

## NOTES AND NEWS

### CHARLES-FRANCOIS DU FAY, A PIONEER IN CRYSTAL OPTICS

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The foundations for correlation of the optical properties of crystals with their form or symmetry were laid in the second decade of the nineteenth century by Biot and Brewster.<sup>1</sup> Their success depended on the use of polarized light. Haüy had attempted to distinguish between singly and doubly refracting crystals and had correlated optical isotropism with certain highly symmetrical *molécules intégrantes*, but his method, observing the image of a pin through crystal prisms, could not lead to satisfactory results.

Some eighty years before Brewster the first correlation of crystal form and optical properties was attempted by Charles-Francois de Cisternai du Fay. Unfortunately his early death prevented the full publication of his results and the only knowledge we have of his work is from the *éloge* written by de Fontenelle, at that time *secrétaire perpétuel* of the Academie.<sup>2</sup>

Du Fay was born in Paris, September 14, 1698, of a family long accustomed to the profession of arms. He also entered the military service, but after a brief career as a lieutenant he began to devote himself to chemistry and in 1723, at a remarkably early age, he became a member of the Academie des Sciences as a chemist. During the next fifteen years he was active in all the branches of science then recognized and made important contributions to the Memoires of the Academie. His best-known work was in the fields of electricity and phosphorescence, and this is usually cited in the histories of physics. Within a few years he attained such a reputation as a successful experimenter that he was engaged by the royal council to work out chemical tests for the quality of dyes.

In 1732 the king appointed du Fay superintendent, *intendant*, of the royal gardens and in this capacity he was an active botanist until his death, July 16, 1739, after a brief illness. It must have been during these last years that he did his work on the optical properties of crystals.

The *éloge* by de Fontenelle is charmingly written with many

<sup>1</sup> David Brewster, On the laws of polarization and double refraction in regularly crystallized bodies: *Phil. Trans. Roy. Soc. London*, **1818**, pp. 199-273.

<sup>2</sup> Histoire de l'Academie Royale des Sciences, **1739**, pp. 73-83, Paris, 1741.

sidelights on the conditions of the time and interesting reflections on international scientific cooperation and the relations of scientists and diplomats. In figure 1 is reproduced that page of the *éloge* which contains the mention of du Fay's work on crystals. The paragraph of chief interest, freely translated, follows.

His last work for the academy, which, though not quite complete, is far enough advanced for announcement and possibly for publication, has been on rock crystal and iceland spar. These crystals, like many other transparent stones, have a double refraction which was known to Bartolinus, Huyghens and Newton and which they tried to measure and explain. But neither are their measurements exact, nor their explanations free from great difficulties. By a great number of experiments he arrived at exact measurements and general facts, which however, considering the first physical cause, may represent even more general principles. He discovered, for instance, that all transparent stones which have right angles are but singly refracting, whereas those whose angles are not right angles are doubly refracting and that the measure of their double refraction depends on the inclination of their angles.

De Fontenelle does not state the basis for these remarks but it seems certain that he must have had before him some notes or unfinished manuscript. Being a poet he probably was little able to interpret or to judge du Fay's work. One wishes for a more complete report. By what means did du Fay arrive at better determinations of refraction than his forerunners? Just what fault did he have to find with their explanations? If his notes or manuscript can be found it would be most desirable to have them made available.

Under the circumstances it is impossible to say how far the erroneous or ambiguous statements in the quotation above are due to du Fay and how far they are due to the author of the *éloge*. In any event it is certain that du Fay should be credited with a great achievement. It seems that he discovered the optically isotropic character of isometric crystals, the anisotropic character of all other crystals, and the fact that the amount of birefringence is, in general, different for each species. He had taken the first steps toward a correlation of crystal form and optical properties. The knowledge of his predecessors was limited to the fact that calcite

comprises dans la variété de ses connoissances. Il étoit presque le seul qui, quoiqu'étranger à ces respectables Assemblées, y fût ordinairement appellé.

Son dernier travail pour l'Académie, qui, quoiqu'il ne soit pas entièrement fini, est en état d'être annoncé ici, & peut-être publié, a été sur le Cristal de Roche, & celui d'Islande. Ces Cristaux, ainsi que plusieurs autres Pierres transparentes, ont une double Réfraction, qui a été connuë de M<sup>rs</sup> Bartholin, Huguens, & Newton, & dont ils ont tâché de trouver la mesure, & d'expliquer la cause. Mais ni leurs mesures ne sont exactes, ni leurs explications exemptes de grandes difficultés. Il étoit arrivé par un grand nombre d'expériences à une mesure juste, & à des faits généraux, qui du moins pouvoient tenir lieu de principes, en attendant la première cause Phisique, encore plus générale. Il avoit découvert, par exemple, que toutes les Pierres transparentes, dont les angles sont droits, n'ont qu'une seule réfraction, & que toutes celles dont les angles ne sont pas droits, en ont une double dont la mesure dépend de l'inclinaison de leurs angles.

Il tomba malade au mois de Juillet dernier, & dès qu'on s'aperçut que c'étoit la petite Vérole, il ne voulut point attendre qu'on vînt avec des tours préparés lui parler de la mort sans en prononcer le nom, il s'y condamna lui-même pour plus de sûreté, & demanda courageusement ses Sacrements, qu'il reçut avec une entière connoissance.

Il fit son Testament, dont c'étoit presque une partie qu'une Lettre qu'il écrivit à M. de Maurepas pour lui indiquer celui qu'il croyoit le plus propre à lui succéder dans l'Intendance du Jardin Royal. Il le prenoit dans l'Académie des Sciences, à laquelle il souhaitoit que cette place fût toujours unie, & le choix de M. de Buffon qu'il proposoit étoit si bon, que le Roy n'en a pas voulu faire d'autre.

Il mourut le 16 Juillet après six ou sept jours de maladie.

Par son Testament il donne au Jardin une Collection de Pierres précieuses, qui fera partie d'un grand Cabinet

*Hist. 1739.*

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and quartz are birefringent. At that time when no attempt at crystal classification had yet been made and when testing for birefringence by polarized light was unknown, he could hardly be expected to accomplish more.

Du Fay has been sadly slighted by the historians of crystallography, probably because of the unusual and incomplete manner in which his results were published. Groth<sup>3</sup> fails entirely to mention him. Kobell<sup>4</sup> mentions him only for his work on phosphorescence.

As previously stated he is mentioned by several historians of physics. So far as the writer is aware only one of these, Edmund Hoppe,<sup>5</sup> refers to du Fay's work on the optics of crystals.

<sup>3</sup> P. Groth, *Entwicklungsgeschichte der Mineralogischen Wissenschaften, Berlin, 1926.*

<sup>4</sup> F. von Kobell, *Geschichte der Mineralogie, pages 32 and 70, Munich, 1864.*

<sup>5</sup> Edmund Hoppe, *Geschichte der Physik. p. 260. Braunschweig, 1926.*

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Professor Edward H. Karus, Director of the Mineralogical Laboratory at the University of Michigan, was elected an honorary member of the German Mineralogical Society at a meeting held at Frankfurt on Sept. 23.

Dr. Frederick Henry Hatch, a past president of the British Institution of Mining and Metallurgy and a member of the governing body of the Imperial Institute, died on Sept. 22, at the age of sixty-eight years.

Professor Ulysses Sherman Grant, Head of the department of Geology and Geography of Northwestern University, died at the age of sixty-five on Sept. 21, after a short illness and operation.

Adolph Lomb, vice-president of the Bausch & Lomb Optical Co., died at his home in Pittsford, N. Y., a suburb of Rochester, on Sept. 30th, after a brief illness. He was sixty-six years old.

The death was announced of Dr. Adolf Sauer, professor of mineralogy and geology at the University of Stuttgart, also of Dr. Otto Mügge, professor of mineralogy at Göttingen.

Dr. George I. Adams, head of the department of geology in the University of Alabama, died on September 8 at the age of sixty-one years.

Dr. Adam C. Gill, Emeritus Professor of Mineralogy and petrography at Cornell University, where he had served since 1894, died on Nov. 8, at Ithaca, New York, at the age of sixty-nine years.

Attention is called to the Thirteenth Annual Meeting of The Mineralogical Society of America to be held at Harvard University, December 28-30, 1932, and to the *preliminary* list of titles of papers to be presented at this meeting, printed in this issue.