XXI. *Results of some recent Experiments on the Properties impressed upon Light by the Action of Glass raised to different Temperatures, and cooled under different Circumstances. By* David Brewster, *LL. D. F. R. S. Edin. and F. A. S. E. in a Letter to the Right Hon. Sir* Joseph Banks, *Bart. K. B. P. R. S. &c. &c. &c.*

Read May 19, 1814.

DEAR SIR,

THE interest which you take in every thing which contributes to the progress of science, renders it unnecessary to make any apology for communicating to you the results of some recent experiments on the properties impressed upon light by the action of glass, raised to different temperatures and cooled under different circumstances. The imperfect state of these experiments will still require your indulgence; but I trust that independent of all farther developement, the results themselves will be deemed of sufficient importance to justify me in submitting them so early to your consideration.

During an extensive course of experiments on the depolarisation of light, by soft bodies melted and cooled between plates of glass, it was necessary to bring the plates to different temperatures, in order to fuse the substance which they inclosed. When the body melted at a high temperature and was in a fluid state, I frequently perceived a partial depolarisation of the transmitted light, which gradually went off as the heat diminished. This effect I at first ascribed to an incipient crystallisation in the included substance; but the increase of

the quantity of depolarised light by an augmentation of temperature refuted this conjecture, and rendered it necessary to search for some other cause.

Having procured a plate of glass about $\frac{4}{10}$ of an inch thick, I brought it nearly to the temperature of a red heat. When a pencil of light polarised by reflection was transmitted in a perpendicular direction through the heated glass, the whole of the light was completely depolarised, and found a ready passage through a plate of agate, having its veins perpendicular to the plane of reflection. As the temperature diminished, the quantity of depolarised light seemed to diminish in the same proportion; and after the glass had completely cooled, the whole of the pencil preserved its original polarisation, and refused to penetrate the agate. Hence it follows *that glass brought to a certain temperature forms two images, and polarises them in an opposite manner, like all doubly refracting crystals, the one image being coincident with the other.*

The analogy thus indicated between heated glass and regularly crystallised bodies was in some degree imperfect, as I could perceive no traces of the coloured rings which almost every crystal exhibits by polarised light. It occurred to me, that the temperature of the glass might not have been sufficiently high, and that the phenomenon of the coloured rings could only be developed when the glass was in absolute fusion, or in a state approaching to it. The impracticability, however, of making any experiments of this kind with melted glass, compelled me to have recourse to another expedient.

In the formation of glass tears, or Rupert's drops, as they are sometimes called, by dropping melted glass into cold water, it appeared probable, that in consequence of the sudden conso-

lidation of the outer crust, the interior part of the drop had a structure similar to that of fluid glass, or at least, that the ultimate particles were in both cases at the same distance, having been prevented, in the case of the drop, from approaching each other by the action of the external coat.

I therefore procured several of these drops made of bottle glass, and upon exposing them to a polarised pencil, I found that they not only depolarised it completely, but produced the alternation of the prismatic colours, which I was so anxious to discover. In order to observe this interesting phenomenon with more satisfaction, I obtained several drops made of flint glass. All of them exhibited the same phenomena which appeared in those made of bottled glass, and there was a decided approximation to neutral axes in lines parallel and perpendicular to the axis of the drop. When the polarised ray was transmitted through a part of the drop nearer to the slender stem, the neutral and depolarising axes became still more distinct, till at a certain thickness of the stem these axes were as completely developed as in the most perfect crystals.

Having succeeded in detaching the thick bulb of the drop from its long slender tail, I ground upon it two parallel surfaces, perpendicular to the axis of the drop, and other two parallel to the same axis. When polarised light was transmitted in both these directions, it was depolarised as before, and exhibited the segments of the coloured rings, but there was no appearance of any neutral axes, the depolarisation being equally complete in every position of the drop.

When a piece of plate glass is brought to a red heat, and suddenly cooled by immersion in water, it is intersected by numerous fissures, arranged somewhat like the cells of a

honeycomb; but as the rupture of the surface leaves the particles at liberty to dispose themselves at distances corresponding to the temperature, the glass exhibits no power either in polarising or depolarising light.

The effects of heat upon crystallised bodies, but particularly upon those which, like fluor spar and muriate of soda, do not possess the property either of polarisation or depolarisation, I propose immediately to investigate; but even if the inquiry should be carried no farther, the results which I have described must be considered as of the utmost importance, not only as giving us positive information respecting the structure of crystallised bodies, but as opening a new path to the solution of the great problem of double refraction.

I have the honour to be,

dear Sir,

your most obedient and humble servant,

DAVID BREWSTER.

Edinburgh, April 8th, 1814.

To the Right Hon. Sir JOSEPH BANKS, Bart. K. B. P. R. S.
&c. &c. &c.