IV. Ἀμόρφωτα, No. I.—*On a Case of Superficial Colour presented by a homogeneous liquid internally colourless.* *By Sir* John Frederick William Herschel, *Bart., K.H., F.R.S., &c. &c.*

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A CERTAIN variety of fluor spar, of a green colour, from Alston Moor, is well known to mineralogists by its curious property of exhibiting a superficial colour, differing much from its transmitted tint, being a fine blue of a peculiar and delicate aspect like the bloom on a plum, and like that bloom might perhaps be referred to a peculiar texture of the surface, the result of crystallization, were it not that it appears equally on a surface artificially cut and polished. Glasses also are manufactured which, by the agency of a delicate superficial film, consisting apparently of a dull green-coloured powder, and reflecting (or rather dispersing) a green light, exhibit a brownish red tint by transmission; chloride of sulphur, and the infusion of lignum nephriticum are particularized in some books as exhibiting different colours by transmitted and reflected light. As respects the chloride of sulphur, the statement is incorrect, and has originated in a misapprehension of its scale of absorbent action, which (as is the case with many dichromatic media) causes its hue to change from green to red by mere increase of thickness. In the infusion of lignum nephriticum, and in one other instance which has occurred to my notice, the reflected tint arises from suspended particles too minute, or too nearly of the specific gravity of the liquid, to be separated by *subsidence**, the transmitted colour being that of the transparent liquid in which they float, and the particles themselves being opake.

The case which I am about to describe is not precisely parallel to any of these, though far more striking than either. That of the fluor spar presents the closest analogy to it, though from what we know of the impracticability of obliterating the internal structure of mother-of-pearl by any artificial polish, the difference between the solid and fluid states of aggregation precludes any argument from that phenomenon to the one in question.

The sulphate of quinine is well known to be of extremely sparing solubility in water. It is however easily and copiously soluble in tartaric acid. Equal weights of the sulphate and of crystallised tartaric acid†, rubbed up together with addition of a very little water, dissolve entirely and immediately. It is this solution, largely diluted, which exhibits the optical phenomenon in question. Though perfectly trans-

* I write from recollection of an experiment made nearly twenty years ago, and which I cannot repeat for want of a specimen of the wood. I think the *filtered* liquid did *not* exhibit the double colour.

† Citric acid answers equally well.

parent and colourless when held between the eye and the light, or a white object, it yet exhibits in certain aspects, and under certain incidences of the light, an extremely vivid and beautiful celestial blue colour, which, from the circumstances of its occurrence, would seem to originate in those strata which the light first penetrates in entering the liquid, and which, if not strictly superficial, at least exert their peculiar power of analysing the incident rays and dispersing those which compose the tint in question, only through a very small depth within the medium.

To see the colour in question to advantage, all that is requisite is to dissolve the two ingredients above mentioned in equal proportions, in about a hundred times their joint weight of water, and having filtered the solution, pour it into a tall narrow cylindrical glass vessel or test tube, which is to be set upright on a dark-coloured substance before an open window exposed to strong daylight or sunshine, but with no cross lights, or any strong reflected light from behind. If we look down perpendicularly into the vessel so that the visual ray shall graze the internal surface of the glass through a great part of its depth, the whole of that surface of the liquid on which the light first strikes will appear of a lively blue, which as the situation of the eye changes is either fore-shortened into a vivid concave gleam, or opens out into a paler and broader band, as the visual line is more or less oblique to the glass surface.

If the liquid be poured out into another vessel, the descending stream gleams internally from all its undulating inequalities with the same lively yet delicate blue colour, thus clearly demonstrating that contact with a denser medium has no share in producing this singular phenomenon.

The thinnest film of the liquid seems quite as effective in producing this superficial colour as a considerable thickness. For instance, if in pouring it from one glass into another, it be made to trickle down the internal surface of the receiving glass towards the light, or if instead of falling in drops from a filter, the end of the funnel be made to touch the internal surface of the vessel well moistened, so as to spread the descending stream over an extensive surface, the intensity of the colour is such that it is almost impossible to avoid supposing that we have a highly coloured liquid under our view.

By candlelight the gleam is less vivid, and verges more to violet. Analysed by a prism the red rays are found to be almost entirely absent. No signs of polarization were perceived in it, on viewing it through a tourmaline plate turned round in its own plane.

As this phenomenon in all its circumstances is (so far as I am aware) unique in physical optics, I have thought no apology necessary for simply describing, without attempting to pursue it further, which present circumstances do not permit. It would be interesting to know whether the property in question is characteristic of quinine, or is participated in by cinchonine, salicine, or any of the other vegetable alkaloids, which I have not been able to decide for want of specimens.

J. F. W. Herschel.

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P.S.—Having been obligingly favoured by Professor DANIELL with specimens of very pure cinchonine and salicine, I am enabled to state that they do not possess in the smallest appreciable degree the curious property above shown to belong to quinine.

As regards the latter alkaloid, all the acids I have tried appear to produce the same effect, though not all in an equal degree. The muriatic seems least efficacious; the sulphuric and acetic decidedly the most so. The intensity of the superficial colour produced when either of the latter acids (very dilute) is used, is really surprising.

Only *acid* solutions succeed. After precipitating by excess of potash a solution of quinine, the liquid filtered was very bitter, and of course contained quinine. It however exhibited no trace of superficial colour; but on dropping powdered tartaric acid into the test glass the blue colour was instantly developed, and seen to follow the course of the descending acid.

J. F. W. H.

Feb. 16, 1845.