway in Canada, and was engineer of several great undertakings. It is stated that he was a man of herculean strength, but of gentle manners, and very sensitive to defamation and censure. The Toronto *Leader* states that the cause of his death was a mental malady, traced to the attacks of an unscrupulous clique in London, led by G. R. Stephenson, a relative of the late Robert. He sought to detract from the fame of Mr. Ross by publications, claiming all the credit for Mr. Stephenson as designor of the Victoria Bridge, and censuring Mr. Ross for receiving public praise. In Canada, where he was so well known, the papers state that he was one of the most courteous and unassuming of men, and they denounce the persecution to which he had been subjected.

London Exhibition—Wave Line Models of Ships.

The following condensed from *Mitchell's Steam Shipping Journal* will be interesting to all our naval architects, shipwrights and nautical men:—

By lectures and practical demonstration Mr. Scott Russell has associated his name with the wave-line principle of ship building. Mr. Russell contributes several examples of his style at the World's Fair. Mr. Russel exhibits models of the iron paddlewheel gunboats *Bann* and *Brune*, built in 1856 for the Government. They are 287 tuns and 80-horse power. Then there is the screw *Annette*, of 845 tuns and 100-horse power, built in 1861 for A. Remington, Esq. She is full rigged, with lifting screw and classing A 1 twelve years at Lloyd's. The *Lyons* and *Orleans*, paddle boats, of 415 tuns and 160-horse power, built for the London and Brighton Railway Company, to ply between Newhaven and Dieppe, are no doubt very fast vessels, but exceedingly wet ones. The form of the bow is that of a long tapering wedge standing on its side with the sharp end as the stem. There is no rounding off for the run as the wedge is flat-floored. Another model displayed by Mr. Russell is that of the Antwerp steamer *Baron Osy* of 792 tuns and 160-horse power. This vesel seems to have been constructed to gain the greatest amount of passenger space on aggregate tunnage. Her stern post rakes aft, and is built over or outward very considerably, so that in bad weather she rolls heavily. In smooth water she is a fast and pleasant boat. The next vessel is the *Wave Queen*, paddlewheel steamer, of 250 tuns and 80-horse power, said to be the narrowest sea-going vessel for her length ever built. The *Wave Queen* was launched in 1852. She is 210 feet in length by 15 feet beam, which gives one foot of beam to every 14 feet in length. This steamer may be classed as of the race horse build, but, if she was loaded like a pack horse she would be unseaworthy. Vessels are built very long and sharp to obtain speed, and then they are loaded like collier brigs. The result is that they swim deep, and if they ship a weight of water their buoyancy is destroyed. Mr. Russell built the large screw steamships *Adelaide* and *Victoria* of 1,852 tuns and 450-horse power, for the Australian Mail Steam Navigation Company. He claims for the *Victoria* that she gained the prize of £500 offered by the Australian Colonies for the quickest passage. They are, like Mr. Russell's other ships, wall-sided and flat-floored. A model of the *Great Eastern* is also exhibited. The first plate was laid in 1853, and she was ready for launching in 1858. The *Great Eastern* is most decidedly the best of Mr. Scott Russell's models. Although she is flat floored she is rounded off from the bilge, so that the water is not driven off in a square at the bottom. The *Great Eastern's* lines have been admired by all who had the opportunity of inspecting them when she was on the ways. It would be difficult to improve them. She has a double skin, and longitudinal divisions, which makes her a strong ship.

To AMALGAMATE the zinc of electric batteries, Mr. Berjot uses the following process:—Dissolve 7 ounces 375 grains of mercury in 3 pints 4 ounces of nitro-muriatic acid (nitric acid 1 part, hydrochloric acid 3 parts). Heat the mixture a little, and add to it 2 pints 4 ounces hydrochloric acid. The zinc is thus amalgamated in a few seconds. The above amount of mercury is enough to amalgamate 150 to 200 cylinders of zinc.

THE 15th of August was designated as the day for opening the railroad from Algiers to Blidah. All of the employees wear uniforms, with their employment inscribed on the front of their caps.