still in progress and complete results for *B. orientalis* are not yet available, but a few observations which I have made on *Periplaneta americana* show a correlation between dry weight percentage and temperature-preference.

It appears that when the percentage of water has fallen below a certain minimum, the animal seeks a lower temperature than it did previously. Thus, when the animal is kept in air which is not saturated, it loses water at a rate which depends on the drying power of the air. Its percentage of water falls and it then has a lower preferred temperature, with the result that, whether the air is dry or not, it finds itself in air of lower drying power than previously and further loss of water is reduced.

Further work has shown that the food which *Blatta* is given also affects its temperature-preference, and in particular a diet of nothing but sugar solution has a marked effect. A full description of my experiments will be published shortly.

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[1] *Zeit. für vergl. Physiol.*, vol. 13, p. 740; 1931.

## The Pyranoid Structure of Glucuronic Acid and of Theophylline Arabinoside.

IN the course of an investigation of the structure of glucuronic acid, we have obtained results which clearly prove that this acid, like the related hexose *d*-glucose, possesses a pyranoid structure. Our starting material was bornyl-*d*-glucuronide (borneol glucuronic acid) isolated as the zinc salt from the urine of humans and dogs receiving small doses of borneol.

Bornyl-*d*-glucuronide has been methylated and the resulting methyl ester of trimethyl bornyl-*d*-glucuronide, which was obtained crystalline, has been converted to the methyl ester of trimethyl methyl-*d*-glucuronide by the use of 1 per cent sulphuric acid in methyl alcohol at 100°. The fully methylated glucuronide, obtained as a liquid mixture of the α- and β-isomerides, has been oxidised with nitric acid ($d = 1{\cdot}42$), using the method first described by Hirst and Purves.[1] The product consisted of a mixture of *d*-dimethoxysuccinic acid and *i*-*xylo*-trimethoxyglutaric acid. These were purified by distillation as the esters and identified as the crystalline diamides. The final result is therefore similar to that obtained by Hirst [2] in his study of the structure of the normal derivatives of glucose, and a similar conclusion may be drawn in the present case, namely, that the glucuronic acid residue in bornyl glucuronide possesses a ring structure of the pyranoid type.

Challinor, Haworth, and Hirst,[3] from a comparison of the rates of hydrolysis of trimethyl-β-methyl glucuronide and β-methyl glucopyranoside, have deduced a pyranoid structure for the glucuronic acid component of the aldobionic acid from gum arabic. Our direct chemical evidence from material obtained by synthesis in the living animal therefore agrees with that derived from a product of plant origin. In a further series of investigations it has been found possible to methylate *d*-glucurone (the lactone of glucuronic acid) to yield two stereoisomeric crystalline trimethyl glucurones. It seems probable that the second ring system in these compounds is of the furanoid type, but our results do not yet permit us to state that this is so.

Investigations in progress in this laboratory concerning the nature of the sugar of nucleic acids necessitated the synthesis of a purine pentoside. Theophylline arabinoside was selected on account of the stability of its purine residue, and having the material at our disposal the structure of the pentose residue was investigated by the standard methods. The synthesis of theophylline-*l*-arabinoside has been described by Helferich and Kühlewein,[4] and their procedure, using silver theophylline and triacetyl arabinosidyl bromide, has been followed with excellent results.

In view of the method of synthesis adopted, the question of structure possesses a further interest in that a proof of the structure of the pentose residue in the arabinoside establishes by implication the structure of the triacetyl arabinosidyl bromide used in the initial step of the synthesis. No difficulty was experienced in methylating completely the arabinoside and the trimethyl theophylline *l*-arabinoside obtained crystallised readily. The latter was subjected to the action of nitric acid ($d = 1{\cdot}2$) and the main oxidation product of the pentose residue proved to be *d*-*arabo*-trimethoxyglutaric acid, which was isolated in excellent yield as the dimethyl ester and identified as the crystalline diamide described by Hirst and Robertson.[5] We therefore infer that theophylline arabinoside and triacetyl arabinosidyl bromide are pyranoid compounds. The purine residue of the original arabinoside was isolated as a yellow crystalline compound (m.p. 275°) which reacted and analysed as a nitro-theophylline having the composition $(C_7H_7N_4O_2.NO_2)_2.H_2O$. Brunner and Leins[6] have described a nitro-theobromine, but we have been unable to find any reference in the literature to nitro-theophylline. Our compound is presumably 8-nitro-theophylline.

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[1] *Jour. Chem. Soc.*, **123**, 1356; 1923.
[2] *Jour. Chem. Soc.*, 350; 1926.
[3] *Jour. Chem. Soc.*, 258; 1931.
[4] *Ber. der Deutsch. chem. Gesell.*, **53**, 17; 1920.
[5] *Jour. Chem. Soc.*, **127**, 358; 1925.
[6] *Ber. der Deutsch. chem. Gesell.*, **30**, 2584; 1897.

## A New Virus Disease of the Tobacco Plant.

IN recent years investigators have recognised many virus diseases of the tobacco plant, all, however, producing chlorosis or necrosis of the leaves. I have investigated at Amani a disease of different manifestation, which I believe to be caused by a virus. The characteristic symptom of this disease is leafy outgrowths from the veins on the lower surface of the leaves, sometimes up to a centimetre wide, but usually amounting to no more than a dark green thickening of sections of the veins. Combined with this feature is a stunting of the whole plant and twisting and curling of the leaves. The manifestation of the disease varies greatly according to environmental conditions and the variety of tobacco concerned. I have, however, never observed chlorosis or necrosis in affected plants.

I have successfully transmitted this disease to healthy tobacco plants by grafting diseased scions on to them. I have also produced the disease in healthy plants by transferring to them an undetermined species of whitefly (Aleurodidæ) collected on diseased plants. These experiments carried out under controlled conditions afford evidence which, with my failure to detect a visible parasite, justifies the inclusion of this disease in the virus group.

A condition of the tobacco plant in which the leaves are curled has been reported to occur in most of the tobacco-growing districts of South and East Africa. It is uncertain, however, whether the condition of the plants in any of these regions is due to the same