acid.[7] The warm aqueous extract from the crystalline residue of hydrazo ester was heated with ammonium molybdate–nitric acid reagent and gave a voluminous yellow precipitate at once, showing the presence of phosphoric acid. The aqueous extract also gave a faint turbidity with saturated aqueous salicylaldehyde, indicating slight cleavage of the hydrazo ester to hydrazine.

Reaction of triethyl phosphite with ethyl azodicarboxylate. In the pure state these react violently so the action was moderated by dilution with anhydrous ether. A solution of 17.1 ml. (0.1 mole) of triethyl phosphite in 50 ml. of anhydrous ether was treated dropwise with 15.9 ml. (0.1 mole) of the azo ester under a reflux system. A few drops of the azo ester were added at first to start the reaction, and as soon as warming occurred, the remaining ester was added at such a rate that gentle refluxing of the ether took place. After the addition, the solution was refluxed for 0.5 hr. and then ether was distilled from the yellowish solution (an excess of the phosphite did not decolorize, even on heating). The residue was distilled at 170–190° at 10 mm. The product weighed 22.3 g. or 65.6%. The forerun contained a pink material which was somewhat difficult to separate from the product. The addition product was redistilled at 175–188°/10 mm. or 140–155°/2 mm. for analysis.

Anal: Calcd. for $C_{12}H_{25}N_2PO_7$ (1:1 adduct): C, 42.35; H, 7.35. Found, Prepn. I: C, 42.61; H, 6.65. Prepn. II: C, 42.80; H, 7.40.

The density of sample II was 1.1413. The product is a colorless oil, more mobile than the reaction product of diethyl phosphite. It forms two layers with water but is soluble in 30–40 volumes of water on stirring. On warming the saturated aqueous solution, the ester precipitates as an oil which redissolves on cooling.

Acid cleavage of the ester. An analytical sample was heated with an excess of concentrated hydrochloric acid on the steam bath for 12 hr. and left to evaporate on the bath to dryness. A water-soluble, very viscous colorless oil was formed. This gave a strong phosphate test with the molybdate reagent but no hydrazo ester or other crystalline material could be isolated. Only a faint turbidity was produced with salicylaldehyde.

The ester also appears to be hydrolyzed by heating for several days with dilute aqueous ammonium hydroxide. Evaporation left a viscous water-soluble sirup from which no crystalline product could be obtained.

The reaction of trimethyl phosphite with the azo ester gave a similar, distillable compound, also accompanied by a pink by-product. Analysis of the purified product for carbon gave values which were slightly higher than the theoretical.

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Isolation of *N*-Methylcytisine from *Ormosia stipitata* Schery

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During the course of a study of the alkaloids of *Ormosia* species, a number of new alkaloids were isolated. Three oxygen-free compounds, ormosinine, ormosanine, and panamine and two minor oxygen-containing bases were found in *Ormosia panamensis*. Seeds of a number of other species (*O. avilensis, O. coccinea, O. jamaicensis, O. macrophylla, O. monosperma, O. tovarensis, O. costulata, O. fastigiata, O. nobilis,* and *O. xanthocarpa*) were examined by means of paper chromatography of the alkaloid extracts. Three solvent systems were employed. The results indicated that all of the species contained approximately the same alkaloids in varying amounts.[1]

A recent collection of seeds of *O. stipitata* Schery from the province of Chiriqui, Panama, gave quite different data. Paper chromatographic examinations in various solvents revealed the presence of a large amount of one alkaloid with no indication of other bases. This alkaloid showed bright blue fluorescence under ultraviolet light, but none of the alkaloids present in the other species exhibited fluorescence.

An extraction of the seeds and purification of the alkaloid fraction was carried out on a larger scale by usual methods, and a 1.9% yield of crystalline material was obtained. The analytical data fitted the formula $C_{12}H_{16}ON_2$ and the melting point, optical rotation, and infrared spectrum were in agreement with those reported in the literature for *N*-methylcytisine. Further proof of identity was obtained by comparison of the melting point data for the hydrochloride, picrate, and perchlorate of the isolated material with literature values.

N-Methylcytisine was first found in nature by Power and Salway[2] in *Caulophyllum thalictroides* (Berberidaceae) and since then it has been obtained from many Papilionaceae either as the main alkaloid or with a number of others. A yield of the magnitude found here has not been experienced previously.

The presence of *N*-methylcytisine in *O. stipitata* seeds and its absence in the eleven other *Ormosiae* examined raises a doubt as to whether *O. stipitata* has been correctly assigned to the genus *Ormosia*. This question is currently under study by Dr. J. D. Dwyer of the Department of Biology, St. Louis University, and Dr. G. B. Schubert of the U. S. Department of Agriculture.

EXPERIMENTAL[3]

Paper chromatographic examination. A few seeds of *O. stipitata*, collected by Dr. W. H. Holdridge in Chiriqui, Panama, were crushed with a hammer, defatted with hexane, and extracted with methanol. The extract was evaporated and the residue was dissolved in dilute hydrochloric acid. This solution was placed on Whatman #1 paper and subjected to chromatography in four solvent systems. Each system yielded a single well-defined spot detected by its blue fluorescence under UV light or by spraying the paper with Munier-Dragendorf reagent. The R_f values are in Table I.

(1) H. A. Lloyd and E. C. Horning, *J. Am. Chem. Soc.*, **80,** 1506 (1958).

(2) F. B. Power and A. H. Salway, *J. Chem. Soc.*, **103,** 191 (1913).

(3) All melting points were taken on a Kofler stage. Analyses by J. F. Alicino, Metuchen, N. J.

TABLE I

Solvent System	R_f Value
1. *n*-BuOH, HCl, H_2O (100:20:36)	0.33
2. *sec*-BuOH, HCl, H_2O (100:20:36)	0.41
3. *tert*-BuOH, HCl, H_2O (100:10:20)	0.22
4. *n*-PrOH, 1N NH_4OH (5:1)	0.83

Isolation of N-methylcytisine. The ground seeds (240 g.) were extracted with methanol in a Soxhlet extractor. The extract was evaporated and the residue was treated with 10% hydrochloric acid. The acid solution was shaken with methylene chloride to remove lipids; it was then made basic by the addition of solid potassium carbonate and ammonia, and extracted with chloroform until the aqueous layer gave negative alkaloid tests. The chloroform extract was dried and the solvent was removed *in vacuo*. There was obtained 4.5 g. (1.9%) of colorless crystalline material, m.p. 137–139.5°. After recrystallization from ethyl acetate–cyclohexane a sample melted at 140–141°, $[\alpha]^{25}_{589}$ −223°, $[\alpha]^{25}_{436}$ −690° (*c*, 0.905, water).

Anal. Calcd. for $C_{12}H_{16}ON_2$: C, 70.56; H, 7.90; N, 13.72; NCH_3, 7.36. Found: C, 70.54; H, 7.87; N, 13.81; NCH_3, 7.19.

The hydrochloride, picrate, and perchlorate were prepared by standard methods. The melting points are given in Table II.

TABLE II

N-METHYLCYTISINE DATA

			Lit. Values
Base	m.p.	140–141°	138°[2,4]
	$[\alpha]^{25}_{589}$ (water)	−223°	−221.6°[2]
Hydrochloride	m.p.	255–258°	250–255°[2]
Picrate	m.p.	232°(dec.)	234°[4]
Perchlorate	m.p.	277–281°	282°[4]

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(4) L. Marion and J. Ouellet, *J. Am. Chem. Soc.*, **70**, 691 (1948).

11-Alkylated Steroids. II. 11-Methyl-3,11,20-trioxygenated Pregnanes

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Despite the fact that 11-oxosteroids have, on a number of occasions,[1] been treated with organometallic reagents that effected transformations elsewhere in the molecule, reaction at the 11-oxo group has been reported only recently.[2]

We wished to extend our knowledge of 11-methylsteroids, particularly of the pregnane series, and accordingly have prepared several new members of this group.

5β-Pregnane-3,11,20-trione 3,20-bis(ethylene acetal)[3] (IIa) underwent addition of methyllithium smoothly in good yield to give the bisketal IIIa, which, being somewhat difficult to crystallize, was usually not isolated but was hydrolyzed directly to 11β-hydroxy-11-methyl-5β-pregnane-3,20-dione (Va), obtained in 65% yield from IIa. Similarly the hitherto unknown 5α-pregnane-3,11,20-trione 3,20-bis(ethylene acetal) (IIb) was treated with methyllithium to give the crystalline bisketal IIIb in 82% yield. Hydrolysis of IIIb afforded 11β-hydroxy-11-methyl-5α-pregnane-3,20-dione (Vb) in 80% yield. Apparently the configuration of the molecule at C-5 has little or no effect on the addition reaction at the 11-oxo group.

In the first paper in this series,[2] it was pointed out that although 21-triphenylmethoxypregna-5,-17(20)-[cis]-diene-3,11-dione 3-ethylene acetal underwent addition of methyllithium to the 11-oxo group, neither 21-hydroxypregna-5,17(20)-[cis]-diene-3,11-dione 3-ethylene acetal nor its acetate could be converted to the 11-methylated derivative. This was felt to be caused by initial formation of the 21-alcohol lithium salt, which might then be expected to be resistant to further attack by methyllithium. The adverse effect of the hydroxyl group (or of a group readily converted to hydroxyl by methyllithium) seemed clear. However, we have now found that in at least one case where the molecule contains a free hydroxyl group, namely 3α-hydroxy-5β-pregnane-11,20-dione 20-ethylene acetal[3] (VII), addition of methyllithium to the 11-oxo group does take place. Subsequent acid hydrolysis of the product gave 3α,11β-dihydroxy-11-methyl-5β-pregnan-20-one (VIIIa), which was also prepared by selective sodium borohydride reduction[4] of 11β-hydroxy-11-methyl-5β-pregnane-3,20-dione (Va).

In connection with the preparation of Va, it was possible to isolate a second substance by chromatography of the total crude acid hydrolysis product. This material appeared, in the basis of analytical data, to be a monoacetal. In order to determine which ketone group was protected, the material was reduced with sodium borohydride and then subjected to acid hydrolysis. The resultant diol IXa could not be crystallized but was converted to the crystalline acetate IXb, which was not identical with the acetate (VIIIb) of 3α,11β-dihydroxy-11-methyl-5β-pregnan-20-one (VIIIa). Accordingly, IXb must have been a 20-acetoxy compound, de-

(1) See, for example: R. B. Turner, V. R. Mattox, L. L. Engel, B. F. McKenzie, and E. C. Kendall, *J. Biol. Chem.*, **166**, 345 (1946); A. Wettstein and C. Meystre, *Helv. Chim. Acta*, **30**, 1262 (1947); V. R. Mattox and E. C. Kendall, *J. Biol. Chem.*, **185**, 589 (1950).

(2) G. S. Fonken and J. A. Hogg, *Tetrahedron*, **2**, 365, (1958).

(3) E. P. Oliveto, T. Clayton, and E. B. Hershberg, *J. Am. Chem. Soc.*, **75**, 486 (1953).

(4) E. R. Garrett and D. A. Lyttle, *J. Am. Chem. Soc.*, **75**, 6051 (1953).