ionospheric data which have been freely used in this work are supplied by the Central Radio Propagation Laboratory of the National Bureau of Standards, Washington, which subsidizes the Ionosphere Laboratory here in co-operation with the National Wuhan University.

P. H. LIANG

Ionosphere Laboratory,
National Wuhan University,
Wuchang, Hupeh, China.
August 14.

[1] Appleton, E. V., *Nature*, 157, 691 (1946).
[2] Mitra, S. K., *Nature*, 158, 668 (1946).
[3] Obtained from Fig. 8, p. 12, "Terrestrial Magnetism and Electricity", edited by J. A. Fleming.

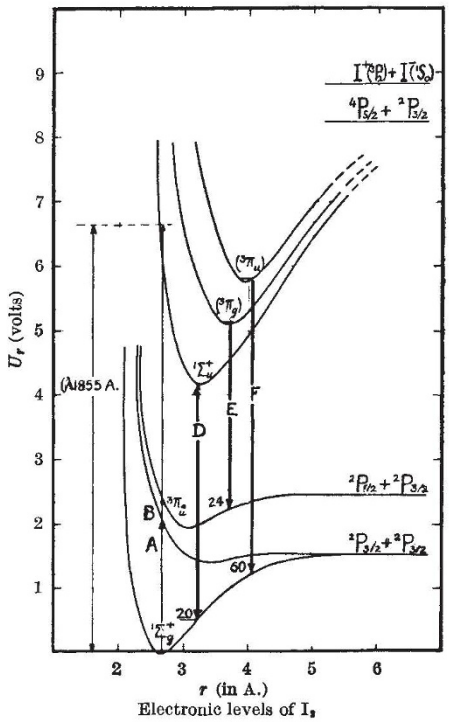
I AGREE with Prof. Liang about the desirability of plotting F_2-layer critical frequencies with magnetic latitude rather than with magnetic dip. In an article in *Science*, p. 17, July 4, 1947, I have given such a plot, which, for noon values of equinox critical frequency, shows two sharp maxima at ± 18° magnetic latitude. The high midnight values of F_2-layer critical frequency at stations on the geomagnetic equator are also attributed to the low electron recombination which is associated with the marked bifurcation of the F-layer into the F_1 and F_2 strata.

E. V. APPLETON

Emission Spectrum of Iodine Molecules in the Presence of an Inert Gas

THE emission spectrum of iodine (I_2) between 5000 and 2500 A. consists of a large number of diffuse bands (McLennan bands) and, especially in the presence of *small* amounts of an inert gas, of some apparently structureless continua[1] at 4800, 4300 and 3420 A. However, as has been shown, particularly by Elliott[2], the spectrum has quite a different appearance if excited in fluorescence by the Al spark lines at 1855–1863 A. in the presence of *large* amounts of nitrogen. The McLennan bands disappear almost entirely, the continua change into well-developed band systems at 4630–4440, 4321–4041(E) and 3450–3040 A.(D), and another well-developed band system appears at 2730–2520 A.(F). From a vibrational analysis of system D, Elliott was able to confirm an earlier interpretation of this system as an electronic transition from an upper state $^1\Sigma_u^+$ to the ground state $^1\Sigma_g^+$ of I_2 (with vibrational quantum numbers $v'' = 13$–29). He also set up a formula for system F, but his v''-assignment is uncertain, and indeed entirely incorrect according to our analysis. He was unable to interpret the other two systems.

We succeeded in obtaining the emission spectrum of iodine vapour in the presence of several hundred millimetres of argon by a high-frequency discharge. The spectrum was photographed with prism spectrographs of high dispersion and proved to be very similar to the fluorescence spectrum of Elliott. The main differences consist in the absence of the bands (degraded towards the violet) at 4630–4440 A., which, therefore, might belong to the molecule IN, and the appearance of three small continua or band systems at 2880, 2820 and 2770 A. not present in Elliott's fluorescence spectrum (but present in the spectrum excited by active nitrogen[2]). Our present investigation is concerned only with the well-developed band systems F and E. The vibration analysis of these systems strongly suggests the interpretation sketched in the accompanying figure. This assignment of electronic levels is supported by energy considerations based on the fact that the systems considered may be obtained in fluorescence by light of λ 1855 A.



Electronic levels of I_2

The observed band heads, with very few exceptions, are represented, with an average error of about ± 2 cm.$^{-1}$, by the following formulæ :

System F : 2720–2533 A. bands degraded towards the red
$$\nu = 46440{\cdot}7 + (96{\cdot}21\ v' - 0{\cdot}49\ v'^2) - (213{\cdot}77\ v'' - 0{\cdot}599\ v''^2 - 0{\cdot}00367\ v''^3)$$
with $v' = 0$–5, $v'' = 40$–62, intensity maximum at $\sim v'$, $v'' = 3{,}60$.

System E : 4327–4039 A. bands degraded towards the red
$$\nu = 25757{\cdot}2 + (101{\cdot}88\ v' - 0{\cdot}34\ v'^2) - (126{\cdot}59\ v'' - 0{\cdot}755\ v''^2 - 0{\cdot}0033\ v''^3)$$
with $v' = 0$–8, $v'' = 13$–32, intensity maximum at $\sim v'$, $v'' = 1{,}24$.

Our formula for the ground-state of I_2 involved in system F is valid for high values of v'' only (say, $v'' > 30$) and converges, as expected, more strongly than the formula $\nu_{(v'')} = 213{\cdot}76\ v'' - 0{\cdot}596\ v''^2 - 0{\cdot}0021\ v''^3$ given by Loomis[3], following Mecke, for small values of v'' (0–20). The formula used for the lower state of system E is the one given by Loomis for the upper state $^3\Pi_0$ ($= O_u^+$) of the visible bands of I_2. The frequency difference of 5085 cm.$^{-1}$ between the upper electronic states of systems E and F suggests the tentative identification of these states with the terms $^3\Pi_g$ and $^3\Pi_u$ discussed by Mulliken[4].

All three band systems D, E and F are degraded toward the red and have their intensity maxima near the long wave-length end. This situation usually occurs if the atomic distance r' of the upper state is much larger than the distance r'' of the lower state, that is, if the upper potential curve has ionic character as discussed by Mulliken[4]. These states do not necessarily dissociate into the ions $I^+ + I^-$ but more probably into the lower lying state $I(^4P_{5/2}) + I(^2P_{3/2})$. It is of interest that ion-like spectra of this type occur also for the molecules HgX, CdX and ZnX [5], where X = Cl, Br, I.