

Furthermore, taking into account an external electromagnetic field by substituting, as usual,

$$P_v = p_v - \frac{e}{c} A_v \text{ in place of } p_v \left( \equiv \frac{\hbar}{i} \partial_v \right),$$

one obtains a magnetic moment of the value  $e\hbar/2mc$ , that is, of one Bohr magneton. No electric moment appears, in contrast to the case of the Dirac equation; more precisely, the only eigenvalues of an electric moment are zero.

Finally, it may be mentioned that the Hamiltonian form of equation (1) can be obtained only by an artifice similar to that which Kemmer used<sup>2</sup>. Further, by aid of the proper Hamiltonian one can show that the eigenvalues of the velocity operator

$$\dot{x}_i = \frac{i}{\hbar} [H, x_i]$$

may have any real value. So the well-known difficulty appearing in the Dirac equation does not appear in the non-relativistic case.

Further investigations concerning the connexion of spin and wave function and the structure of the wave equation in the case of different particles are in progress.

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<sup>1</sup>van der Waerden, "Mod. Alg.", 2 (Springer, 1937).

<sup>2</sup>Kemmer, *Proc. Roy. Soc., A*, 173, 91 (1939).

### Spectrum of Doubly Ionized Iodine

THE spectrum of iodine excited to various stages of ionization by condensed discharges in capillary tubes of different cross-sections has been photographed by Littrow spectrographs in the visible and quartz regions. The use of a series inductance and spark gaps of different lengths helped in the selection of lines due to the doubly ionized atom of iodine. These results, supplemented by those of Blochs and Felici<sup>1</sup> in the far ultra-violet, facilitated the analysis of the main features of the structure of iodine III.

The important intervals  $6s(4P_{3/2} - 4P_{1/2})$ ,  $6s(2P_{3/2} - 2P_{1/2})$ , and  $6s(2D_{3/2} - 2D_{1/2})$  were found to be 6,313, 11,254 and -1,609 wave-numbers, respectively. About seven of the  $6p$ -levels, and six of the  $md$ -levels, have also been obtained. The calculation from the two members 130,615  $\nu$  and 19,306.7  $\nu$  of the  $mp4S$  series identified in the present work leads to a value of 32.6 volts for the second ionization potential of iodine.

The normal Russel-Saunders coupling which is disobeyed in the  $6s4P$ -intervals of the isoelectronic spectra of Sb I<sup>2</sup> and Te II<sup>3</sup> appears to be obeyed in this spectrum. However, Zeeman effect confirmation of the  $6p$ -term combinations with the  $6s4P_{21/2}$  level is being sought by further experiments.

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<sup>1</sup>*J. Phys. et le Rad.*, 8, 355 (1937).

<sup>2</sup>Bacher and Goudsmit, "Atomic Energy States", 408.

<sup>3</sup>*Ind. J. Phys.*, 14, 423 (1940).

### Isolation of a Pectic Substance from Passion Fruit (*Passiflora edulis*)

AN investigation was undertaken of the constituents of the skins of passion fruit (*Passiflora edulis*), the raw material being available from a processing factory in Sydney.

The ripe skins, from which the pulp had been removed by scooping, swell very much on heating with water and give a viscous extract. Extraction with water alone produces a liquid which can be freed from suspended matter only with great difficulty and considerable losses of material. Dilute acid, for example, 0.5 per cent citric acid, as recommended in the literature<sup>1</sup>, and applied in the industrial practice of pectin manufacture, results in an extract which is readily handled from a colloidal point of view. Precipitation with alcohol or acetone gave a jelly-like product which on drying produced an amorphous substance. This material behaved like a pectin; it is a high-molecular substance and forms a jelly with sugar and acid; alkaline hydrolysis gave methyl alcohol and a high molecular acid. Its homogeneity was shown by the results of fractional precipitation with alcohol.

Final concentration of alcohol (%)	Uronic anhydride (%)	Equivalent weight
73	90.4	891
63	89.5	912
55	90.0	834
47	87.2	900

Another preparation was tested for homogeneity by repeated extraction with 70 per cent alcohol (boiling), when 28 per cent of substance dissolved; all extracts gave strong positive tests for uronic acid, indicating that the process not only removed a non-acidic, non-pectic 'balast' polysaccharide. The contents of the product before and after the extraction are:

Uronic anhydride (%)	Equivalent weight before saponification	Equivalent weight after	OME	$[\alpha]_D$
Before extraction	82.4	1198	251	9.75 +208°
After extraction	84.4	1515	276	9.6 +272°

It therefore appears as if this operation essentially removes the lower molecular portion of the material and not 'balast'.

The material is rather resistant to hydrolysis, for after two hours heating in a water bath with 5N sulphuric acid it is not completely broken down to monomeric sugars. Complete hydrolysis was easily effected enzymatically with 'Pectinol 100D' (Rhöm and Haas, Philadelphia, U.S.A.<sup>2</sup>), and the following constituents were isolated and identified: *d*-galacturonic acid,  $[\alpha]_D + 49.7^\circ$ , *l*-arabinose as the diphenyl-hydrazone and *l*-sorbose as the phenyl-osazone. This pectic substance is therefore unlike any previously described, as it contains no galactose<sup>3</sup> but does contain *l*-sorbose, which is a novel constituent for this class of substance.

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<sup>1</sup>Wilson, P. P., *Indust. Eng. Chem.*, 17, 1065 (1925). Rooker, W. A., "Fruit Pectin" (Avi, New York). Nelson, E. K., and Mottorn, H. H., *Fruit Prod. J.*, 10, 138 (1931). Meyers, B. B., and Baker, G. L., Delaware Agric. Expt. Sta. Bull. Nos. 160 and 168.

<sup>2</sup>Meyers, B. B., and Baker, G. L., Delaware Agric. Expt. Sta. Bull. No. 168.

<sup>3</sup>Joslyn, M. A., and Phaff, Wallerstein Lab. Com., 10, No. 29 (April 1947).