made through D.C. silicone fluid 200. The energy-resolution was tested by passing mono-energetic electrons into the crystal along its axis. Fig. 1 shows the photomultiplier pulse-height spectrum for an incident energy of 140 MeV. The resolution is about 40 per cent. The mean pulse-height corresponds to approximately 44 photoelectrons from the multiplier cathode, that is, about 0·3 electron per MeV. The poor resolution is thought to be due to the variation in the fraction of the incident energy trapped in the crystal; this variation can only be reduced by increasing the size of the crystal. The mean pulse-height almost corresponds to that predicted.

This behaviour can be compared with that of a similar instrument built by Cassels[2]. His absorber was a glass cylinder, 20 cm. long and 12·5 cm. diameter (8 and 5 radiation-lengths respectively). This instrument measured the energy of 125-MeV. electrons with about 30 per cent resolution and gave pulses corresponding to 0·7 photoelectron per MeV. This superiority is expected, as a glass absorber of comparable dimensions to a lead fluoride absorber will give a greater Čerenkov light output due to the longer total electron-path at the same energy. However, light collection is more difficult.

These results indicate that in the range 50–300 MeV. lead glass is the better absorber, since the size required is still manageable. A lead fluoride absorber has, however, only one-third the linear dimensions of the equivalent glass absorber ; therefore, at energies where the lead glass required is too large, lead fluoride will be more convenient. The resolution should improve as the energy increases.

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Ionization Potentials of Hydrogen Fluoride and the Ground-State of the HF+ Ion

Johns and Barrow[1] have recently reported the results of their ultra-violet spectroscopic studies of the DF+ and HF+ molecular ions. They concluded that the observed bands were due to transitions between a lower A-state and an upper B-state. The A-state was regarded as being the $A\,^2\Sigma^+$-state arising from the combination $H^+ + F(^2P)$. Johns and Barrow state that if $A\,^2\Sigma^+$ is the ground-state of the HF+ ion, then the ionization potential of HF would be 16·88 eV.

The ground-states of the HCl+ and HBr+ molecular ions are $^2\Pi_i$-states arising from the combination $H + X^+(^3P)$. This $^2\Pi_i$-state could, of course, be the ground-state of HF+.

Recently, we determined the ionization potentials of HF, using essentially mono-energetic electrons[2], and found that the first ionization potential was 15·77 eV. and that there is another ionization potential at about 1·2 eV. above this due to the formation of the HF+ ion in its first excited state. A detailed consideration of the electronic structure of the HF molecule led us to conclude that the ionization potential at 15·77 eV. refers to the formation of the HF+ ion in its $^2\Pi_i$-state, and the second ionization potential refers to the formation of HF+ ion in its first excited $A\,^2\Sigma^+$-state. Bands due to the transitions $A\,^2\Sigma^+ - \,^2\Pi_i$ and $B\,^2\Sigma^+ - \,^2\Pi_i$ are therefore still to be found for the HF+ ion. Our results indicate that the former bands should be found in the near infra-red.

A detailed discussion of these matters is contained in a paper presented at the annual conference of the Chemical Institute of Canada held in Vancouver, B.C., June 3–5, 1957.

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IT is very satisfactory that evidence for the $^2\Pi_i$-state of HF+, which proves to be the ground-state, has now been obtained, and the agreement between the electron impact value of the ionization potential to $A\,^2\Sigma^+$, 15·77 + 1·2 = 16·9₇ eV., and the spectroscopic and thermochemical value, 16·88 eV., is very good. Comparison with HCl and HBr suggests that ω_e'' and r_e'' for HF+ should have values similar to those for the ground-state of the neutral molecule. The relative dispositions of the potential curves (Fig. 1) are such that the transition B–X

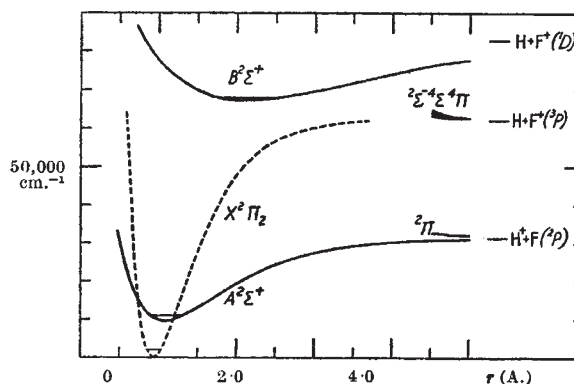Fig. 1. Morse potential energy – internuclear distance curves for electronic states of HF+

in the ultra-violet region must be weak : however, it seems likely that the A–X transition should be observable. The 0,0 band should lie at about 11,200 A., and the 1,0 band at about 8500 A.

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