

Note on some Organic Substances of High Refractive Power

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XXXIX. *Note on some Organic Substances of High Refractive Power.* By H. G. MADAN, M.A.*

IN the course of some correspondence respecting M. Bertrand's polarizing-prisms, one of which I had the honour of showing to the Society last summer, I was informed that the cement used was naphthyl-phenyl-ketone dibromide. It was evident, from the theory of the prism, that this substance must have a refractive index at least as high as that of calc-spar for the ordinary ray, viz. 1.658; and as so highly refractive a cement seemed likely to be of great value for many purposes, I thought it worth while to prepare some of the ketone and examine its properties. I now exhibit a specimen of it.

I prepared it by the general method devised by Grucarevic and Merz (*Berichte der deutschen chemischen Gesellschaft*, vi. pp. 60 & 1238) for obtaining double ketones; viz. by heating together benzoyl chloride and naphthalene, and placing in the mixture a strip of zinc. The product was fractionally distilled, to free it from the excess of naphthalene, and was finally obtained as a thick yellow oil, boiling at a point so nearly that of mercury that a mercury-thermometer could not be used to determine it. In properties it seems a very stable, neutral, harmless substance like Canada balsam; but unfortunately it does not appear capable of hardening like balsam, and hence it is not by itself adapted for a cement. It is insoluble in water, but dissolves readily in alcohol and benzol.

Its refractive index was determined in the usual way, a hollow prism (of refracting angle of $59^{\circ} 48'$) being filled with it, and the angle of minimum deviation for yellow sodium-light observed with a refractometer; from which data the usual formula gave as its refractive index, 1.666. This is even higher than that of carbon disulphide (1.63), and very nearly the same as that of calc-spar given above.

I compared its dispersive power with that of a prism of very dense glass (refractive index 1.73) having a refracting angle of 60° , with the following results:—

* Read January 23, 1886.

Fraunhofer's line.	Ketone. $\mu =$	Glass. $\mu =$	Carbon disul- phide. $\mu =$
B . . .	1.654	1.725	1.617
E . . .	1.678	1.744	1.643

From this it is easily seen that the coefficient of dispersion of the ketone is $1\frac{1}{4}$ times that of the glass, and almost exactly the same as that of carbon disulphide.

I have made the compound of the ketone with bromine, referred to by M. Bertrand, but I hesitate to recommend it as a cement, at any rate for anything made of calspar; as it seems liable (like many similar bromides) to decompose with formation of hydrobromic acid, which of course acts upon the spar.

The ketone itself has a refractive index quite sufficiently high, if only some means can be found of hardening it.

I cannot, however, yet vouch for its permanency. It was made in August last, and remained for several months without change; but it has lately shown a tendency to pass from the colloidal to a crystalline condition, especially during the cold weather, although I had previously exposed it to a temperature of -20° without causing any alteration beyond an increase of viscosity.

I would also ask permission to show the Society a specimen of another highly refractive substance, viz., metacinnamene. It is a polymeric form of cinnamene, obtained by the action of light or heat upon the latter substance.

Cinnamene is a colourless liquid, obtained by distillation from the resin storax. Its refractive index I found to be 1.54 for the D line, nearly the same as that of Canada balsam. When this liquid is exposed to light for a few weeks, or heated to 190° in a sealed tube for half an hour, it becomes a glass-like solid, contracting greatly during the change.

In order to determine its refractive index, it was heated until it became viscous and placed in a hollow prism. The angle of minimum deviation for yellow sodium-light was found to be $39^{\circ} 44' 35''$; whence its refractive index is calculated to be 1.593. This is much higher than that of any other resin, so far as I can make out; and metacinnamene

would make a very valuable cement, since it is readily softened by heat and becomes remarkably hard and tough on cooling, but it does not show any great adhesiveness for glass. I hope to get good results by mixing it with other things, such as the ketone above described.

Another highly refractive organic substance is monobromonaphthalene, of which I exhibit a specimen.

It is a nearly colourless liquid, more stable than similar compounds containing bromine usually are, and boiling at the high temperature of 285°C . Its refractive index for the D line is 1.662; very nearly equal to that of naphthyl-phenylketone. I am rather surprised that it has not come into use as a substitute for carbon disulphide for filling prisms, as it is much less volatile and inflammable than the latter substance, while it has an even higher refractive and dispersive power.

The great desideratum at present is, a substance which has all the excellent qualities of Canada balsam—colourless, neutral, permanent in the air, becoming fluid when moderately heated, but hard and tough when cold, and with a refractive index of *at least* 1.66.

Such a substance would not only be of great use in the construction of polarizing and other prisms, but it would also be invaluable as a medium for mounting microscopic objects; since details of structure are brought out much more clearly when the object is immersed in a medium which differs greatly from it in refractivity. Phosphorus, arsenic sulphide, and mercury-potassium iodide have been used for this purpose, but they are all open to grave objections. None of them are permanent in the air; some are dangerously inflammable; while most of them act on delicate organic structures, although available for such things as siliceous Diatomaceæ.

The most hopeful direction in which to look is undoubtedly towards some of those complex organic compounds which are now being built up by many workers in England and Germany.