N-**Nicotinoyl-2-pyrrolidone (3b).**—Nicotinoyl chloride hydrochloride, prepared from 20 g of nicotinic acid and 40 g of thionyl chloride, was dissolved in 10 g of pyridine and was stirred at room temperature for 1 hr. After this time, 40 g of 2-pyrrolidone was slowly added to the reaction flask and the mixture was stirred for ~15 hr at room temperature. The reaction mixture was dissolved in methylene chloride and was washed with dilute hydrochloric acid. The aqueous solution was adjusted to pH 9 and extracted with methylene chloride. After the mixture dried, the solvent was removed and the crude solid was crystallized from chloroform-hexane. The crystalline product (25.5 g, 73%) exhibited mp 104–105° (lit.[5] mp 103°).

Anal. Calcd for $C_{10}H_{10}N_2O_2$: C, 63.15; H, 5.30; N, 14.73. Found: C, 63.78; H, 5.03; N, 14.82.

Myosmine (4b).—*N*-Nicotinoyl-2-pyrrolidone (1.5 g) was mixed with an equal weight of calcium oxide, and the mixture was subjected to free-flame distillation. The crude product from this procedure (1.3 g) was shown by glc analysis (6-ft column of 2% OV-17) to be 67% myosmine and 33% 2-pyrrolidone.[10] Distillation of the crude product yielded myosmine [0.75 g 65%)], bp 82–86° (0.5 mm) [lit.[4] mp 82–84° (0.5 mm)]. This material was shown by glc to be uncontaminated with 2-pyrrolidone. Myosmine was characterized by its mass spectrum,[8] and a dipicrate derivative (mp 184–185, lit.[4] mp 184–185°). The nmr spectrum was consistant with the structure.

Registry No.—**3b,** 34236-73-2; **4b,** 532-12-7.

Acknowledgments.—We would like to express our appreciation to the National Science Foundation for support of L. F. M. and to Professor Henry Rapoport for helpful discussions. We acknowledge the financial assistance of The Endowment and Research Foundation of Montana State University.

[10] Other possible reaction products which might constitute the remainder of the crude product were not found from this glc analysis; only the two reported products were noted, in the ratio of 67:33.

LL-D253α, -β, and -γ, Novel Chromanones from the Fungus *Phoma Pigmentivora*

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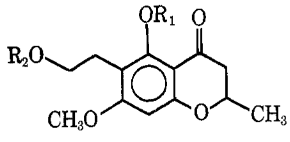
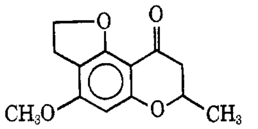
The fungus *Phoma pigmentivora* elaborates (2*R*)-5-hydroxy-6-(2′-hydroxyethyl)-7-methoxy-2-methylchromanone (LL-D253α, I) in good yield in both surface and agitated fermentations. In surface fermentation, the culture also produces in lower yield the monoacetate of this material or (2*R*)-5-hydroxy-6-(2′-acetoxyethyl)-7-methoxy-2-methylchromanone (LL-D253β, II). Treatment of the major metabolite with concentrated sulfuric acid gives 7-methoxy-5,6-(2′,3′-dihydrofuro)-2-methylchromanone (LL-D253γ, III) which is also produced in low yield in agitated fermentations of the fungus. The basic degradation of these chromanones is discussed.

In our quest for novel metabolites of pharmacological interest, we investigated the fungus *Phoma pigmentivora* or Lederle culture D253. Culture D253 was grown both by the surface and deep fermentation methods which are described in the Experimental Section. The still fermentation process in the presence of beechwood shavings[1] yielded the metabolites LL-D253α and LL-D253β which are represented respectively by structures I and II.

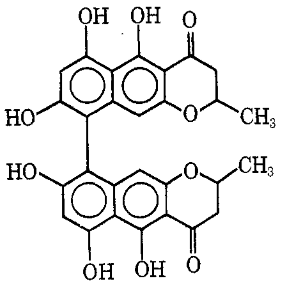


I, $R_1 = R_2 = H$
II, $R_1 = H$; $R_2 = CH_3CO$
IV, $R_1 = R_2 = CH_3CO$
V, $R_1 = CH_3$; $R_2 = H$
VI, $R_1 = CH_3CO$; $R_2 = H$



III

Agitated fermentations of the fungus yielded I as the major product and LL-D253γ or III. These metabolites are 2-methylchromanones and on tlc give a characteristic yellow spot when sprayed with sulfuric acid and heated for 1 min or so. To our knowledge, only two microbial metabolites have been isolated so far which have been characterized as chromanones. Allport and Bu'Lock isolated 5-hydroxy-2-methylchromanone from the ascomycete *Daldinia concentrica.*[2] This natural product was optically inactive. The other chromanone, rosellinic acid, was isolated from culture filtrates of *Rosellinia necatrix Berlese*[3] and shown to be 6-carboxy-8-hydroxy-2-methylchromanone.[4] A yellow pigment called cephalochromin[5] has been briefly reported. This material is a dimer in which the 2-methylchromanone nucleus is fused to an aryl group as shown below.



cephalochromin

The major metabolite I melts at 188–189°, is optically active, and has the empirical formula $C_{13}H_{16}O_5$. A uv maximum of the material in methanol at 287 nm is shifted to 325 nm in basic solution in addition to displaying a large hyperchromic effect. The ir spectrum shows a carbonyl frequency at 1655 cm^{-1} which is shifted to 1699 cm^{-1} in the diacetate IV. All of these features point to a chelated phenolic ketone.

The nmr spectrum of the monomethyl ether V was

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(1) F. Kavanagh, A. Hervey, and W. J. Robbins, *Proc. Nat. Acad. Sci.*, **37**, 570 (1951).

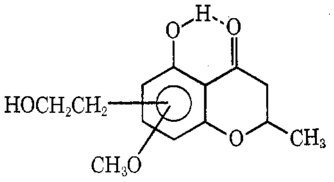
(2) D. C. Allport and J. D. Bu'Lock, *J. Chem. Soc.*, 654 (1960).

(3) Y. Chen, *Agr. Biol. Chem.*, **24**, 372 (1960).

(4) Y. Chen, *ibid.*, **28**, 431 (1964).

(5) G. Tertzakina, R. H. Haskins, G. P. Slater, and L. R. Nesbitt, *Proc. Chem. Soc.*, 195 (1964).

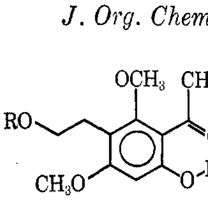
easier to interpret than that of the parent compound. A split methyl signal at δ 1.48 ($J \sim 7$ cps) and a complex quartet at δ 4.50 account for a methyl group and a single proton on a carbon bearing an oxygen. A sharp exchangeable singlet at δ 1.85 is due to a relatively nonacidic hydroxyl proton. Two almost coincidental signals around δ 2.51 and a singlet at δ 2.63 together account for a methylene group adjacent to a carbonyl, while a benzylic methylene group is represented by a triplet centered at δ 2.87 ($J \sim 7$ cps). Another triplet at δ 3.73 ($J \sim 7$ cps) may be attributed to a methylene group attached to an oxygen and coupled with the adjacent benzylic protons. Sharp singlets at δ 3.89 and 3.90 integrating for three protons each indicate two aromatic methoxyl groups. The remaining signal in the spectrum is a singlet at δ 6.12 which represents a single aromatic proton. Based on the evidence presented so far, partial structure i may be written for I. Placement of the ethanolic side chain at C-6 as opposed to C-7 or C-8 is shown by the formation of the dihydrofuran III on cyclization of I in sulfuric acid. In the ir spectrum of III, the O–H stretch frequencies have virtually vanished and the carbonyl band appears at 1680^{-1} cm. The nmr spectrum of III shows the remaining chromanone features still intact. The methoxyl group is placed at the 7 position as a result of two pieces of evidence. The material gives a positive Gibbs test which indicates that the position para to the phenolic group in the aromatic ring is open and secondly fusion of I with sodium hydroxide yields phloroglucinol. Hence, the structure of LL-D253α is unequivocally I or 5-hydroxy-6-(2′-hydroxyethyl)-7-methoxy-2-methylchromanone.



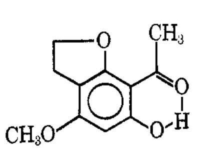
i

It has already been mentioned that I gives a diacetate which melts at 121–122°. In the nmr of this derivative in deuterated chloroform the acetyl methyl groups are located at δ 2.0 and 2.35, respectively. If I is treated with 1 equiv of acetic anhydride in pyridine, two products are formed, the diacetate IV and a monoacetate, mp 129°. The shift in the frequency of the chromanone carbonyl from 1655 to 1690 cm^{-1} in the monoacetate indicates that it is the chelated phenolic group which had been acetylated. The acetyl methyl signal in the nmr of this derivative VI is located at δ 2.33. Metabolite LL-D253β, which was isolated from surface fermentation only, has a molecular ion at *m/e* 294 and carbonyl frequencies in the ir spectrum at 1655 and 1740 cm^{-1}, respectively. In the nmr spectrum the acetyl methyl signal is present at δ 2.0 and hence this metabolite has structure II. Compound II could be synthesized in good yield by the reaction of I with acetic acid in ethyl acetate saturated with dry hydrogen chloride.

The reaction of the monomethyl ether V with strong alkali gave some unexpected products in addition to the expected degradation compound VII.[2,4] Methylation of VII using methyl iodide and silver oxide yielded VIII indicating that in this compound the chelation of the phenolic group is very strong.[6,7]



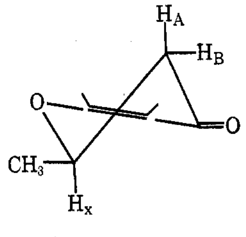
VII, R = H
VIII, R = CH₃
IX, R = CH₃CO



X

In the nmr spectrum of VII, the primary hydroxy proton signal is at δ 1.87 while the strongly chelated phenolic proton is a ringing singlet at δ 13.93. Among the unexpected products of the alkaline degradation is IX which has the empirical formula $C_{14}H_{18}O_6$ and melts at 97°. The nmr spectrum has the acetyl methyl signal at δ 2.0 and the chelated phenolic proton singlet at δ 13.92. Evidently, the acetyl fragment cleaved during alkaline degradation acetylates the primary hydroxyl group during the subsequent acidic work-up of the reaction. The chemical preparation of II from I confirms this observation. The other unusual product isolated from the alkaline degradation is X which was also obtained by similar degradation of III.

As has already been mentioned, the nmr spectrum of the monomethyl ether V was more amenable to interpretation than that of the parent metabolite. Nevertheless, from the normal spectra in deuterated chloroform or benzene, the coupling constants of the carbon three methylene protons with the carbon two methine proton were not discernable. However, the use of as much of the shift reagent dipivalomethanatoeuropium(III) as is consistent with solubility in chloroform[8] results in resonance peak shifts so that nearly all the lines associated with this ABX system can be seen. Under these conditions, the values observed are $J_{AB} = 16.5$ cps for the geminal coupling, $J_{AX} = 4.0$ cps for the axial–equatorial coupling, and $J_{BX} = 11.2$ cps for the trans axial–axial coupling. Consequently, the methine proton of position 2 is axial while the methyl group at the same position is equatorial as would be expected.



The absolute stereochemistry at C-2 is determined to be *R* from the positive Cotton effect $[\theta]_{322.5} = +6710$ in the CD spectrum of III since the relative stereochemistry is known. Flavanones show a uv maximum at 270–290 nm and an inflection at 320–330 nm. These absorptions have been assigned $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$ origins, respectively.[9,10] Clearly the same assignments can be made for the maximum at 287 nm and the shoulder at 320 nm in the uv spectra of I–III. Snatzke[11] has derived a relationship between the chirality of

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[6] J. F. Garden and R. H. Thomson, *J. Chem. Soc.*, 2483 (1957).

[7] W. J. McGahren and L. A. Mitscher, *J. Org. Chem.*, **33**, 1577 (1968).

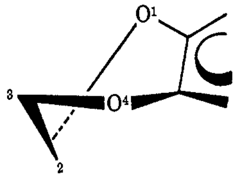
[8] C. C. Hinckley, *J. Amer. Chem. Soc.*, **91**, 5160 (1969).

[9] H. H. Jaffe and M. Orchin, "Theory and Application of Ultraviolet Spectroscopy," Wiley, New York, N. Y., 1962, p 204.

[10] W. Gaffield, *Tetrahedron*, **26**, 4093 (1970).

[11] G. Snatzke, *ibid.*, **21**, 413 (1965).

α,β-unsaturated ketones and the sign of their n → π^* Cotton effects. Extension of this rule to aryl ketones[12] and flavanones[10] suggests that chromanones of the conformation shown below will exhibit a positive n → π^* Cotton effect.



Experimental Section

Uv spectra were recorded using a Cary 11 spectrophotometer. Nmr spectra were run on a Varian A-60 instrument. Ir spectra were made using a Perkin-Elmer Infracord. Mass spectra were run on AEI MS9 high-resolution direct inlet spectrometer. CD data were obtained using a Cary 60 spectropolarimeter with CD attachment.

Fermentations.—A slant of Lederle culture D253 was used to inoculate 50 ml of sterile medium consisting o 0.2% ammonium tartrate, 0.05% $MgSO_4 \cdot 7H_2O$, 0.1% KH_2PO_4, 0.05% KCl, 0.001% $FeSO_4 \cdot 7H_2O$, 5.0% glucose, and 1% corn steep liquor (pH adjusted to 6.5 with NaOH) in 250-ml Erlenmeyer flasks and incubated for 3 days on a rotary shaker at 22°. Three Fernbach flasks, each containing 1.5 g of KH_2PO_4, 5.0 g of corn steep liquor, 0.5 g of KCl, 0.5 g of $MgSO_4 \cdot 7H_2O$, 3.0 g of $NaNO_3$, 40 g of dextrose, and 5 g of beechwood shavings in 1 l. of distilled water with pH adjusted to 6.5 before sterilization, were inoculated using 10 ml per flask of the preformed inoculum. The flasks were incubated at ambient temperature. After 5 weeks, the contents of the flasks were extracted with ethyl acetate at harvest pH to give 300 mg of gum. The pH of the mash was then adjusted to pH 2.5 and extraction with $CHCl_3$ gave another 200 mg of gum. Both lots of gum were combined and upon trituration with ether yielded 110 mg of off-white crystals. Recrystallization from ethyl acetate–hexane gave white crystals, mp 188–188.5°, of LL-D253α (I): $[\alpha]^{25}D$ +25.2 ± 0.42 (*c* 0.477, MeOH); λ_{max}^{MeOH} 213 nm (ϵ 22,700), 233 (sh, 13,500), 287 (18,900), 320 (sh, 5670); λ_{max}^{NaOH} 245 nm (ϵ 8500) and 325 (25,100); mass spectrum *m/e* 252.

Anal. Calcd for $C_{13}H_{16}O_5$: C, 61.90; H, 6.34. Found: C, 62.14; H, 6.31.

The filtrate from which 110 mg of I was obtained was concentrated and put on two 2.0-mm thick-layer silica gel plates and developed for two passes using 10% MeOH in $CHCl_3$. Two uv positive bands were scraped off and eluted with MeOH. The more polar band yielded 50 mg of I. The less polar band yielded 50 mg of white solid which was difficult to recrystallize. Finally, 27 mg of white solid material was recovered which softened at 180° and slowly darkened thereafter. The mass spectrum indicated a pure material with a molecular ion *m/e* 294 and a peak at *m/e* 251 indicating the loss of an acetyl fragment. This material was called LL-D253β (II). A 30-l. stirred, aerated tank was grown for 117 hr at 28° on the ammonium tartrate medium previously described and extracted with ethyl acetate and chloroform as mentioned before. The solvent extracts yielded about 3.7 g of a gum from which about 800 mg of I crystallized. The remainder was passed over 160 g of Davison grade 62 acid-washed silica gel using $CHCl_3$ as eluting solvent. Fractions of 80–90 ml volume were collected. Fractions 3–15 upon evaporation gave 400 mg of crystals which upon recrystallization from ethyl acetate–hexane yielded a first crop of 250 mg of LL-D253γ (III): mp 158–159°; $[\alpha]^{25}D$ +26.2 ± 0.27 (*c* 0.715, MeOH); λ_{max}^{MeOH} 213 nm (ϵ 22,200), 240 (15,000), 289 (17,100), 310 (sh, 7000); mass spectrum *m/e* 234.

Anal. Calcd for $C_{13}H_{14}O_4$: C, 66.65; H, 6.02. Found: C, 66.80; H, 5.98.

The CD curve of III was run on a methanol solution of concentration 2.225 mg/ml in a cell of 0.1-mm width: $[\theta] \times 10^3$ 322.5 nm (+6.71), 306 (±0), 287.5 (−14.80), 245 (±0), 235 (+3.50, inflection), 216 (+16.37); δ ($CDCl_3$) 1.47 [3 H, doublet ($J \sim 6.5$ cps)] methyl, 2.60 [2 H, doublet ($J \sim 7.5$ cps)] methylene adjacent to carbonyl, 3.12 [2 H, triplet ($J \sim 8.5$ cps)] benzylic methylene, 3.86 (3 H, singlet) methoxyl, 4.57 (1 H, irregular quartet) methine proton, 4.65 [2 H, triplet ($J \sim 8.5$ cps)] 2′-methylene of dihydrofuran ring, 6.06 (1 H, singlet) aromatic proton.

Preparation of Diacetate IV.—About 100 mg of I was treated with 2 ml of Ac_2O and a drop of pyridine and heated for a few minutes on a steam bath. The solvents were evaporated under reduced pressure and the resultant gum was passed over 20 g of grade 62 silica gel using 50:50 ethyl acetate–hexane as solvent. Fractions of 20-ml volume were collected and fractions 3 and 4 yielded 70 mg of solids which upon recrystallization from ether–hexane gave the diacetate IV: mp 121–122°; $[\alpha]^{25}D$ +23.1 ± 0.18 (*c* 0.238, $CHCl_3$); ν (KBr) 1772, 1740, and 1699 cm^{-1}.

Anal. Calcd for $C_{17}H_{20}O_7$: C, 60.71; H, 5.99. Found: C, 61.28; H, 6.18.

Methyl Ether V.—Approximately 2.0 g of I was refluxed overnight in 20 ml of acetone with 5 g of K_2CO_3 and 3 ml of CH_3I. Work-up included passage of the reaction concentrate over 90 g of acid-washed silica gel using 50:50 ethyl acetate–$CHCl_3$. Fraction volume was 75–80 ml. Evaporation of fractions 4–16 yielded 1.8 g of white crystals which were recrystallized from ethyl acetate to 1.5 g of V: mp 165–166°; $[\alpha]^{25}D$ +36.0 ± 0.36 (*c* 0.545, MeOH); λ_{max}^{MeOH} 213 nm (ϵ 22,200), 240 (15,000), 289 (17,100), 310 (sh, 7000); λ_{max}^{NaOH} 216 nm (ϵ 45,800), 240 (12,600), 292 (16,400), 320 (sh, 7000).

Anal. Calcd for $C_{14}H_{18}O_5$: C, 63.14; H, 6.81. Found: C, 63.29; H, 6.75.

Monoacetate VI.—Exactly 252 mg or 1 mmol of I was dissolved in 0.5 ml of pyridine and 0.12 ml or 1.1 mmol of Ac_2O was added. After 10 min the reaction solution was evaporated to an oil which was passed over 15 g of acid-washed silica gel using 20% hexane in $CHCl_3$ as eluting solvent. Fraction size was 15–18 ml. Fractions 3–5 gave 90 mg of diacetate IV. Fractions 12–23 gave 120 mg of material which was recrystallized from ether–hexane to get 90 mg of monoacetate VI: mp 128.5–129°; $[\alpha]^{25}D$ +51.4 ± 0.34 (*c* 0.584, MeOH); ν (KBr) 1760 and 1695 cm^{-1}; δ ($CDCl_3$) 1.50 [3 H, doublet ($J \sim 7$ cps)] methyl, 1.70 (1 H, exchangeable singlet] OH, 2.33 (3 H, singlet) acetyl methyl, 2.67 (2 signals) and 2.70 (1 signal) (2*H*)methylene group adjacent to carbonyl, 2.82 [2 H, triplet ($J \sim 7$ cps)] benzylic methylene, 3.73 [2 H, triplet ($J \sim 7$ cps)] hydroxymethylene, 3.85 (3 H, singlet) methoxyl, 4.57 (1 H, irregular quartet) methine proton, 6.28 (1 H, singlet) aromatic H.

Anal. Calcd for $C_{15}H_{18}O_6$: C, 61.21; H, 6.17. Found: C, 61.28; H, 6.03.

Fusion of I with NaOH.—About 0.5 g of I was mixed with 2.0 g of powdered NaOH and the mixture heated under N_2 in a stainless steel vessel for 15 min up to a temperature of 280°. The fused mass was cooled, treated with H_2O, and acidified with 4 *N* HCl and subjected to liquid–liquid extraction overnight with ethyl acetate. Work-up of the extract yielded 170 mg of a gum which was put on a thick-layer silica gel plate (2.0 mm) and developed using 20% MeOH in $CHCl_3$. A broad uv positive band was scraped off and eluted with MeOH to yield 70 mg of off-white solid. Attempts to recrystallize this material following Darco treatment failed. By evaporation of solvent, 42 mg of white crystals was obtained, mp 203–206°. The nmr, ir, and uv spectra of this material were identical with those of phloroglucinol.

Anal. Calcd for $C_6H_6O_3$: C, 56.25; H, 4.68. Found: C, 56.04; H, 5.34.

Reaction of I with Concentrated H_2SO_4.—About 500 mg of I was dissolved in 2 ml of concentrated H_2SO_4 to give a distinctly yellow solution which was refrigerated overnight. The solution was carefully diluted to 25 ml with ice water, neutralized with 4 *N* NaOH, and subjected to liquid–liquid extraction with ethyl acetate overnight to yield upon work-up 250 mg of white solid. Recrystallization from ethyl acetate–hexane gave pure III, mp 159°. The ir and nmr of this material were identical with those of III isolated from agitated fermentations.

Preparation of II from I.—About 0.5 g of I was dissolved in 25 ml of dry ethyl acetate and 2 ml of acetic acid was added. The solution was then saturated with dry HCl gas and the yellow solution was allowed to sit overnight at room temperature. The solution was extracted with 20 ml of H_2O and the organic phase was dried and evaporated to a solid residue which was recrystallized from ethyl acetate–hexane to give a first crop of 290 mg of

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[12] G. Snatzke, *Tetrahedron.*, **21**, 439 (1965).

white crystals: mp 207–208°; $[\alpha]^{25}\text{D}$ +20.99 ± 1.18 (*c* 1.091, MeOH). The ir and nmr spectra of this material were identical with those of the natural product II.

Anal. Calcd for $C_{15}H_{18}O_6$: C, 61.27; H, 6.17. Found: C, 61.30; H, 6.01.

Alkaline Degradation of V.—A 4.1-g aliquot of V was dissolved in 200 ml of absolute EtOH, 20 g of solid KOH was added, and the mixture refluxed overnight under N_2. The cooled reaction mixture was filtered, concentrated to small volume, acidified, and extracted with ethyl acetate to get upon work-up a brown gum which was passed over 200 g of grade 62 acid-washed silica gel and eluted with 70:30 $CHCl_3$–hexane solution. Fraction volume was 80–85 ml. Fractions 3–25 were combined to give 2.5 g of a viscous oil which was a mixture and labeled fraction A. Fractions 26–38 yielded about 2.0 g of an oil which solidified. The material was recrystallized from ethyl acetate–hexane to give a first crop of 1.2 g of faintly yellow crystals which spectral data showed to be VII or 1-hydroxy-3,5-dimethoxy-4-(2′-hydroxyethyl)acetophenone: mp 133–134°; $\lambda_{\max}^{\text{MeOH}}$ 213 nm (ϵ 18,000), 230 (sh, 12,200), 290 (19,200), 330 (sh, 3600); $\lambda_{\max}^{\text{NaOH}}$ 215 nm (ϵ 36,000), 235 (sh, 18,600), 295 (6000), 330 (sh, 3300); δ ($CDCl_3$) 1.85 (1 H, exchangeable singlet) ethanolic OH, 2.60 (3 H, singlet) methyl ketone, 2.92 [2 H, triplet ($J \sim 7$ cps)] hydroxy methylene, 3.84 and 3.89 (3 H and 3 H, singlets) two aromatic methoxyls, 5.98 (1 H, singlet) aromatic H, 13.98 (1 H, exchangeable singlet) aromatic OH.

Anal. Calcd for $C_{12}H_{16}O_5$: C, 60.00; H, 6.66. Found: C, 60.38; H, 6.63.

Fraction A was again passed over silica gel. This time 90 g of acid-washed material was used and elution was carried out using a gradient of 10–50% ethyl acetate in hexane solution. Fraction size was 80–90 ml. Fractions 2–5 gave 0.6 g of residue which was recrystallized from ethyl acetate–hexane to give a first crop of 300 mg of faintly yellow crystals which were subsequently shown to be X or 1-hydroxy-3-methoxy-4,5-(2′,3′-dihydrofuro)acetophenone: mp 106–107°; $\lambda_{\max}^{\text{MeOH}}$ 212 nm (ϵ 18,700), 238 (sh, 10,400), 292 (18,500); $\lambda_{\max}^{\text{NaOH}}$ 214 nm (ϵ 38,000), 238 (sh, 15,600), 300 (6200); δ ($CDCl_3$) 2.57 (3 H, singlet) methyl ketone, 3.12 [2 H, triplet ($J \sim 7$ cps)] benzylic methylene, 3.83 (3 H, singlet) aromatic methoxyl, 4.67 [2 H, triplet ($J \sim 7$ cps)] methylene of ether linkage, 5.95 (1 H, singlet) aromatic proton, 14.00 (1 H, exchangeable singlet) phenolic proton.

Anal. Calcd for $C_{11}H_{12}O_4$: C, 63.45; H, 5.81. Found: C, 63.30; H, 5.67.

Fraction 8–16 on evaporation gave 1.0 g of a viscous oil which partially solidified. The solid was recrystallized from ethyl acetate–hexane to yield 300 mg of faintly yellow crystals, mp 97°, which spectral data showed to be IX: $\lambda_{\max}^{\text{MeOH}}$ 213 nm (ϵ 21,100), 230 (sh, 15,500), 290 (21,300), 330 (sh, 4200); $\lambda_{\max}^{\text{NaOH}}$ 213 nm (ϵ 49,000), 235 (sh, 16,900), 295 (7000), 240 (sh, 4100); ν (KBr) 1740 and 1635 cm^{-1}; δ ($CDCl_3$) 2.00 (3 H, singlet) acetyl methyl, 2.63 (3 H, singlet) aryl methyl ketone, 2.95 [2 H, triplet ($J \sim 7$ cps)] benzylic methylene, 3.90 and 3.92 (3 H and 3 H, singlets) aromatic methoxyls, 4.20 [2 H, triplet ($J \sim 7$ cps)] acetoxy methylene, 5.98 (1 H, singlet) aromatic proton, 13.93 (1 H, singlet) chelated phenolic proton.

Anal. Calcd for $C_{14}H_{18}O_6$: C, 59.56; H, 6.43. Found: C, 59.26; H, 6.36.

Work-up of fractions 27–37 yielded 250 mg of VII.

Alkaline Degradation of III.—About 0.4 g of III was dissolved in 25 ml of EtOH, 3 g of KOH was added, and the mixture was refluxed overnight under N_2. The solvent was evaporated and the mixture acidified with 4 *N* HCl and then extracted with ethyl acetate. Work-up of the ethyl acetate extract gave 270 mg of yellow solids which were passed over 18 g of acid-washed grade 62 silica gel and eluted with 5% ethyl acetate in hexane. The second holdback volume yielded 200 mg of material which upon recrystallization gave 110 mg of X, mp 107–108°.

Preparation of VIII.—About 1.2 g of VII was stirred overnight in 200 ml of $CHCl_3$ with 15 g of Ag_2O and 20 ml of CH_3I. The reaction mixture was filtered and the solvent evaporated to get 1.2 g of solid material which was passed over 90 g of acid-washed grade 62 silica gel and eluted with a gradient of 5–20% ethyl acetate in hexane. Fraction size was 80–85 ml. Fractions 9–12 gave 0.7 g of crystals which were recrystallized to give a first crop of 320 mg, mp 94–94.5°, which spectral data showed to be VIII: $\lambda_{\max}^{\text{MeOH}}$ 213 nm (ϵ 18,000), 230 (sh, 12,700), 287 (20,300), 330 (sh, 3800); δ ($CDCl_3$) 2.62 (3 H, singlet) methyl ketone, 2.93 [2 H, split triplet ($J \sim 7$ cps)] benzylic methylene, 3.37 (3 H, singlet) aliphatic methoxyl, 3.48 [2 H, split triplet ($J \sim 7$ cps)] $-OCH_2$, 3.90 (6 H, singlet) 2 aromatic methoxyls, 5.98 (1 H, singlet) aromatic proton, 13.93 (1 H, singlet) chelated phenolic proton.

Anal. Calcd for $C_{13}H_{18}O_5$: C, 61.52; H, 7.14. Found: C, 61.40; H, 7.06.

Registry No.—I, 34288-33-0; II, 34288-34-1; III, 34288-35-2; IV, 34288-36-3; V, 34288-37-4; VI, 34288-38-5; VII, 34288-73-8; VIII, 34288-74-9; IX, 34288-75-0; X, 34288-76-1; phlaroglucinol, 108-73-6.

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Chemical Modifications of Zearalenone. I

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Chemical transformations of the aliphatic portion of the mold metabolite zearalenone were examined. Reactions at the C′-6 ketone and the C′-1 double bond and positions adjacent to these reaction centers are reported. The reactions proved to be quite regioselective.

The mold metabolite zearalenone (**1**),[1] which has shown hormonal and growth-promotant activities,[1a] has previously been synthesized,[2] its absolute configuration has been determined,[3] and modifications in the aromatic ring with the resulting changes in biological activity have been reported.[4] In this report some transformations of the lactone ring are examined. Although one might expect a 14-member ring to have several conformations of relatively equal energies, we

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