

cases it needs refinements. The lack of satisfactory agreement between the theory and experiment for the bromo and iodo complexes may be due to the fact that the model underlying the theory neglects bonding effects; in the halopentammine series where the ionic character of the cobalt halogen-bond decreases from F to I, the discrepancy between the theory and experiment also increases progressively in the series.

Our results also show that the thiocyanato and the isocyanato complexes can be clearly identified with the help of n.m.r. There is a chemical shift of about 5.6 gauss (at 10 K. gauss) between these two isomers. The thiocyanato complex gave two lines; the intensity of one was more than the other. The weaker line was identified to be due to the isocyanato isomer from its position, which corresponded exactly with that of the line observed in a separate experiment for the pure isocyanato complex. It is evident that the thiocyanato complex prepared by conventional method has an impurity of the isocyanato isomer. The absorption maxima corresponding to $d-d$ transition for the two isomers lie very close to each other ($510\text{ m}\mu$, $\epsilon_{\text{max.}} = 25.8$ for thiocyanato compound and $504\text{ m}\mu$, $\epsilon_{\text{max.}} = 51.2$ for the other isomer). It is therefore difficult to distinguish between these isomers from merely their absorption spectra in the visible region.

The authors are thankful to Shri M. A. Pujar, Karnatak University, Dharwar, for preparation of these complexes and Shri V. R. Marathe for running the n.m.r. spectra.

Tata Institute of Fundamental Research, Bombay-5. C. R. KANEKAR.

and

Department of Inorganic Chemistry, Karnatak University, Dharwar. N. S. BIRADAR.
November 10, 1965.

1. Proctor, W. G., and Yu, F. C., *Phys. Rev.*, 1951, **81**, 20.
2. Freeman, Murray and Richards, *Proc. Roy. Soc. London*, 1957, **242 A**, 455.
3. Dharmatti, Kanekar and Mathur, *Symposium on Co-ordination Compounds, National Academy of Sciences, (India), Agra*, 1959; N.A.S.I. Publication, 1960, Part II, p. 157.
4. — and —, *J. Chem. Phys.*, 1959, **31**, No. 1436-37.
5. Griffith, J. S. and Orgel, L. E., *Trans. Farad. Soc.*, 1957, **53**, 601.

ON LOW-LYING EVEN-PARITY LEVELS OF ${}^2F^{18}$ NUCLEUS

CALCULATIONS¹ for the nuclei with $A = 18$ have been made on the basis of the intermediate-coupling individual particle model with a modified Gaussian potential and with both Serber and Rosenfeld exchange forces. These nuclei are treated as an even-even core, $A = 16$ nucleus plus two nucleons in $1d$ and $2s$ harmonic oscillator orbitals.

The two-nucleon interaction energy matrices for the ten different states $(JT) = (10), (30), (40), (50), (11), (21), (31), (41), (01), (20)$, are constructed and diagonalized following the method of Redlich² and Elliot and Flowers³ with the two-nucleon interaction $V(r) = (V_0 e^{-r^2/r_0^2}) / (r/r_0)$ where² $V_0 = -70.8$ MeV and $r_0 = 1.498 \times 10^{-13}$ cm. This potential is intermediary⁴ to the usual Yukawa and Gaussian potentials and, in conjunction with the Serber force, explains⁵ the ground state binding energies of a large number of nuclei.

TABLE I

Calculated energy level orders of F^{18} nucleus

State (JT)	Energy (in MeV) with Serber Exchange force	State (JT)	Energy (in MeV) with Rosenfeld Exchange force
$(10)_a$	0	$(10)_a$	0
$(30)_a$	3.093	$(30)_a$	5.433
$(50)_a$	3.662	$(50)_a$	6.800
$(10)_b$	5.158	$(10)_b$	8.445
$(20)_a$	5.537	$(20)_a$	9.113
$(30)_b$	6.635	$(10)_c$	10.50
$(10)_c$	7.396	$(30)_b$	10.89
$(40)_a$	8.705	$(40)_a$	11.88
$(20)_b$	9.549	$(20)_b$	14.24

The suffixes a, b and c of the state (JT) indicate the levels in increasing order, a being the lowest.

The first few predicted energy levels ($T = 0$) for F^{18} nucleus with both the Serber and Rosenfeld forces are given in Table I. Here the lowest $J = 1$ and $T = 0$ energy is treated as the observed ground state of the F^{18} nucleus and the remaining levels are calculated relative to this energy. The relative positions of the energy levels with $T = 1$ with respect to those with $T = 0$ as well as the level spacings within the $T = 1$ group are found to be highly sensitive to the assumed exchange character. A study and comparison of these levels with the observed levels (with $T = 1$) in O^{18} nucleus will be reported later.

A comparison of the predicted energy spacings with those experimentally observed indicates that the predicted energy spacings are large. The estimated energy spacings are enhanced even

more with a Rosenfeld exchange character than with the Serber force. The comparison is represented diagrammatically in Fig. 1 adopting the

on the Serber force. But the possibility that 2.53 MeV level can have 3^+ is not supported by the measurements made at Oxford by Poletti

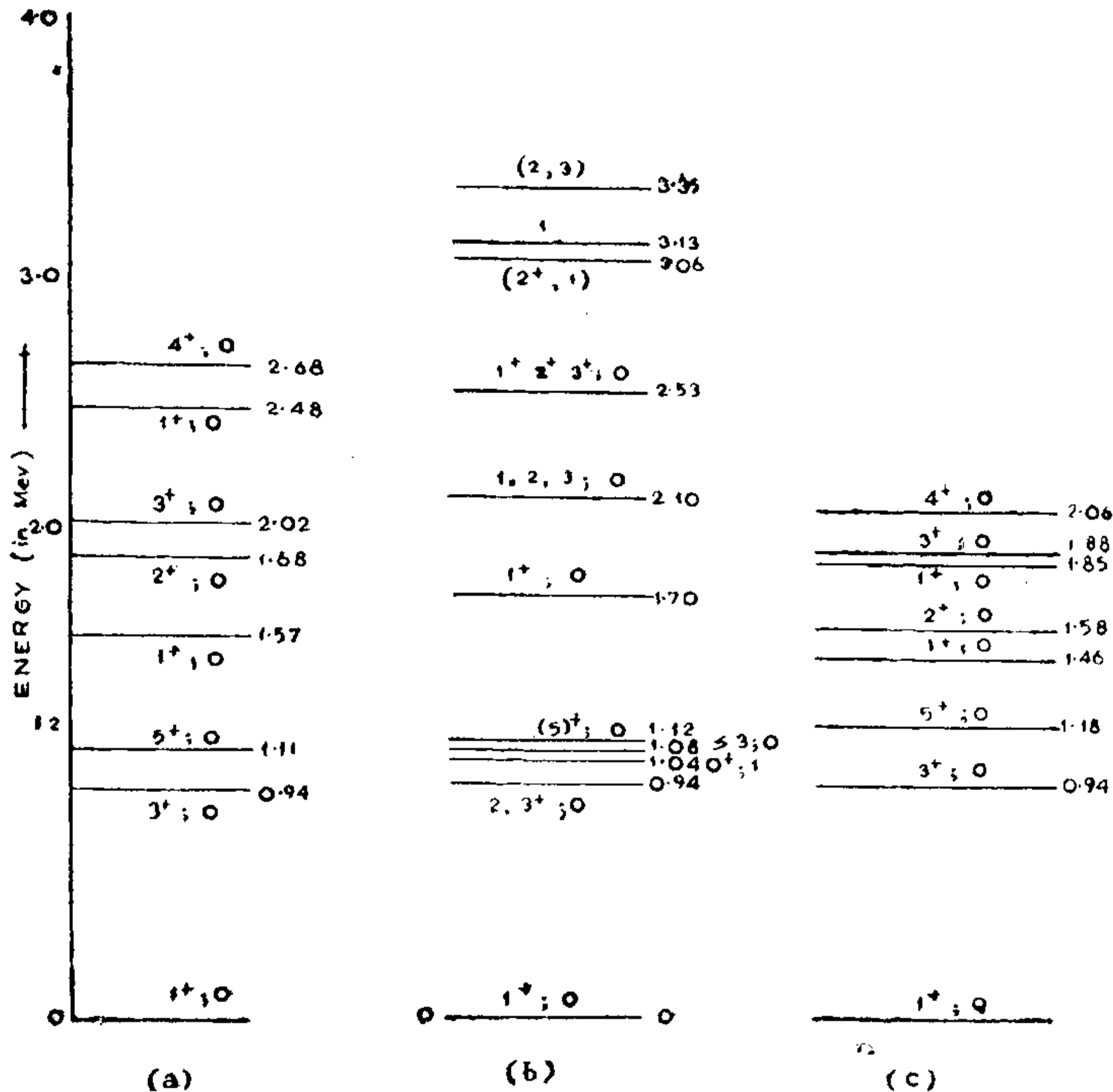


FIG. 1. Comparison of the predicted and experimentally observed low-lying levels of F^{18} . The spin, parity and isotopic spin are indicated by J^{π}, T on each level. (a) The theoretical level scheme with Serber exchange force. (b) Experimental level scheme. (c) Predicted energy level scheme with Rosenfeld exchange character.

multiplication factors 0.310 and 0.173 in order to bring the theoretical $(30)_a$ level in correspondence with the 0.94 MeV level. The next two predicted levels $(50)_a$ and $(10)_b$ may be identified with 1.12 MeV and 1.70 MeV levels based on the spin order arrangements. The 1.04 and 1.08 MeV levels need not be considered here as they are found to have $T=1$ and an odd parity respectively. Both the Serber and Rosenfeld exchange forces are consistent with the assignment of the four levels— F^{18} ground state, 0.94 MeV, 1.12 MeV and 1.70 MeV as having the spins and iso-spins $(10)_a, (30)_a, (50)_a$ and $(10)_b$ respectively.

Kuehner *et al.*⁷ have identified the 2.10 and 2.53 MeV levels on the basis of Redlich's calculations with $(20)_a$ and $(30)_a$ levels. This is in conformity with the present results based

and Warburton.⁶ The present calculations indicate that $(20)_a$ level must be below $(30)_a$, irrespective of the exchange character assumed. An experimental confirmation whether 2.53 or 3.35 MeV level can be the 3^+ would be helpful.

Another interesting result of the present calculation is the inversion of the $(30)_a$ and $(10)_b$ levels when we change from the Serber to Rosenfeld force. Both these levels however continue to be situated in between the $(20)_a$ and $(40)_a$ levels independent of the assumed exchange character. This inversion is not observed in earlier theoretical investigations.⁸ An experimental identification of the $(40)_a$ and $(20)_b$ levels together with the fact that the next shell model state, immediately below the $(40)_a$ state has either 1^- or 3^- would help to decide upon the probable exchange character of

the central interaction just based on the spin orders.

The author wishes to express his thanks to Dr. (Mrs.) C. Santhamma for her guidance and to the C.S.I.R. for the award of a fellowship. He is grateful to Prof. K. R. Rao for his interest and encouragement.

Andhra University, K. L. NARAYANA,
Waltair, November 11, 1965.

1. Narayana, K. L., *Ph.D. Thesis*, Andhra University, Waltair (Unpublished), 1964.
2. Redlich, M. G., *Phys. Rev.*, 1958, **110**, 468; *Ibid.*, 1955, **99**, 1427; *Ibid.*, 1954, **95**, 448.
3. Elliot, J. P. and Flowers, B. H., *Proc. Roy. Soc. (Lond.)*, 1955, **229 A**, 536.
4. Sasaki, K., *Prog. Theor. Phys. (Japan)*, 1963, **22**, 383.
5. Thieberger, R., *Phys. Rev.*, 1959, **116**, 713.
6. Poletti, A. R. and Warburton, E. K., *Ibid.*, 1965, **137 B**, 595; *Nuclear Data Sheets*, compiled by K. Way *et al.*, National Academy of Sciences, National Research Council, Washington, 25, D. C.
7. Kuehner, J. A., Almqvist, E. and Bromley, D. A., *Phys. Rev.*, 1961, **122**, 908.
8. Flowers, B. H. and Wilmore, D., *Proc. Phys. Soc.*, 1964, **83**, 683.

ACTION OF PERIODATE ON FLAVANDIOLS

THE use of periodic acid as a glycol-splitting agent is well known.¹ This has been made use of in the structural studies of flavan-3, 4-diols. Earlier oxidation studies have been carried out with naturally occurring leucoanthocyanidins. The periodic acid consumption of leucocyanidin has been quantitatively estimated.² It consumes 2 moles accounting for the glycol and catechol units. However, for the isolation of the oxidation products the methylethers are more convenient. King and Bottomley³ isolated 2-hydroxy, 3, 4-dimethoxy benzaldehyde as its semicarbazone by the oxidation of melacacidin methyl ether with periodic acid. Veratraldehyde and phloroglucinaldehyde dimethyl ether were isolated⁴ when leucocyanidin methyl ether was treated with an aqueous solution of periodic acid (50%) for 24 hr. at room temperature. The following mechanism has been suggested.

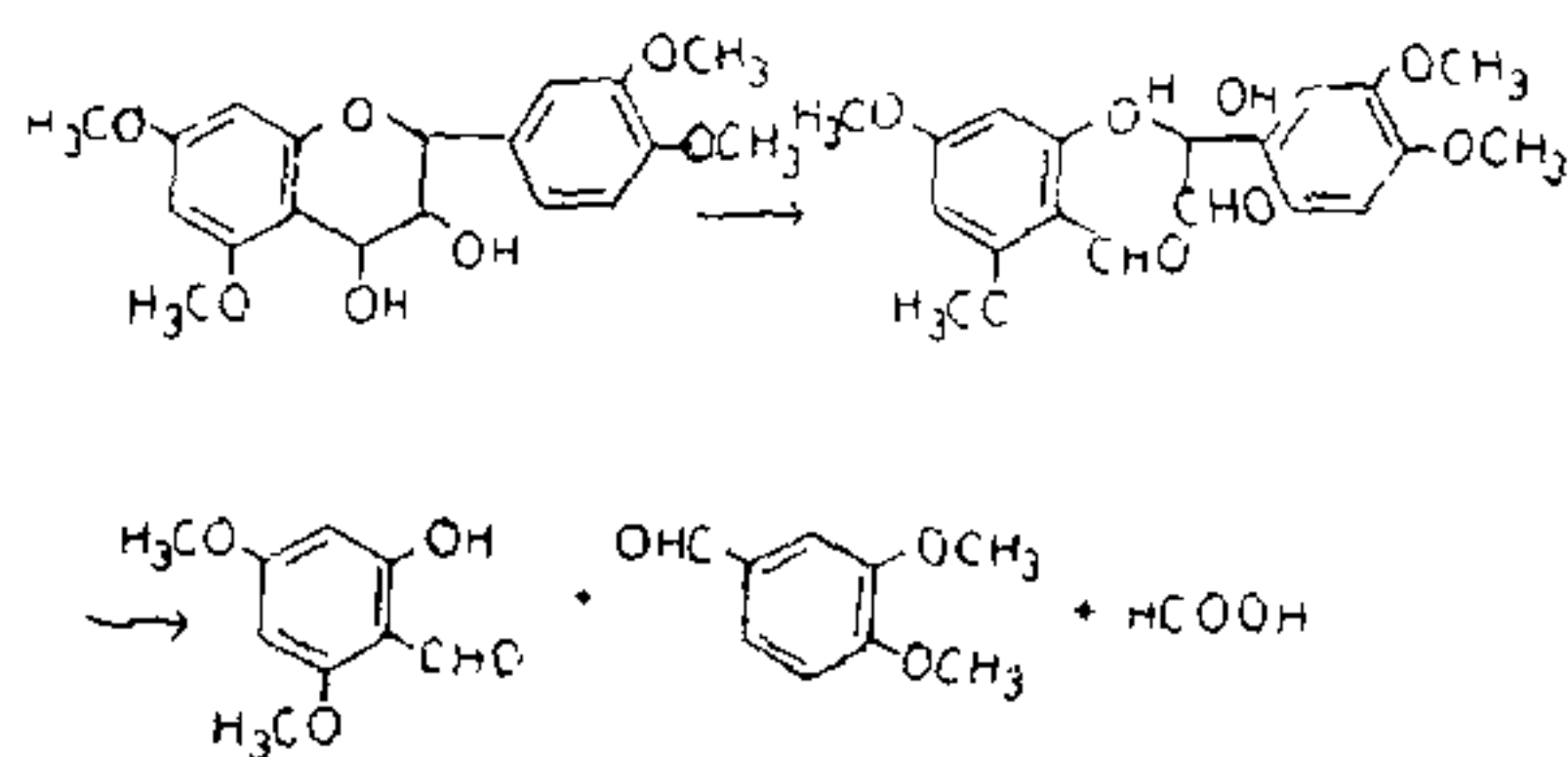


CHART. I

More recently periodic acid has been used in determining the configurations of leucoanthocyanidins.⁵ When the methyl ethers are employed, the *cis* diol consumes 1 mole of periodic acid in about 7 min. whereas the *trans* is much slower and takes 40 minutes.

There has been so far no definite criterion for the determination of the molecular size of leucoanthocyanidins as monomer, dimer, trimer or polymer. The method of using solubility in different solvents like ethylacetate has limited application and is not definite. On the basis that the 4-hydroxyl is involved in linking up with another polyphenol molecule and is thus locked up, it is possible to assay the end group by periodic acid titration. This is feasible only when the end group is a diol. If other polyphenols like catechins are involved then there will be no consumption of periodic acid. The method has quantitative application only in the case of homogeneous polymers. For determination of the constitution of new leucoanthocyanidin the fission method will be useful if both parts of the molecule could be obtained as recognisable units.

For purposes of standardisation of conditions and understanding the products, a leucoanthocyanidin of known structure was necessary. Therefore the synthetic leucocyanidin methyl ether has now been studied. It has been prepared by the borohydride reduction of taxifolin-5, 7, 3', 4'-tetra-O-methyl ether. Quantitative estimations using an aqueous solution of sodium metaperiodate (pH 6.4) showed that one mole of the synthetic sample consumes 1.1 mole of sodium metaperiodate. Under identical conditions glucose consumes 5.3 moles of periodate. Since the formation of veratraldehyde and phloroglucinaldehyde dimethylether needs the consumption of 2 moles of periodate, it can be concluded that the oxidation with an aqueous solution of sodium metaperiodate stops at the first stage, *i.e.*, with the formation of a dialdehyde. The product is definitely different from veratraldehyde or phloroglucinaldehyde dimethylether. The new aldehyde has been isolated as its oxime since the preparation of a 2, 4-dinitrophenylhydrazone would involve objectionably high acid concentrations. The mass spectrum of the oxime has been studied. The molecular ion peak of the oxime could not be obtained though the spectrum had peaks up to 368. The presence of peaks beyond 200 obviously rules out the simpler aldehydes mentioned above. Significant among the mass peaks is the peak at 353 which can be attributed to $M - (2H_2O + H)$ (II). Nitrogen estimation of the oxime shows it to be a