time the bomb was in contact with the furnace. The bomb was then withdrawn and allowed to air cool.

The contents of the cooled bomb were filtered to remove carbonaceous materials. When unreacted halogenated starting material was present, methanol was added until the reaction mixture became homogeneous. An nmr of the solution was taken using a Varian A-60A spectrometer. Peaks were repeatedly integrated and average areas were employed. Table IV lists the identity of the signals used to calculate the product yields.

In order to determine whether 2-pyridone was present in 3-halopyridine reaction mixtures, the following was employed. 3-Halopyridine reaction mixtures were thoroughly extracted with chloroform and the aqueous phase was acidified to pH 7 with dilute hydrochloric acid. The neutralized phase was extracted with chloroform and dried ($MgSO_4$). (Control runs showed that the hydroxypyridines could be removed from aqueous solutions by this method.) Thin layer chromatography using silica gel plates and acetone containing a small amount of acetic acid as eluent showed that mixtures of the hydroxypyridines could be clearly separated. The order of increasing R_f value is 4-pyridone, 2-pyridone, and 3-hydroxypyridine. No attempt was made to establish the lower limits of detection of 2-pyridone by tlc.

The pyridine content of 3-iodopyridine reaction mixtures was obtained as follows. The nmr spectra of alkaline reaction mixtures were recorded before and after extraction with methylene chloride. Spectra taken before extraction provide a measure of hydroxypyridines as well as of pyridine. Spectra after extraction measure the hydroxypyridines. The amount of pyridine present was obtained by subtraction. In addition the dried ($MgSO_4$) methylene chloride extracts were concentrated and the amount of pyridine present was determined by weight. The two results, Table III, are in reasonable agreement but it is to be noted that both methods assume impurities are not present. These results, then, should be regarded as giving the maximum amounts. The recovered pyridine was distilled and compared with authentic material. Aqueous solutions were neutralized and analyzed for 2-pyridone content as described above.

Isolation of 3-Hydroxypyridine and 4-Pyridone from the Hydrolysis of 3-Bromopyridine.—After 3.16 g (0.20 mol) of 3-bromopyridine was hydrolyzed at 300° for 1 hr with 4 *M* potassium hydroxide (no isobutyric acid), the aqueous solution was acidified to pH 7 with dilute HCl and evaporated to dryness under reduced pressure. The solid was extracted with acetone and then the insoluble portion was dissolved in a minimum amount of water. After adjusting to pH 8, the evaporation–extraction process was repeated. The process was repeated a third time at pH 6. The acetone extracts were dried ($MgSO_4$) and the solvent was removed. The crude mixture of 3-hydroxypyridine and 4-pyridone was sublimed at 140–160° (0.5 Torr). The sublimate was chromatographed on a silica gel column. Elution with 4% methanol in chloroform (v/v) gave 0.40 g (21%) of 3-hydroxypyridine which on recrystallization from benzene showed mp and mmp 127–129° (lit.[25] mp 129°). Elution with 60% methanol in chloroform (v/v) gave 0.48 g (25%) of 4-pyridone which on recrystallization from chloroform–hexane showed mp and mmp 145–149° (lit.[25] 148.5°).

Isolation of 4-Aminopyridine from the Hydrolysis of 4-Bromopyridine.—A mixture of 3.89 g (0.092 mol) of 4-bromopyridine hydrochloride and 25 ml of 4 *M* potassium hydroxide was heated at 300° for 10 min. The cold mixture was extracted with methylene chloride and dried ($MgSO_4$). Removal of the solvent gave 0.226 g (12%) of 4-aminopyridine, mp and mmp 158–159° (lit.[25] mp 158°). Nmr analysis of the aqueous solution indicated that 61% of 4-hydroxypyridine was present.

Registry No.—2-Chloropyridine, 109-09-1; 2-bromopyridine, 109-04-6; 2-iodopyridine, 5029-67-4; 3-chloropyridine, 626-60-8; 3-bromopyridine, 626-55-1; 3-iodopyridine, 1120-90-7; 4-chloropyridine, 626-61-9; 4-bromopyridine, 1120-87-2; 4-iodopyridine, 15854-87-2.

Acknowledgment.—Support of this work by the National Science Foundation (GP 9488) is gratefully acknowledged. The College of Arts and Sciences generously provided the reaction bomb.

[25] "Dictionary of Organic Compounds," 4th ed, Oxford University Press, New York, N. Y., 1965.

Independent Syntheses of the Products of Acid- and Base-Catalyzed Rearrangements of 2-(1-Isoquinolyl)-3,3,5-triarylpyrrolenines

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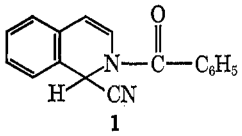
2-(1-Isoquinolyl)-3,4,5-triphenylpyrrole (4) and 2-(1-isoquinolyl)-3-*p*-anisyl-4,5-diphenylpyrrole (6) have been synthesized by unambiguous methods. The synthetic samples are identical with the products of the acid- or base-catalyzed isomerization of 2-(1-isoquinolyl)-3,3,5-triphenylpyrrolenine (3) and the base-catalyzed isomerization of 2-(1-isoquinolyl)-3-*p*-anisyl-3,5-diphenylpyrrolenine (21), respectively. By inference, 2-(1-isoquinolyl)-4-*p*-anisyl-3,5-diphenylpyrrole (7) is the product of the acid-catalyzed isomerization of **21**. These facts provide additional support for the mechanisms of the isomerization reactions proposed in previous papers.

Mainly by a series of tracer studies, but also on the basis of other evidence, it has been established that the acid-catalyzed condensation of 2-benzoyl-1,2-dihydroisoquinaldonitrile (**1**) with 1,1-diphenylethylene (**2**) affords a mixture of 2-(1-isoquinolyl)-3,3,5-triphenylpyrrolenine (**3**) and 2-(1-isoquinolyl)-3,4,5-triphenylpyrrole (**4**).[1] It was also established that **3** can be isomerized to **4** by the action of acid or by fusion with potassium hydroxide. Mechanisms were suggested for the formation of **3** and its isomerization to **4**. It was also pointed out in a footnote of a previous paper[1] that 2-(1-isoquinolyl)-3-*p*-anisyl-3,5-diphenylpyrrolenine (**21**), obtained by the acid-catalyzed condensation of **1** with 1-*p*-anisyl-1-phenylethylene (**5**), gives two isomeric pyrroles, one predominating in the acid-catalyzed isomerization and the other in the potassium hydroxide fusion. It was suggested that the two pyrroles are 2-(1-isoquinolyl)-3-*p*-anisyl-4,5-diphenylpyrrole (**6**) and 2-(1-isoquinolyl)-4-*p*-anisyl-3,5-diphenylpyrrole (**7**). Based on mechanistic considerations, it was further suggested that **6** should be the product of the alkali fusion reaction and **7** that of the acid-catalyzed isomerization. We have now developed unambiguous syntheses of **4** and **6**, and these results serve to complete the proofs of structure of the compounds and to provide a firm foundation for the mechanistic considerations.

2,3,4-Triphenylpyrrole (**8**), prepared by the procedure of Pollak and Tisler,[2] was the principal starting material in the unambiguous synthesis of **4**. The key step

[1] W. E. McEwen, T. T. Yee, T.-K. Liao, and A. P. Wolf, *J. Org. Chem.*, **32**, 1947 (1967).

[2] A. Pollak and M. Tisler, *Tetrahedron Lett.*, 253 (1964).



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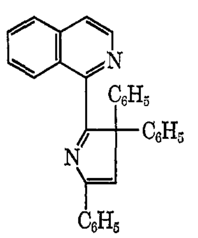

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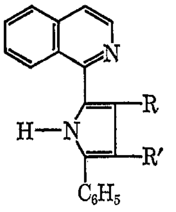
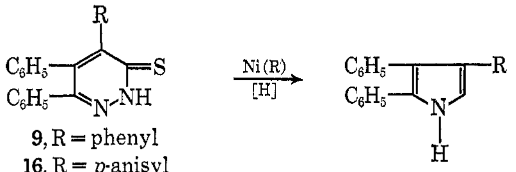


4, R = R′ = phenyl
6, R = *p*-anisyl; R′ = phenyl
7, R = phenyl; R′ = *p*-anisyl

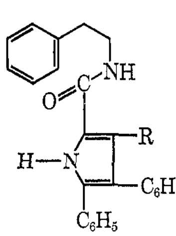
in the preparation of **8** consists of the treatment of 4,5,6-triphenyl-3(2*H*)-pyridazinethione (**9**) with Raney nickel W-6 catalyst and ammonia in alcohol solution. Pollak and Tisler[2] did not suggest a mechanism for this reaction, nor did they report the formation of other products.



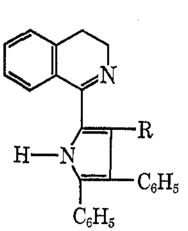
9, R = phenyl
16, R = *p*-anisyl

8, R = phenyl
17, R = *p*-anisyl

Ethyl 3,4,5-triphenylpyrrole-2-carboxylate (**10**) was obtained by treatment of **8** first with ethylmagnesium bromide and subsequently with ethyl chloroformate.[3] Reaction of **10** with β-phenethylamine gave *N*′-(2-phenethyl)-3,4,5-triphenylpyrrole-2-carboxamide (**11**), which was converted to 2-(3,4-dihydro-1-isoquinolyl)-3,4,5-triphenylpyrrole (**12**) by the action of polyphosphoric acid at 120–140° in a typical Bischler–Napieralski reaction. Dehydrogenation of **12** to **4** was effected by use of 10% palladium on charcoal in refluxing tetralin.



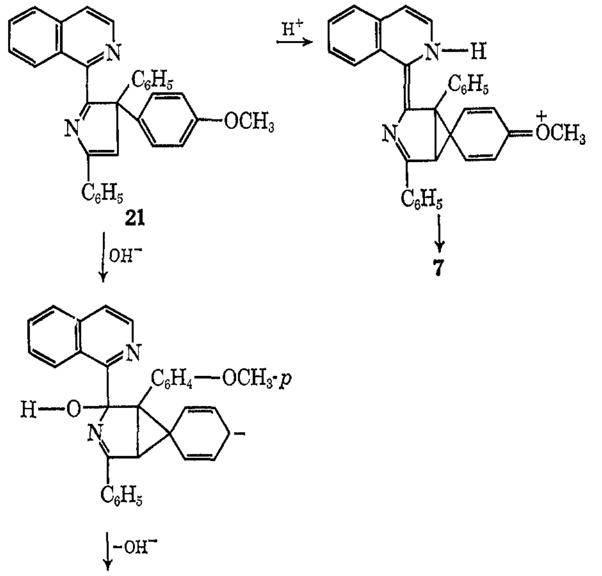
11, R = phenyl
19, R = *p*-anisyl



12, R = phenyl
20, R = *p*-anisyl

The initial step in the preparation of **6** was the condensation of benzil monohydrazone (**13**) with ethyl *p*-anisylacetate (**14**) to give 4-*p*-anisyl-5,6-diphenyl-3-(2*H*)-pyridazone (**15**). Conversion of **15** to 4-*p*-anisyl-5,6-diphenyl-3(2*H*)-pyridazinethione (**16**) was effected by the action of phosphorus pentasulfide in toluene solution. The remaining steps paralleled those employed for the independent preparation of **4**. The action of Raney nickel and ammonia on **16** in ethanol solution gave 2,3-diphenyl-4-*p*-anisylpyrrole (**17**). Treatment of **17** first with ethylmagnesium bromide and then with ethyl chloroformate gave ethyl 4,5-diphenyl-3-*p*-anisylpyrrole-2-carboxylate (**18**). Condensation of **18** with β-phenethylamine afforded *N*′-(2-phenethyl)-3-*p*-anisyl-4,5-diphenylpyrrole-2-carboxamide (**19**), which was cyclized to 2-(3,4-dihydro-1-isoquinolyl)-3-*p*-anisyl-4,5-diphenylpyrrole (**20**) by the action of phosphorus oxychloride. Dehydrogenation of **20** with 10% palladium on charcoal in refluxing decalin gave **6**.

Detailed mechanisms for both the acid-catalyzed and base-catalyzed isomerization of **3** to **4** have been published.[1] When the same mechanisms are applied to 2-(1-isoquinolyl)-3-*p*-anisyl-3,5-diphenylpyrrolenine (**21**), it is obvious that, if 2-(1-isoquinolyl)-3-*p*-anisyl-4,5-diphenylpyrrole (**6**) is the major product of the potassium hydroxide fusion reaction, then 2-(1-isoquinolyl)-4-*p*-anisyl-3,5-diphenylpyrrole (**7**) must be the isomeric product produced in the acid-catalyzed isomerization. These results are completely reasonable in that the base-catalyzed process requires migration of an aryl group carrying a net negative charge,[4] while the acid-catalyzed process requires migration of an aryl group carrying a net positive charge. Clearly, a phenyl group is better able to undergo the former migration than a *p*-anisyl group, and *vice versa* for the latter migration.[5]



An attempt was made to synthesize **7** by a scheme similar to that used for the synthesis of **6**. However, this synthesis was abandoned when the reaction of *p*-methoxybenzil (**22**) with hydrazine hydrate gave a mixture of two isomeric monohydrazones which could not be separated.[6]

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[3] *Cf.* H. Fischer and B. Walach, *Justus Liebigs Ann. Chem.*, **460**, 125 (1926).

[4] Whether "classical" structures or "phenanion" and "anisonium" ion structures, respectively, are the best representations of the transition states for the aryl migrations is not known.

[5] H. E. Zimmerman and A. Zweig, *J. Amer. Chem. Soc.*, **83**, 1196 (1961).

[6] Reaction of the mixture of the two monohydrazones with ethyl phenylacetate gave a mixture of 4,6-diphenyl-5-*p*-anisyl-3(2*H*)-pyridazone and 4,5-diphenyl-6-*p*-anisyl-3(2*H*)-pyridazone. We were not able to separate these isomers either.

An attempt was made to reproduce some results reported previously,[7] *viz.*, that the acid-catalyzed condensation of **1** with benzhydrol gives α,α-diphenylacetophenone. The only neutral, solid product which could be isolated was benzhydryl ether (**23**). We do not know why the previously reported results could not be confirmed.

Experimental Section[8]

Reaction of 2-Benzoyl-1,2-dihydroisoquinaldonitrile (1) with 1-*p*-Anisyl-1-phenylethylene (5).—To a solution of 10.0 g (0.31 mol) of **1** and 10.0 g (0.048 mol) of **5** in 200 ml of purified dioxane was added gradually, with vigorous stirring, 20 ml of concentrated sulfuric acid, and the mixture was stirred for 26 hr. The mixture was filtered to remove 0.97 g of isoquinaldamide bisulfate salt, and the filtrate was concentrated at room temperature by application of a jet of air. The residual syrupy orange solution was mixed with about 1000 ml of water and stirred vigorously. After having been allowed to stand at room temperature for a few hours, the mixture deposited an orange-yellow solid. This was collected by filtration, washed with 100 ml of hot ethanol, and recrystallized from chloroform–ethanol to give 5.80 g of colorless 2-(1-isoquinolyl)-3-*p*-anisyl-3,5-diphenylpyrrolenine (**21**), mp 204.5–205.8°.

Anal. Calcd for $C_{32}H_{24}N_2O$: C, 84.94; H, 5.35; N, 6.21. Found: C, 85.17; H, 5.34; N, 6.21.

The 100 ml of ethanol wash solution was concentrated and filtered to remove a small amount of **5** which had crystallized. After further concentration of the mother liquor a small amount of orange solid precipitated. This was collected by filtration and recrystallized from ethanol–ether to give 1.0 g of the bisulfate salt of 2-(1-isoquinolyl)-4-*p*-anisyl-3,5-diphenylpyrrole (**7**), mp 277–281°.

Anal. Calcd for $C_{32}H_{24}N_2O \cdot H_2SO_4$: C, 69.81; H, 4.72; N, 5.09; S, 5.81. Found: C, 69.99; H, 4.86; N, 5.37; S, 5.86.

Isolation of 2-(1-Isoquinolyl)-4-*p*-anisyl-4,5-diphenylpyrrole (7).—To a mixture of 1.0 g of the bisulfate salt of **7**, mp 277–281°, and 10 ml of ethanol was added dilute sodium hydroxide solution, with stirring of the mixture and heating on the steam bath, until the orange color changed to yellow. A solid which had formed was collected by filtration, washed with water, and crystallized from chloroform–ethanol to give 0.5 g of **7**, mp 237–238°.

Anal. Calcd for $C_{32}H_{24}N_2O$: C, 84.93; H, 5.35; N, 6.19. Found: C, 84.64; H, 5.29; N, 6.28.

Acid-Catalyzed Isomerization of 2-(1-Isoquinolyl)-3-*p*-anisyl-3,5-diphenylpyrrolenine (21).—A mixture of 2.0 g of **21** and 30 ml of 12 *N* sulfuric acid was heated under reflux for 4 hr. The mixture, which was orange in color, was filtered, and 2.1 g of the bisulfate salt of **7** was obtained, mp 275–280° after crystallization from ethanol–ether. Decomposition of this salt with sodium hydroxide solution gave **7**, mp 237–238° after crystallization from chloroform–ethanol.

Alkali Fusion of 2-(1-Isoquinolyl)-3-*p*-anisyl-3,5-diphenylpyrrolenine (21).—To a molten mixture of 20 g of potassium hydroxide and 2 ml of water contained in a nickel crucible was added 2.0 g of **21**, and the mixture was heated at 250–260° for 20 min, with occasional stirring. The cooled mixture was treated with 200 ml of water, and a brown solid which had precipitated was separated from the alkaline solution by decantation. Several crystallizations of the crude precipitate from ethanol and then from ethanol–chloroform gave 0.3 g of colorless 2-(1-isoquinolyl)-3-*p*-anisyl-4,5-diphenylpyrrole (**6**), mp 212–213°.

Anal. Calcd for $C_{32}H_{24}N_2O$: C, 84.93; H, 5.35; N, 6.19. Found: C, 84.93; H, 5.43; N, 6.18.

2,3,4-Triphenylpyrrole (8).—A mixture of 14.0 g (0.041 mol) of 4,5,6-triphenyl-3(2*H*)-pyridazinethione (**9**),[2] the amount of Raney nickel W-6 catalyst obtainable from 250 g of nickel–aluminum alloy powder (W. R. Grace and Co., No. 2913),[9] 110 ml of concentrated ammonia water, and 600 ml of 95% ethanol was heated under reflux with mechanical stirring for 3 hr. The hot reaction mixture was filtered to remove metallic nickel, and the filtrate was concentrated to 30 ml *in vacuo* at room temperature. A total of 5.0 g (41%) of colorless, needlelike **8**, mp 164.5–165.5° (lit.[2] mp 168°), crystallized from this solution.

Ethyl 3,4,5-Triphenylpyrrole-2-carboxylate (10).—The following procedure is a modification of a method which has been used to prepare ethyl 2,3,4-trimethylpyrrole-5-carboxylate.[3]

To 24 g (0.1 g-atom) of magnesium turnings was added a few milliliters of a solution of 11 g (0.1 mol) of ethyl bromide in 20 ml of absolute ether. When the reaction started, 100 ml of ether was added, and then the remaining ethyl bromide solution was added as fast as the rate of refluxing permitted. After a period of reflux of 45 min, a solution of 18 g (0.06 mol) of the pyrrole **8** in 240 ml of anhydrous ether was added as fast as possible, consistent with maintenance of control of the frothing due to ethane evolution, and the mixture was refluxed for 30 min.

The reaction mixture was cooled to room temperature, and a solution of 9 g (0.083 mol) of ethyl chloroformate in 20 ml of anhydrous ether was added dropwise. The solution first turned pink and then became cloudy. At the end of the addition, a white solid precipitated. The mixture was heated with magnetic stirring for 2.5 hr; then it was allowed to stand overnight at room temperature. At this stage all of the solid had precipitated.

The mixture was hydrolyzed by the addition of 100 ml of saturated ammonium chloride solution and then 100 ml of water. The light pink powder which had formed was collected on a Büchner funnel and then washed with ether. Recrystallization from 4 l. of 95% ethanol gave a pink, fluffy, crystalline solid, 11 g (50%), mp 220–221°.

Anal. Calcd for $C_{25}H_{21}NO_2$: C, 81.71; H, 5.77; N, 3.81. Found: C, 81.52; H, 5.67; N, 4.08.

***N*′-(2-Phenethyl)-3,4,5-triphenylpyrrole-2-carboxamide (11).**—A mixture of 2.0 g (5.45 mmol) of the ester **10** and 2.4 g (20 mmol) of β-phenethylamine was heated at 270° (bath temperature) for 8 hr with magnetic stirring. When the reaction mixture was cooled to room temperature, it solidified. The solid was triturated with a small amount of ether and Skelly B solvent. The white insoluble solid was collected by filtration and washed with ether. After recrystallization from 95% ethanol (800 ml), 1.3 g (54.1%) of **11**, mp 248.5–250.2°, was obtained.

Anal. Calcd for $C_{31}H_{26}N_2O$: C, 84.12; H, 5.93; N, 6.33. Found: C, 83.96; H, 5.81; N, 6.44.

2-(3,4-Dihydro-1-isoquinolyl)-3,4-5-triphenylpyrrole (12).—A mixture of 2.0 g of the amide **11** and 20 g of phosphorus pentoxide in 30 ml of toluene was heated under reflux for 6 hr in a stream of nitrogen gas with stirring. The toluene layer was decanted from the insoluble residue while hot. The black residue was poured into water (500 ml) with stirring, and the greenish-yellow precipitate which formed was collected by filtration, washed with ether, and treated with a small volume of concentrated sodium hydroxide solution. The mixture was then diluted with water. The mixture was neutralized with 6 *N* sulfuric acid and stirred overnight. The crude, dark greenish colored solid which had formed was collected by filtration and weighed 1.6 g. Its melting point was 212–214°. The solid was dissolved in a hot mixture of Skelly B solvent and methyl alcohol, and the solution was concentrated to 100 ml. It was then allowed to stand at room temperature overnight; 0.66 g (34.4%) of yellow prisms of **12** crystallized, mp 229.5–230°.

Anal. Calcd for $C_{31}H_{24}N_2$: C, 87.68; H, 5.71; N, 6.60. Found: C, 87.69; H, 5.54; N, 6.63.

2-(1-Isoquinolyl)-3,4,5-triphenylpyrrole (4) by the Dehydrogenation of 12.—A mixture of 0.3 g (0.7 mmol) of the dihydroisoquinoline **12** and 0.1 g of 10% palladium-on-carbon catalyst in 10 ml of decalin was refluxed in a nitrogen atmosphere with magnetic stirring for 5 hr. The hot reaction mixture was filtered to remove the catalyst. When the filtrate had cooled to room temperature, 0.23 g (76%) of a greenish-yellow solid crystallized. A pale yellow solid was obtained in a yield of 0.15 g (50%), mp 262.5–263.5° after recrystallization from a mixture of methyl alcohol and Skelly B solvent. This compound showed no depression in the melting point when mixed with the compound of the same melting point produced in the reaction between 2-benzoyl-1,2-dihydroisoquinaldonitrile and 1,1-diphenylethylene in the presence of concentrated sulfuric acid.[1] Also, the uv, ir, and nmr spectra of both samples were found to be identical.

4-*p*-Anisyl-5,6-diphenyl-3(2*H*)-pyridazone (15).—A solution of sodium ethoxide was prepared from 18.4 g (0.8 g-atom) of sodium and 3200 ml of absolute ethanol. The solution was placed in a 5-

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[7] T. K. Liao and W. E. McEwen, *J. Org. Chem.*, **26**, 5257 (1961).

[8] Melting points are uncorrected. All nmr spectra were taken on a Varian A-60 spectrometer at a sweep width of 500 cps. Deuteriochloroform was used as the solvent with TMS as an internal standard. Microanalyses were carried out by C. Meade and V. Giridhar.

[9] H. R. Billica and H. Adkins, "Organic Syntheses," Collect. Vol. III, Wiley, New York, N. Y., 1955, p 176.

l. flask, and 179.2 g (0.8 mol) of benzil monohydrazone[10] and 155.2 g (0.8 mol) of ethyl *p*-anisylacetate were added. The reaction mixture was refluxed, with mechanical stirring, for 3 hr, allowed to cool to room temperature, and then filtered. The filtrate was concentrated to about one-third of its original volume *in vacuo*.

The concentrated filtrate was diluted with an equal volume of cold water, and the resulting mixture was acidified with 2 *N* HCl to pH 5. The mixture was filtered to give 229.8 g (81.1%) of yellow solid. The crude product was recrystallized from ethyl ether to yield 145 g of white solid, mp 265.5–266.2°.

Anal. Calcd for $C_{23}H_{18}N_2O_2$: C, 77.97; H, 5.08; N, 7.91. Found: C, 78.21; H, 5.17; N, 7.91.

4-*p*-Anisyl-5,6-diphenyl-3(2*H*)-pyridazinethione (16).—In a typical run, a mixture of 14.16 g (0.04 mol) of 4-*p*-anisyl-5,6-diphenyl-3(2*H*)-pyridazone (15), 24 g of phosphorus pentasulfide, and 400 ml of toluene was refluxed for 1 hr. The supernatant toluene layer of the hot mixture was slowly decanted, leaving solid in the flask. The toluene solution was concentrated to about one-half of its original volume *in vacuo*, and a solid precipitated. The resulting mixture was filtered to give a bright yellow solid, which was recrystallized several times from 95% ethanol.

About 200 ml of 95% ethanol was added to the solid remaining in the original reaction flask, and the mixture was refluxed for several hours. The first crystals obtained from the resulting solution when it was cooled were separated from the mother liquor before substantial sulfur crystallization took place, and these crystals were repeatedly recrystallized from 95% ethanol.

The product from both sources was either yellow or chartreuse in color and was obtained in the form of needles with mp 275.5–277°. The average yield obtained from this reaction was 66%, and the maximum yield obtained was 98.7%.

Anal. Calcd for $C_{23}H_{18}N_2OS$: C, 74.59; H, 4.89; N, 7.57; S, 8.65. Found: C, 74.51; H, 4.91; N, 7.47; S, 8.71.

2,3-Diphenyl-4-*p*-anisylpyrrole (17).—The amount of Raney nickel W-6 catalyst obtainable from 250 g of nickel–aluminum alloy powder (W. R. Grace and Co., No. 2813) was added to 10 g (0.027 mol) of 4-*p*-anisyl-5,6-diphenyl-3(2*H*)-pyridazinethione (16), 400 ml of absolute ethanol, and 75 ml of concentrated ammonium hydroxide. The reaction mixture was heated to reflux with stirring for 3 hr.

The hot reaction mixture was filtered to remove the metallic catalyst, and the filtrate was concentrated to about one-half volume by magnetic stirring, at room temperature, under reduced pressure.

The white solid which was obtained by filtration was recrystallized from cyclohexane, and a light purple crystalline solid, mp 180–182°, was obtained. Both the white solid and the recrystallized purple form had superimposable infrared and nmr spectra, indicating that the color change was not due to decomposition of the product. The white solid also turned to a purple color if the concentration of the original filtrate was carried out until near dryness.

Further reactions were usually carried out with the white form without further purification. The average yield, obtained from this step of the synthesis, was 19%, and the best yield was 37%.

Anal. Calcd for $C_{23}H_{19}NO$: C, 84.92; H, 5.85; N, 4.31. Found: C, 84.76; H, 5.85; N, 4.23.

Ethyl 4,5-Diphenyl-3-*p*-anisylpyrrole-2-carboxylate (18).—The same method was used for the preparation of 18 as described previously for the preparation of 10, 2,3-diphenyl-4-*p*-anisylpyrrole (17) being used in place of 2,3,4-triphenylpyrrole (8).

The product obtained was sometimes a light pink and sometimes a light blue or purple, but both forms had mp 196–198° after recrystallization from 95% ethanol, and the infrared and nmr spectra of the two were superimposable. The average yield obtained was 65%, with a yield of 87.4% being realized in the best reaction.

Anal. Calcd for $C_{26}H_{23}NO_3$: C, 78.59; H, 5.79; N, 3.53. Found: C, 78.75; H, 5.82; N, 3.85.

***N'*-(2-Phenethyl)-3-*p*-anisyl-4,5-diphenylpyrrole-2-carboxamide (19).**—A mixture of 6.06 g (0.05 mol) of freshly distilled β-phenethylamine and 2.0 g (0.005 mol) of the ester 18 was heated at reflux temperature, with magnetic stirring, for 8 hr. At the end of the reflux period, the reaction mixture was cooled by means of an ice bath, and a clear yellow solution resulted. A mixture of 30 ml of ethyl ether and 30 ml of Skelly B solvent was added, and the resulting solution was thoroughly mixed by high-speed magnetic stirring. After 10–30 min, a white precipitate formed, and this was collected by filtration and washed with ether. After recrystallization from 95% ethanol, the product had mp 227–230°.

Purification of the product proved to be difficult because of inclusion of β-phenethylamine and/or ethanol. A prolonged period of heating, at reduced pressure, was required before an analysis could be obtained with a nitrogen percentage within experimental error of the expected figure. The average yield obtained from this reaction was 44%, and the highest yield obtained was 54%.

Anal. Calcd for $C_{32}H_{28}N_2O_2$: C, 81.33; H, 5.97; N, 5.93. Found: C, 79.75; H, 6.32; N, 5.86.

2-(3,4-Dihydro-1-isoquinolyl)-3-*p*-anisyl-4,5-diphenylpyrrole (20).—A solution of 0.472 g (0.001 mol) of the amide 19 in 20 ml of toluene was heated to the reflux temperature. Phosphorus oxychloride (1 ml) was added dropwise, causing the solution to turn pink. The reaction mixture was refluxed for 1 hr, and during this time the color of the solution turned dark. Following the reflux period, the solution was cooled and extracted several times with water.

The aqueous layer was adjusted to a pH value of 7.5 by addition of sodium hydroxide solution and allowed to stand, in the cold, overnight. Since no precipitation was observed at this point, the solution was adjusted to pH 7.0 by addition of a 5% solution of hydrochloric acid and extracted three times with ether. Evaporation of the ether layer left no residue.

The toluene layer, which had yielded only a small amount of solid when allowed to stand for 1 day at room temperature, was placed in the cold room overnight, and 0.187 g (38.6%) of cream-colored product, mp 195–197°, crystallized.

Anal. Calcd for $C_{32}H_{26}N_2O$: C, 84.55; H, 5.77; N, 6.16. Found: C, 84.85; H, 5.77; N, 6.31.

2-(1-Isoquinolyl)-3-*p*-anisyl-4,5-diphenylpyrrole (6).—A suspension of 175 mg (0.385 mmol) of the dihydroisoquinoline 20 and 0.06 g of 1% palladium on powdered charcoal in 6 ml of decalin was refluxed, under a nitrogen atmosphere, with magnetic stirring for 5 hr. The reaction mixture was filtered hot to remove the catalyst. Solid began to crystallize as soon as the solution was allowed to cool. About 20 mg (11.5%) of light yellow product was obtained. The melting point of this compound was 211.5–213°. A mixture melting point with a sample of 6 obtained by fusion of 21 with alkali showed no depression. Also, the infrared and nmr spectra of the two samples were found to be superimposable.

Registry No.—6, 27123-16-6; 7, 28506-35-6; 7 bisulfate, 28506-36-7; 10, 28506-37-8; 11, 28506-38-9; 12, 28506-39-0; 15, 28506-40-3; 16, 28506-41-4; 17, 28506-42-5; 18, 28506-43-6; 19, 28638-50-8; 20, 28506-44-7; 21, 28506-45-8.

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[10] A. I. Vogel, "Practical Organic Chemistry," 3rd ed, Wiley, New York, N. Y., 1957, p 856.