

## RADIATION CHEMISTRY AT THE UNIVERSITY OF NOTRE DAME, INDIANA

ALTHOUGH, as Allsopp<sup>1</sup> has recently indicated, a radiation chemistry is in reality an old subject, it has received its major impetus during the Second World War. Problems of the production of atomic energy and atomic power require information on the effects of high-energy radiation on structural materials, coolants, moderators and chemicals and containers used in separation processes, as well as on the chemistry of nuclear recoils produced in the processes of radioactive decay or in processes for the separation of radioactive nuclides. Technological aspects of these problems have been handled primarily in the National Laboratories in the United States (Argonne, Oak Ridge and Brookhaven) and at the Chalk River Atomic Energy Establishment, Canada, and also at Harwell, England.

Significantly, academic institutions have confined their attention to non-secret, 'unclassified' fundamental investigations. Such a group is working with Dr. F. S. Dainton at Cambridge. Groups working in the United States include those at the Massachusetts Institute of Technology and Syracuse University. A group at the University of Notre Dame is a direct outgrowth of the activities of the Plutonium Project. That group has attempted to stimulate research in radiation chemistry in a variety of ways: by symposia, by research and by training of new personnel.

The seriousness with which radiation chemistry is considered in the United States is again emphasized by the announcement that the Radiation Chemistry Project at the University of Notre Dame will henceforth be operated under contract from the Atomic Energy Commission. With the stimulation and support of the Commission, Notre Dame will be the first academic institution to install a Van de Graaff generator exclusively for studies in radiation chemistry and allied fields (for example, radiobiology). This generator will be housed in a new building to be added to the present chemistry building. Included in the new structure will be a radio-cobalt source room. Construction was to begin by October 1, 1949, and it is expected that the entire new installation will be in operation by May 1, 1950.

The staff of the Radiation Chemistry Project includes Prof. Milton Burton (director) and Andrew J. Boyle (administrative director), Associate Prof. William H. Hamill and John L. Magee, and Assistant Prof. Russell R. Williams, jun. Also on the staff are approximately fifteen graduate fellows and technicians. The number of the latter is not fixed, and it is expected that the increased funds available will lead to substantial increases in the staff.

Among the fields at present under investigation are the effects of high-energy radiation on ionic crystals and on organic compounds and solutions, 'hot-atom' chemistry, radiation chemical monitoring, theory of elementary physical processes, chemical behaviour of excited molecules and ions, stability of metastable ions, etc. Only non-secret work will be done under the auspices of the Atomic Energy Commission.

Prof. Burton will continue to direct systematic investigations in the radiation chemistry of organic compounds, ionic solids, and aqueous solutions, and will collaborate with Prof. Magee, who will direct research on theoretical problems. Prof. Hamill will

direct work which emphasizes employment of radioisotopes in radiation chemistry, while Prof. Williams will direct studies primarily in 'hot-atom' chemistry and the behaviour of energetic radicals as well as continue work in pedagogic aspects of nuclear chemistry.

An interesting aspect of the work of the Radiation Chemistry Project at Notre Dame is the emphasis which is placed on employment of the mass spectrometer, radioisotopes, and special arrangements of the glow-discharge in the elucidation of elementary processes.

<sup>1</sup> *Brit. J. Radiology*, **22**, 183 (1949).

## ELECTRON DEFECT CENTRES IN ALKALI HALIDES

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THE absorption curves of crystals of sodium and potassium chloride coloured by X-rays obtained by Molnar<sup>1</sup> have shown a rise in absorption towards the ultra-violet edge (2,300 Å.) of his spectral range. We have made measurements of this *V*-band<sup>2</sup> extending down to 2,000 Å. which have established that it is an essential feature of all photochemically coloured alkali halide crystals wholly complementary to the *F*-band in the visible spectrum. The *V*-band in the chlorides follows very closely the theoretical absorption curve of a single classical oscillator (Fig. 1). In potassium bromide it has two components, the relative intensity of which depends on the intensity of coloration (Fig. 2).

The position of the maximum and the half-width of the absorption (shown in the table) are characteristic of the crystals investigated. The results are independent of the state of purity of the crystals (indicated by the value of  $k_0$ ) and of the irradiation conditions (for example, crystals of 10 mm. × 5 mm. × 1 mm., 30–120 min. exposure to filtered X-rays from a crystallographic set, 50 kV., 20 m.amp.,  $\lambda < 0.7$  Å.).

TABLE SHOWING ABSORPTION FOR DIFFERENT ALKALI-HALIDE CRYSTALS COLOURED BY X-RAYS.  $k_0$  IS THE ABSORPTION CONSTANT BEFORE X-IRRADIATION

Source	$k_0$ in cm. <sup>-1</sup>	Maximum of the absorption band		Half-width of band in eV.
		in Å.	in eV.	
KCl (synthetic)	0.51	2 205	5.60	1.39
NaCl (synthetic)	1.30	2 170	5.70	1.03
NaCl (natural)				
No. 1	3.61	2,170	5.70	1.03
No. 2	3.27	2,180	5.67	1.03
KBr (synthetic)	2.08	2,320	5.32	0.83
		2,580	4.77	0.86

Experiments on the properties of X-ray coloured crystals, chiefly potassium chloride, associated with the *V*-band have yielded the following results.

*Ageing Process.* The *V*-absorption continues to grow after the end of X-ray exposure and, at room temperature, reaches a final steady value only after an ageing period of about twenty hours. The increase