

CHEMISTRY OF NATURALLY OCCURRING PYRONES

SYMPOSIUM IN DUBLIN

A SYMPOSIUM on recent advances in the "Chemistry of Naturally Occurring Pyrones" was held in the Department of Chemistry, University College, Dublin, during July 12-14. The symposium was organized by the College and the Institute of Chemistry of Ireland to mark the fortieth anniversary of the first paper on flavones published by Prof. Hugh Ryan, who was professor of chemistry in University College during 1899-1931. This branch of chemistry has been systematically studied in Dublin since 1915, and a number of useful syntheses of flavonoids have been devised. The meeting was opened by Prof. T. S. Wheeler on behalf of Dr. Michael Tierney, president of University College, Dublin. Some one hundred and thirty chemists from twelve countries took part in the proceedings.

Prof. W. Cocker (Trinity College, Dublin) was chairman of the first of five half-day sessions. Prof. J. Algar (University College, Dublin) gave a brief account of the researches of Prof. Hugh Ryan. He was followed by Prof. Gertrud Woker (University of Berne), who assessed the pioneering work of Kostanecki in the flavone field.

Prof. T. R. Seshadri (University of Delhi) reported some new results on the occurrence of chalcones and flavanones in plant products. The presence of a 5-hydroxyl group in flavanones makes the structure so stable that the corresponding chalcones do not occur in the plant. This effect is attributable to chelation. Detailed work on the flowers of *Butea frondosa*, on the bark of *Prunus puddum*, and on carthamin, the pigment of the safflower, was described.

Prof. F. E. King (University of Nottingham) discussed the constitution and synthesis of leucoanthocyanidins. The identification of melacacidin (from *Acacia melanoxylon*) as 7:8:3':4'-tetrahydroxyflavan-3:4-diol and the nature of the products obtained from its treatment with hot mineral acid afford conclusive evidence that the flavan-3:4-diol structure is typical of the majority of the ill-defined natural products known collectively as leucoanthocyanidins. The (\pm)-tetramethoxyflavandiols—one of four theoretically possible racemates—which is formed by the catalytic reduction of 7:8:3':4'-tetramethoxyflavonol is believed to be *dl*-O-tetramethylmelacacidin. The probable conformational structure of this product was discussed.

In the second session, over which Dr. V. C. Barry (Medical Research Council of Ireland) presided, Prof. K. Venkataraman (University of Bombay) gave an account of some naturally occurring γ -pyrone derivatives. He discussed the synthesis of muningin (6:4'-dihydroxy-5:7-dimethoxyisoflavone). Pinoquercetin and pinomyricetin, which occur in *Ponderosa* pine bark, have been shown to be, respectively, 6-methylquercetin and 6-methylmyricetin. The structure of a new, yellow, colouring matter (artocarpin) from the heartwood of *Artocarpus integrifolia* and of morellin (from the seeds of *Garcinia morella*) were discussed.

Dr. W. B. Whalley (University of Liverpool) suggested that the abnormal resinification of 2'-methoxyisoflavones when demethylated by hydriodic and hydrobromic acids (Whalley, *J. Amer. Chem. Soc.*, **75**, 1059; 1953; and Baker *et al.*, *J. Chem. Soc.*, 1853; 1953) could be explained by postulating a

rearrangement of 2'-hydroxyisoflavones to the acid-sensitive 2-unsubstituted-3-arylbzofurans, under the influence of the demethylating reagent. A series of such 3-arylbzofurans has now been synthesized and the properties, including various transformation reactions, examined. Several other potential routes to these benzofurans have been explored. It has been found that 2'-hydroxydeoxybenzoin (prepared from isoflavones) undergo spontaneous cyclization to the corresponding 2-arylbzofurans. Cognate reactions were discussed in the light of these and other transformations.

Dr. T. H. Simpson (Torry Research Station, Aberdeen) spoke on the use of isopropyl groups for protection of phenolic hydroxyl groups in the synthesis of flavones by selenium oxidation of the appropriate chalcones. The use of the isopropyl group permits the synthesis of compounds such as acacetin, diosmetin, chrysoeriol, croxylin-A, pectolinarigenin, in excellent yield.

The second morning session (chairman, Prof. P. O'Colla, University College, Galway) was opened by Prof. Wilson Baker (University of Bristol), who outlined recent developments in the synthesis of isoflavones. A method evolved in Bristol in recent years employs the reaction of 2-hydroxydeoxybenzoin with ethoxalyl chloride in pyridine to yield 2-carbethoxyisoflavones. Mild alkaline hydrolysis of these esters, followed by thermal decarboxylation of the resulting acids, gives isoflavones. Good yields are obtained and it is unnecessary to protect hydroxyl groups.

Prof. H. Erdtman (Royal Institute of Technology, Stockholm) described studies on the flavones and flavanones present in the heartwood of conifers, especially the genus *Pinus*. These studies were undertaken as part of a systematic investigation of the conifer group to obtain chemical evidence relating to the phylogeny of the class Coniferae. About 75-80 per cent of the pines have been examined by preparative or chromatographic methods, and ten flavonoids and three stilbenes have been isolated. These compounds have one unsubstituted phenyl nucleus, so that it is possible that these nuclei are ontogenetically identical. The botanical subdivision of the genus *Pinus* into two sections, *Diploxylon* and *Haploxylon*, is favoured by the chemical results. Flavone derivatives have also been isolated from the heartwood of some conifers botanically related to the pines. Together with other chemical evidence, the flavone derivatives provide useful indications of taxonomic relations between various conifers, especially those belonging to the natural order *Pinales*. In other orders other compounds appear to be equally significant as 'taxonomic tracers'. Examples are terpenic and tropolonoid constituents in the natural order *Cupressales*.

Prof. S. Hattori (University of Tokyo) spoke on the seasonal changes of flavone and flavanone glycosides in the leaves and fruits of *Poncerus trifoliata*. The leaves in the middle of May when in full development contain approximately equal quantities of poncirin (7-rhamnoglucoside of 5:7-dihydroxy-4'-methoxyflavanone) and rhoifolin (7-rhamnoglucoside of 5:7:4'-trihydroxyflavone). At the end of the month only a small quantity of poncirin remains. Poncirin predominates in the middle of April when the leaves are just developed from the buds. The percentage of poncirin in the fruits falls during the summer and autumn.

The fourth session, which was held on the morning of July 14, had Dr. R. G. R. Bacon (The Queen's

University, Belfast) as chairman. Prof. H. Schmid (University of Zurich) surveyed the components of *Ammi visnaga*. He discussed the chemistry of visaminol, a chromone present in the plant. The structure of athamantine, which is present in *Athamanta creoselinium* L., and which is related to compounds in *Ammi visnaga*, was described. Prof. Schmid also spoke on other compounds from tropical plants.

Prof. K. Freudenberg (University of Heidelberg) gave an address on catechins and related compounds. The number of known catechins has been enlarged, by syntheses, and by the discovery of new naturally occurring members of the series. The explanation of the sensitivity of catechins towards acids lies in the presence of hydroxyl groups in both the 4'- and 7- positions. The possibility of acid polymerization was discussed, as was the relation of catechins to the phloretannins and to the flavylum salts.

Dr. W. D. Ollis (University of Bristol) described work relating to the synthesis of diploicin. This compound is a member of the group of natural products termed depsidones and, as yet, no synthesis of a member of this group has been reported. Depsidones may be regarded as lactones derived from various 2-carboxy-2'-hydroxydiphenyl ethers, and the dehydration of this acid and related acids was discussed. An interesting feature of these reactions is an effect of hydrogen bonding which promotes intermolecular reaction and inhibits intramolecular reaction. This intermolecular reaction leads to certain macrocyclic compounds the formation of which is facilitated by the presence of rigid assemblies of atoms in the reactant molecules. The synthesis of depsidone and progress towards the synthesis of diploicin were discussed.

Prof. Joseph Algar (University College, Dublin) was chairman of the final session, which was held on the afternoon of July 14. Dr. E. C. Bate-Smith (Low Temperature Laboratory, Cambridge) discussed the chromatographic identification of phenolic constituents of plants and their systematic distribution. Phenolic substances occur in living plant cells almost exclusively in the form of glycosides or esters. As a first step in the recognition of these compounds, it is necessary to ascertain the nature of the phenolic residues. Practically every commonly occurring phenolic residue can be recognized by chromatography employing four or five solvent systems. Using such procedures, a systematic survey is being made of the phenolic constituents of the leaves of vascular plants. Particular phenolic compounds tend to be associated with particular systematic groups, and a number of such associations was discussed.

Dr. R. G. R. Bacon (The Queen's University, Belfast) reported the results of investigations on the Elbs persulphate reaction, which has been widely used in the preparation of hydroxyflavones. He presented data for the process to illustrate the effects of varying the nature and the relative proportions of the reactants. Reaction-rates were discussed and examples were given of the competition which occurs in the reaction between the desired effect, namely, nuclear sulphation, and other modes of oxidation.

Prof. T. S. Wheeler (University College, Dublin) described studies in the synthesis of γ -pyrones. For many years the Auwers method of synthesizing flavonols from aurone dibromides provided the only known example of ring expansion of an aurone to a flavone derivative. Recently two further methods of effecting this ring enlargement have been developed in Dublin. Treatment of certain aurones with

ethanolic potassium cyanide gives the corresponding flavones. Oxidative ring enlargement of aurones to flavonols is obtained with hydrogen peroxide. This latter reaction was independently observed by Prof. T. A. Geissman, of the University of California, Los Angeles. A new synthesis of flavonols involving the action of an aromatic aldehyde on an ω -chloro- o -hydroxyacetophenone was discussed.

At an evening meeting during the symposium, under the chairmanship of Prof. T. Dillon, president of the Institute of Chemistry of Ireland, Dr. W. D. Ollis lectured on the total synthesis of strychnine. He described this recent achievement of the Harvard group, who worked under the direction of Prof. R. B. Woodward, and of which Dr. Ollis was a member. During the symposium receptions were given by Their Excellencies the President of Ireland and Mrs. O'Kelly, and by the President of University College, Dublin, and Mrs. Tierney. A successful symposium dinner was also held.

This symposium was probably the first to be devoted mainly to the chemistry of flavonoids and related compounds. The papers and discussions covered both the chemical and biochemical sections of the subject and showed the increasing interest which since the War has been taken in this field of chemistry. The development of the method of paper chromatography has greatly increased our knowledge of the occurrence of these substances in plants. Apart from their importance as natural products, flavonoids are of therapeutic interest. They are effective in treating capillary fragility and may have value in rheumatic fever and poliomyelitis. They are, of course, no longer used as dyestuffs.

T. S. WHEELER

AMERICAN PHYSICAL SOCIETY AND AMERICAN ASSOCIATION OF PHYSICS TEACHERS ANNUAL MEETINGS

THE 1955 annual meeting of the American Physical Society and the twenty-fourth annual meeting of the American Association of Physics Teachers were held simultaneously in New York City, during January 27-29, but not, as formerly, in the buildings of Columbia University. The various scientific sessions of the Society's meeting were distributed over several centres, including the Hotel New Yorker, the Hotel McAlpin, the Manhattan Center and the Vanderbilt Hall of New York University. Not all of the halls proved adequate; nevertheless the regrettable but inevitable dispersal was not, on the whole, unsatisfactory. The registration for the meetings was 1,987, about 5 per cent less than for the 1954 meetings, but the number of contributed papers presented to the Physical Society was about 10 per cent higher.

At the joint ceremonial session of the two bodies during January 28 in the great theatre of the Manhattan Center, the retiring presidential address of the Physical Society was delivered by Prof. H. A. Bethe (Cornell University), who took as his subject "Pions and Nucleons"; the Oersted Medal of the Association was presented to Prof. V. E. Eaton (Wesleyan University), who responded by discussing physics as an art; and the thirteenth Richtmyer Memorial Lecture was delivered by Prof. E. P. Wigner (Princeton University), who spoke on "The