On the evolution of light during crystallization

Henry Rose

To cite this article: Henry Rose (1835) On the evolution of light during crystallization, Philosophical Magazine Series 3, 7:42, 534-537, DOI: [10.1080/14786443508648777](https://doi.org/10.1080/14786443508648777)

To link to this article: <http://dx.doi.org/10.1080/14786443508648777>

Published online: 01 Jun 2009.

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"The stomach is muscular, small, and glandular, and of the shape of an egg. The *duodenum* is broad at its origin, and at about 3½ inches from its commencement the biliary and pancreatic ducts enter. The gall-bladder is 6 inches long and 2 inches in circumference; it is attached to the under side of the liver, and, gradually diminishing in diameter, it passes over the stomach, and is inserted into the intestine, without the intervention of any duct.

"The *testes* were large, as were the supra-renal glands and kidneys. I did not observe any difference from the usual structure and proportions in any other parts.

"The small intestines measured 22 feet 6 inches in length, and were about the thickness of the little finger. There were attached to them two *cæca*, each measuring about 1 inch 3 lines in length, which were of the same diameter as the intestines. The great intestines were somewhat larger than the small. The measurements of the stomach and the intestines were as follows:

	Feet.	Inches.	Lines.
Length of the <i>œsophagus</i>	0	10	0
Breadth at the <i>pharynx</i>	0	1	6
<i>infundibulum</i>	0	2	4
Length of the <i>infundibulum</i>	0	10	0
Breadth at the junction of the <i>infundibulum</i> with the stomach	0	6	0
Length of the stomach	0	4	0
Width of ditto	0	2	6
Length of the <i>duodenum</i>	1	3	0
Circumference of ditto	0	4	0
Length of the small intestines, inclusive of the <i>duodenum</i>	22	6	0
Length of the <i>cæca</i>	0	1	3
Circumference of the <i>cæca</i> and the small intes- tines	0	2	6
Length of the large intestines	0	6	0
Circumference of ditto	0	2	9

"The total length of the individual examined, measured over the back, was 3 feet 2 inches and 6 lines; the length of the neck, 11 inches and 9 lines; that of the trunk, 1 foot 1 inch and 9 lines."

The reading of Mr. Reid's communication was illustrated by the exhibition of the skeleton of the specimen of the *Patagonian Penguin* described by him, and of preparations of many of the *viscera*, the whole forming part of the collection of Mr. Blackett.

LXVI. Intelligence and Miscellaneous Articles.

ON THE EVOLUTION OF LIGHT DURING CRYSTALLIZATION. BY
HENRY ROSE.*

AN emission of light has often been noticed during crystallization, but its appearance has always been a casual one, and never, as far as I am aware of, has it been produced at will. I have observed during

* Read to the Academy of Sciences at Berlin, July 30, 1835.

the crystallization of arsenious acid a strong emission of light, which differs from that seen during the crystallization of other substances, in as much as it may be produced at pleasure. Take two or three drachms of the transparent or vitreous arsenious acid, put it in a matrass of white glass along with an ounce and a half of not fuming muriatic acid of the common strength, and half an ounce of water; allow the whole to boil for ten minutes or a quarter of an hour, and then let it cool as slowly as possible, which is best done by gradually decreasing the flame of the spirit-lamp which has been used for the boiling. If the experiment is conducted in a dark room, the crystallization is accompanied by a strong emission of light, the formation of each little crystal being attended by a spark. If the vessel is then agitated, a great number of crystals suddenly shoot up, and an equal number of sparks occur at the same time. If a considerable quantity of arsenious acid, such as an ounce or an ounce and a half, or more, is treated with a corresponding quantity of diluted muriatic acid, then, on shaking the vessel, if the right moment is seized, the emission of light from the shooting of the crystals is so powerful that a dark room may be lighted up by it.

Considerable time elapses before the acid solution of arsenious acid leaves off depositing crystals, consequently the cooled solution still continues to emit light on the second and even on the third evening, but only extremely feebly, and only when it is agitated. It is, however, impossible after this to produce any emission of light; a proof that it is occasioned by the shooting of the crystals, and not by electricity of friction.

If the hot solution of the transparent arsenious acid is allowed to cool rapidly, whereby a friable mass of arsenious acid is obtained, then either a very feeble light or none at all can be observed. Equally little light is observable if the transparent acid is treated with acetic or nitric acid, the latter either of the common strength or fuming. The reason of this is simply that these acids dissolve but very little of the arsenious acid, especially the acetic acid, so that this solution is but slightly tinged yellow by sulphuretted hydrogen, without any sulphuret of arsenic being precipitated. Dilute sulphuric acid, on the other hand, dissolves rather more arsenious acid by boiling, and if this solution be allowed to cool very slowly, a feeble light may sometimes be observed. If a large quantity of the transparent arsenious acid is treated with only so much nitro-muriatic acid (which, however, must contain an excess of muriatic acid,) that it is not completely dissolved and oxidized to arsenic acid, a strong light is then observed on cooling.

The cause of the luminosity of crystals during their formation has long appeared to me to be this: that the substance which separates from a fluid in the form of a luminous crystal is not contained as such in the solution, but that it is only formed when the crystal is formed, and that the appearance of light is necessarily conditioned by the formation of a new substance in a crystalline state.

The light evolved during the crystallization of substances has most frequently been observed with sulphate of potash, but always only

casually, and never during the recrystallization of pure sulphate of potash, but, as I believe, merely during the crystallization of the solution of the residue from the preparation of nitric acid. This contains almost always sesquisulphate of potash, which as such is soluble in water, but which, according to Phillips, is decomposed whilst crystallizing into bisulphate and neutral sulphate of potash; and the latter becomes luminous during crystallization, whilst it is formed in the fluid, and crystallizing out of it.

Two isomeric states of the arsenious acid are commonly known: it is either transparent and vitreous, or porcellanous and opaque. At first after melting it is quite transparent, but simply by keeping it, and without its experiencing any increase of weight, it becomes milky-white and opaque. In both states the acid has different specific gravity and solubility in water.

I have only been able to observe the evolution of strong light during the crystallization of the arsenious acid, when I treated the vitreous acid with muriatic acid in the above-mentioned manner. In the same manner the opaque acid and also the pulverulent arsenious acid, which is obtained by sublimation during the roasting of the arsenical ore, and which is known in commerce under the name of "Giftmehl*," when treated with muriatic acid did not produce, even by the most gradual cooling, any light, and it was only by shaking the vessel that a very feeble light was visible; in the latter case most likely because the opaque acid contained still some portions of the vitreous acid. But this feeble light could never be compared with the strong light which was visible when the transparent acid was employed. The light evolved during the shooting of the crystals of the arsenious acid appears, therefore, to depend upon this, that the solution of the transparent acid is changed by crystallizing into the opaque or porcellaneous kind. The crystals produced belong, therefore, to the opaque modification; and the change of the transparent into the opaque acid is caused by nothing else than the transformation of the acid from a completely uncrystalline to a crystalline state.

The crystals of arsenious acid which are obtained from a very slowly cooled solution in muriatic acid are, however, transparent; but this transparency is caused only by their size, and an aggregate of very small crystals of the acid would exhibit an opaque appearance. The crystals formed were always regular octohedrons, and did not possess the form observed by Wöhler, which is, perhaps, a third isomeric modification of arsenious acid.

If the transparent acid is treated in the above-mentioned manner and proportions, and the crystals have been formed accompanied by phosphorescence, and the whole been allowed to cool perfectly, the phosphorescence can be obtained once more, and sometimes even very powerfully, if the whole is again heated to the boiling-point and slowly cooled. However, the light is much more feeble than that first observed, and is only caused by the muriatic solution still containing portions of the transparent arsenious acid, and which during crystal-

* The suboxide of arsenic of Berzelius.

lization evolves this feeble light. Moreover, the quantity of dilute muriatic acid in the mixture above-described is not sufficient to dissolve all the arsenious acid, and there remains, therefore, a small portion in the vitreous state.

But still all the appearances of light which have been observed cannot be explained on the principle of a new arrangement or formation, and I myself hold this hypothesis to be one which requires the evidence of more facts to establish its probability. Thus, Berzelius observed phosphorescence during the crystallization of fluoride of sodium out of a solution which held the same salt already in solution.

HYDRATE OF OIL OF TURPENTINE.

MM. Dumas and Peligot state that they received from M. Julien Fontenelle some well-defined crystals collected from oil of turpentine: 0.287 of these, submitted to analysis, yielded 0.295 of water and 0.662 of carbonic acid, which indicate:

Carbon	63.8
Hydrogen	11.4
Oxygen	24.8—100.0

M. Bonastre had observed prismatic crystals resembling the preceding in the *essence de basilic* (*Ocimum basilicum*); of these 0.285 yielded 0.297 of water and 0.657 of carbonic acid, or

Carbon	63.8
Hydrogen	11.5
Oxygen	24.7—100.0

Lastly, on examining the oils in the laboratory at the Jardin des Plantes, a bottle of oil of the *Cardamomum minus* was found in which there were numerous colourless prismatic crystals like the foregoing. They were purified by pressure, and 0.213 of them gave 0.493 of carbonic acid and 0.220 of water, or

Carbon	64.
Hydrogen	11.4
Oxygen	24.6—100.0

These numbers nearly coincide with those which give the following formula:

C ⁴⁰	1530.4		63.6
H ⁴⁴	275.0		11.4
O ⁵	600.0		25.0
		2405.4	100.0

This formula may be explained by C⁴⁰ H³² + H¹² O⁶.

If, as the authors believe, these three substances are identical, the hydrate which constitutes them ought to be found in a multitude of cases. If they are merely isomeric, the study of them would require more of them than the authors possessed; their object in publishing these analyses is to call the attention of chemists to a product which is but little known, but of considerable interest.—*Ann. de Chim. et de Phys.*, tome lvii. p. 334.

Third Series, Vol. 7. No. 43. Supplement, 1835.

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