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There is the preservation of custom and the growth of equity, is the function of the law, the courts, the Legislature; and the execution of the law, which is the function of the ruler and his ants. A superior civilization aids commerce by the establish lighthouses, by improvements of rivers and harbors, constr looks after the public health in the establishment of quar vents the spread of infectious disease, provides cities with w sewers, seeks to insure education among its citizens, regulates trols the medium of exchange. The governments of civilizatio been progressive in these regards. This country now confronts problem of too great power in the hands of the wielders of tra tation—they thwart the first principles of our Government, iron of their oppression has entered into the soul of our people.

BOHEMIAN GLASS.

By Professor HEINRICH SCHWARZ.

THE northern edge of Bohemia, which borders on Silesia, and Bavaria, is at once the principal seat of the German p tion of the country and of its industrial activity. A person app ing this border region from the interior will be struck at on the contrast between the stagnation of the Czech districts and th dom and active enterprise of the Germans, under the impulse of a not very fertile soil has been made to support a dense popul Besides the textile industries which profitably utilize the wate of the mountainous region, and the large mining, metallurgic chemical enterprises, the ceramic establishments, and the manu ries of stone-ware, porcelain, and glass, are prominent features district.

Notwithstanding numerous efforts, the quality of the fam hemian art-glass has never been quite equaled anywhere else. principal seat of its production is in Northeastern Bohemia, w district is separated by the Riesengebirge from Silesia; but, as sult of the active trade which has been carried on over that several centuries, branches of the manufacture have also spre the latter country. The exquisite products of the *Josephinen* Warmbrunn have long maintained a rivalry with the Bohemian and Frau Heckert's establishment in Petersdorff can exhibit wo specimens of luster and color, polish and etching, that might make one imagine he had been transported into Aladdin's The bases of the manufacture are really the same on either side range. The mountains furnish a pure quartz and a limestone of whiteness for raw materials, and the abundant woods, with which were clothed, formerly supplied the best of fuel to the furnaces

resultant ashes afforded the necessary potash. The Bohemian crystal serves in art as the type of the most perfect glass, and is unquestionably recognized as one of the superior kinds, rivaling in transparency and clear whiteness rock-crystal itself. Pure specimens of it, free from blisters, grains, and specks, have a peculiarly attractive look, even in their simplest forms. It is, moreover, by reason of its tenacity, its constancy of luster, hardness, and difficult fusibility, eminently adapted to artistic molding and ornamentation.

The heating of the furnace with wood only, from which a comparatively small quantity of ashes was produced, and they entering into the composition of the glass, contributed no little to the attainment of the highest perfection. While the glass-houses were at first built where they might be made a means of utilizing the superfluous wood, they have now to contend against a continually rising price of wood and increasing difficulty in procuring it. Some factories, like the Josephinenhütte of Count Schaffgotsch, and that of Count Harrach at Neuwelt, have the extensive forests of their owners to rely upon, while the much more important establishment of Joseph Riedel in Polaun is looking forward to direct railroad connection with the lower Silesian coal-mines or the Bohemian brown coal.

While formerly only the best, finely-split, well-seasoned trunk-wood could be depended upon to heat the furnaces to the needed temperature, the required degree is now obtained from limbs, knots, roots, and even green wood, by distilling the gas from them in an imperfectly ventilated regenerator, and burning it with the aid of previously heated air. By this means is obtained a clear, excessively hot flame, by which the most infusible glass is made as fluid as water, and of a very high state of purity. Many experiments will be necessary before such excellence can be obtained with coal-gas; and, in any event, a previous washing of the gas will be required to clear it from tar and ashes. The form of the furnace, the manner of introducing, purifying, and tempering the glass, the processes of bringing it into shape, and the shaping tools, do not vary essentially from those of the old ways; except that complicated figures engraved in iron and brass molds are now applied, the complete transference of which to the glass necessitates the use of air under high pressure. This is furnished by means of a hand compression-pump, so arranged in connection with the other parts of the apparatus that the manipulator can bring it to bear upon the melted glass at the precise moment when it must be brought into the closest contact with the engraved pattern. Other pieces, of a massive character, such as lenses and ring-segments for lighthouse-lanterns, which are now made on a large scale at Polaun, are formed by subjecting the material to a light pressure between an upper and a lower mold. They are then finished and polished after they have cooled.

The after-decoration of the glass is various, and subject to the fre-

quent changes of fashion. New patterns bring a high price and a ready sale till they are crowded out of the market by newer ones. For a long time the old German fashion ruled in glass, and manufacturers were obliged to use crude, impure colors, as if they were living in the childhood of art. Now, when we remember that glass-making has been regarded from a time long past as properly an effort to attain the clearness of rock-crystal and other precious stones, it should appear that it was wrong deliberately to come down from that high standard. The question is the one involved in the old contest of the artists with the artisans, which is still carried on with reference to the use of coal-tar colors. The former dislike these colors because they are too pronounced; the latter are inclined to regard them with more and more favor, on account of their brilliant luster, purity, and strength of color.

The author's studies of the Venetian mosaic glasses satisfied him that the harmony of the designs composed out of them was due to the subdued, broken coloring of the pieces that entered into the work, and that this was due again to the application of an impure, ferruginous sand in the melting. We must not, however, forget that glass is used in our houses, along with the precious metals, to bring out the highest lights, which even the most harmonious pictures can not dispense with. The purer, the more lustrous, and more brilliant the color of the glass, the better it answers this purpose.

The ornamentation of the glass is done partly in connection with the exposure in the furnace, and partly in the finishing-shops, where the work is completed by cutting, polishing, tarnishing, etching, painting, and mounting in metal. The glass-houses have at their command a very complete color-scale for transparent, opaque, and clouded glasses. But it must not be supposed that a crucible is placed in the furnace for each color, from which glass colored for each ornament is to be made. The colors are worked out by means of what are called pastes, which are kept on hand in sticks or cakes. From pieces of these pastes previously warmed till they are soft, suitable quantities are cut off, laid upon the foundation of white or colored glass, and then spread out by drawing or blowing. By this means only is an economical use of such costly materials as gold and silver compositions possible. Some of the glasses thus treated—gold, copper, and silver glasses—remain still little, or not at all, colored after the melting, shaping, and quick cooling; and do not take on their bright hues till they are reheated. This is the case with the new yellow-silver glass, which continues uncolored after the intermelting of the silver salt until it is exposed in the furnace again. Very fine effects are produced by blending or overrunning of the paste-colors provided proper attention is given to the laws of harmony. A blue-glass cup is, for example, overlaid with silver glass at its upper edge, and this is drawn down in gradually thinner tones till it fades away at the foot of the vase. Gold and copper ruby-colors are thus combined with

...sses, etc. Another brilliant effect is produced when a still hot bulb ... glass is rolled in finely pulverized aventurine glass,* and after this is ...ed, and previous to the shaping of the vessel, is overlaid with a ...ting of either colored or colorless glass. A still finer effect is ob... with mica-brocade. The mineral mica, which has deceived so ...y persons by its golden or silvery glitter, besides being applied as ...bstitute for metallic bronze dusts, can be colored by the aniline ...s in all manner of colors and shapes. The coarse powder called ...cade is used in glass-work, and the color-effect is produced by over... it with colored glass. A bulb is blown, for example, out of ...r blue glass, is rolled in the brocade, which readily adheres to it, ... is then overlaid with yellow glass. The brocade will appear, when ...ked at from within, of a steel color; from without, of the color of ...d. Every flake will reflect the light, colored according as it is ...ked at.

A recent kind of decoration is shown in those glasses which appear ... be held together by a network of gold-thread. This is made by ...reparing a skeleton of brass wire, and then introducing the glass and ...lowing it till its mass, having penetrated the interstices of the net... spreads over it and tightly incloses it. The full effect is then ...ought out by a subsequent etching away of the metal, and galvanic ...lding or silvering. Other metal ornaments, insertions, buttons, ...ops, or *figurini*, are often combined with this. They are cast in ...el-engraved forms of type-metal, which reproduce the finest details, ... are then galvanically coppered, silvered, or gilded. Another ...ty effect is obtained from the clouding which glasses mixed with ...e-ashes exhibit on being heated. If a bulb of this kind of glass is ...own into a metallic form which is dotted with projecting points, ... quick cooling ensues at these places, which leaves its mark after ... reheating and finishing in the shape of a regularly distributed ...ouding.

Only a little need be said, and that of the most modern operations, ... finishing, of the grinding, tarnishing, and polishing, ornamentation ...th gold-leaf and platinum-foil, luster, and enamel coloring, etc. ...ne of the most noteworthy of these operations is that of tarnishing ...y the centrifugal sand-blast. The objects to be treated by this process ...e fastened upon revolving wooden pegs in the walls of a wooden ...; the sand is introduced into the middle of the box, and is thrown ...y rapidly rotating fans against its sides and against the glass figures. ...fter it has done its work upon the figures it falls upon the funnel-...aped floor, to flow away and be lifted up again.

A charming effect is produced at the Neuwelt houses by means of ... guillocheeing machine in which an engraver's tool is drawn in regu...rly massed lines over the slowly revolving vase. The vessel has been

* A glass containing bright metallic flakes, probably copper crystals in a brown ...gma. It is made with rare perfection, by a secret process, in Venice.

..ously covered with etcher's varnish, which is removed fr... ...nes of the engraving, where the bare glass is afterward e... to hydrofluoric acid. In this way are produced the wave d... resembling those which are seen on the more finely engraved ... notes.

In another very recent style of ornamentation, fine Venetian ... pearls of various colors are glued by a very fusible enamel up... surface of the finished vessel. As the arrangement is made in ... cold, the work admits of a complete artistic freedom. The enam... then dried and the setting is fixed by heating.

Another important function of the melting-furnaces is to fu... raw material for the now considerable small-glass industries i... shape of sticks and fragments of colored glass. The favorite colo... these is a dark violet or black; but colorless glass is used for the p... ants of chandeliers, and they are sometimes given a reddish tin... overlaying them thinly with gold-ruby. Sticks partly overlaid ... opaque glass are used in a similar manner. There are always accu... lating, in the glass-houses and other shops, piles of droppings, ... flows, and pieces of many colors, which can be sold for very cheap pri... All this stuff is pounded up and mixed together with the additio... manganese or other coloring oxides, and is remelted in a special ... nace. The workmen take out suitable quantities of this mass, and ... a series of deft manipulations, form it into sticks about as thick ... one's thumb.

Very thin globes of about the size and shape of a vitriol-flask ... made from the same dark glass, to be again broken up into sha... which can be packed away in boxes. The manufacturer cuts fr... these sherds slightly curved plates, such as are used, for example, ... foundations for brocades.

The shops of the small-workers are of the simplest charact... Wherever one of the numerous little streams makes it possible to ... water-power enough to drive a grinding and polishing wheel, and ... the modest houses scattered along the mountain-slopes, may be fou... the establishments of these industrials, in which the working force ... the whole family finds active employment. The artisan buys h... sticks and sherds from the glass-house. A little wood-furnace, so... what like a tinker's furnace, gives facilities for heating four or five ... the glass sticks at once, which are taken out and used alternately ... the ends are softened in the fire. The softened end is fastened to ... by a pair of pincers, drawn out a little, and introduced into a mol... which is carved the figure of the object into which it is designed ... be formed, and which is firmly stamped upon it by closing the m... and the application of pressure. If the mold is too cold, the form ... be imperfectly made and the glass will be brittle; if it is too hot, ... glass is liable to stick in it. Fortunately, it can be easily worked ... suitable temperature. The molded pieces are thrown into an ear...

which is kept warm by a moderate flame and serves the purpose of a cooling-vessel.

The button, or whatever is the article manufactured, is still only in the rude state, with the edges yet rough and the surfaces uneven, but already provided with holes for the after-insertion of metallic eyes. The rough edges are smoothed away by grinding on the grooved periphery of a wet sandstone, being held to it by a wooden clamp which is managed by the right hand while it is turned with the left. The surfaces are ground with wet sand on horizontal, fast-turning iron plates, and afterward polished on the face of soft wooden wheels roughened with Tripoli dust. To speed the operation, the workman presses upon the piece with both hands and gives it a peculiar rotary motion that equalizes the stronger friction to which the parts nearest in contact are exposed. The proper application of this movement is a matter of knack, and is founded on mathematical principles, which also appear when the object is rubbed on a solid base, in the epicycloid lines which it is made to describe. On account of the relatively long time required for the operation of polishing, the smaller articles are subjected to what is called a fire-polishing, in which the smoothly ground pieces, imbedded on a plate of clay in fine sand, are heated in a muffle till their surface runs. If more strongly curved plates are wanted, to form a rose, for instance, the disks, previously prepared by notching and perforation in the middle, are placed in funnel-shaped crucibles in the hot muffle. The central part of the disk sinks on being heated. The hollowed leaves are then set one in another, in the order of their diminishing size, and fastened together by a glass-headed pin.

The foundation of the design is formed of a brass plate which has been previously shaped and perforated. Additional decorations are given by means of little beads, which are melted off in the glass-blower's lamp from thin threads of glass, and find their places in minute holes in the plate. Black sealing-wax is added to heighten the gloss and the blackness, as well as to cement the parts together. In other cases lighter figures are made by partly polishing or by etching them out on the smooth background. Iridization of beads, buttons, etc., has been much in vogue for a few years past; by this process those articles are given a metallic appearance. The luster of gold or silver is imparted by covering the black glass with a silver- or gold-leaf varnish and afterward heating moderately in a muffle. Peculiar tarnish-effects are given by the application of what are called luster-colors; and, lastly, these are shaded by a brief treatment with chloride-of-tin vapor. The glass articles, hung upon a wire, having been previously warmed in the muffle-furnace, are drawn through the thick white vapors which are formed when a spoonful of the tin-salt is dropped upon red-hot iron. A long experience and considerable manual dexterity are required to make sure of getting the particular iris-color

that is wanted, which is dependent upon a very well-defined [illegible] thickness of the coating. In this is involved a question of interfe[illegible] colors, the same as is involved in soap-bubbles and the temper[illegible] of steel, in which there must be an exact difference in the wave-l[illegible] of the light reflected from the upper and lower surfaces of the co[illegible] ing. Many colors, like steel-green, require repeated trials to be br[illegible] out in their full beauty. The advance that has been made in this as has been illustrated to me in a specimen-sheet of beads which are [illegible] signed to make trimmings exactly corresponding in color for silks [illegible] very great variety of shades.

In addition to the glass industry, a very extensive interest has b[illegible] developed in the manufacture of brass, bronze, pinchbeck, etc., in which use is made of various galvanic coatings of metal. These branches of the art are carefully taught in the industrial school at Gablonz.—*Translated for the Popular Science Monthly from Das Zeit.*

GEOLOGICAL CLIMATE IN HIGH LATITUDES.*

By C. B. WARRING, Ph. D.

THE peculiar climate of geological times has hitherto been treated as if it were a question of temperature only. Scientists have sought the cause of the remarkable warmth in arctic regions, but have left untouched other questions of equal and perhaps greater importance.

One can hardly contemplate the climatic conditions of that remote period without inquiring how there could be other than a great difference of temperature between the summers and winters of lands less than 8° from the pole; and how could circumstances—environments—so unlike as the four or five months day of those regions, and the twelve-hour day of the tropics, fail to induce great specific differences in their fauna and flora. The questions spontaneously arise. Is it possible that the days and nights in high latitudes were then as they are now? Must not the climate have been warm in January as well as in July? Must not the influences of the solar rays—the actinic force—have been distributed through the year with at least approximate uniformity in high as well as low latitudes? It is these questions, as well as those of temperature, that I shall consider in this paper. I propose to study the record left by the plants and animals which lived in those remote days. Some of their more obvious teachings are startling enough. Regions where now vegetation is of the scantiest character, where no trees exist save a few dwarf willows, where the winters are cold almost beyond endurance, were, as late as

* Read before the New York Academy of Science.