likely that this substance may react with a second molecule of phenol to form the secondary arsonic acid, the arsonic residue entering the position *para* to the hydroxyl groups just as the *p,p'*-hydroxy compound results from the further alteration of *p*-hydroxy-phenylarsonic acid. The yield of the acid also makes it seem probable that we are dealing with the *o,p'*-dihydroxy compound rather than the *o,o'* acid, as well as the additional possibility of its formation by condensation of *p*-hydroxy-phenylarsonic acid with a further molecule of phenol in the *o*-position. It is also probable that the *o,o'*-dihydroxy acid may occur among the reaction products but in such small amount as to render its isolation difficult. We are at present attempting to establish with certainty the identity of the new compound by synthetic means.

NEW YORK CITY.

[CONTRIBUTION FROM THE LABORATORIES OF THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH.]

CERTAIN AMINO AND ACYLAMINO PHENOL ETHERS.

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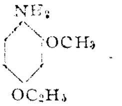
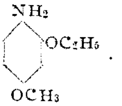
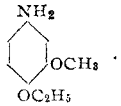
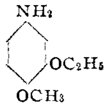
In the course of recent chemotherapeutic studies it was found necessary to prepare as intermediates certain aromatic amines containing hydroxy, methoxy, and ethoxy groups, as well as multiples and combinations of these. While the monosubstituted compounds of this type have been adequately studied there are many gaps in the series of disubstituted amines containing the groups in question, as well as a number of inaccuracies in the descriptions of compounds which have already been prepared. In the present paper we have endeavored to fill some of these gaps and correct those inaccuracies which we have encountered, confining the discussion to certain amines and acylamino derivatives of anisole and phenetole and of the simpler mono- and di-ethers of pyrocatechol and resorcinol.

Of primary interest are perhaps the 4 isomeric methoxy-ethoxy-anilines:

M. P.				
The base..............	27.5–8.5°	22.5°	55°	81.5–2°
Acetamino deriv.........	117.5–8.5	100.5–1	148.5–50	145–6
Chloroacetylamino deriv.	97.5–8	126–7	133–4	135.5–6

Of these the two derived from resorcinol have never been prepared, as far as we have been able to find, while the two amino-pyrocatechol ethers apparently were isolated as their hydrochlorides by Wisinger,[1] who also

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[1] *Monatsh.*, 21, 1013 (1900).

prepared the acetamino compounds and states that the free bases are easily oxidizable oils. Wisinger prepared the hydrochlorides and the acetyl derivatives by reduction of the two isomers obtained by nitrating pyrocatechol methylethyl ether, and designated the isomers by the letters α- and β-, being unable to determine which was the 3,4-methoxy-ethoxy- and which the 4,5-isomer. However, by ethylating 5-nitroguaiacol Paul[1] obtained a nitro ether corresponding to Wisinger's β-compound, whose β-methoxy-ethoxy-acetanilide would therefore be the 4,5-isomer, although the melting point given is considerably lower than that found by us for this compound. We have, on the other hand, found all four bases to be easily crystallizable and quite stable under ordinary conditions.

It seems also that 3-methoxy-4-ethoxy-acetanilide was prepared by Freyss[2] by ethylation of a "*p*-nitroguaiacol" (m. p. 104°), followed by reduction and isolation of the amine as the acetyl derivative. Freyss showed that the nitro group in his *p*-nitroguaiacol was in the position *para* to the hydroxyl group, so that his nitro ethyl ether should have corresponded to Wisinger's α-compound. It melted 20° higher, however, so that Wisinger's product would seem to have been either an *ortho* nitro derivative or a mixture, a conclusion borne out by the low melting point obtained by Wisinger for the acetamino compound as well. In any event, the methods employed in the present paper were such as to render it certain that no confusion between the isomers could arise.

Regarding the methods used, the substances containing the *p*-aminophenol grouping were prepared by reduction of the corresponding *p*-sulfophenylazo dye in ammoniacal solution by means of hydrogen sulfide, a method which we had used to good effect in the preparation of 4-aminoguaiacol.[3] Chloroacetyl derivatives were made according to the method devised by us and used in numerous instances already published.[4] All melting points above 140° are corrected to the short-stem thermometer basis.

EXPERIMENTAL.

(A) Derivatives of the Ethers of Phenol, *o*- and *m*-Cresol.

Chloroacetyl-*o*-anisidine, *o*-$CH_3OC_6H_4NHCOCH_2Cl$.—This substance may be obtained in almost quantitative yield from the base and chloroacetyl chloride in dil. acetic acid solution in the presence of sodium acetate.[5] After recrystallization first from ligroin and then from absolute alcohol the melting point was 48.5–9° (corr.) with slight preliminary

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[1] *Ber.*, **39**, 2777 (1906).

[2] Freyss, *Zentr.*, **1901**, I, 739.

[3] THIS JOURNAL, 41, 467 (1919).

[4] *Ibid.*, **39**, 1439 (1917) and subsequent papers.

[5] *Loc. cit.*

softening, thus confirming our original observation,[1] rather than that of Beckurts and Frerichs (51°).[2]

Chloroacetyl-*m*-anisidine.—The *m*-anisidine used in the preparation of this substance was prepared essentially as given by Reverdin and de Luc,[3] except that hydrolysis of the acetyl derivative was accomplished by boiling for $^1/_2$ hour with approximately 5 parts of 1 : 1 hydrochloric acid. Practically all of the base boiled at 131° under a pressure of 14 mm.

Six g. of *m*-anisidine were chloroacetylated in the usual way. The solution remained clear, but on chilling and rubbing in a freezing mixture it soon set to a solid cake. After adding 2 volumes of water the chloroacetyl compound was filtered off, dried, and recrystallized by dissolving in hot benzene, treating with $^1/_2$ volume of ligroin, and seeding. 6.9 g. separated as tufts of flat needles and long plates. Recrystallized again from absolute alcohol with the aid of a freezing mixture a portion melted constantly at 90.5–1.5° (corr.) with preliminary softening at 90°. It dissolves readily in the usual solvents with the exception of water and ligroin.

Subs., 0.3284: (Kjeldahl), 16.7 cc. 0.1 *N* HCl.
Calc. for $C_9H_{10}O_2NCl$: N, 7.02. Found: 7.12.

Chloroacetyl-*o*-phenetidine, *o*-$C_2H_5OC_6H_4NHCOCH_2Cl$.—This substance was obtained in almost quantitative yield, separating as an oil on dilution of the reaction mixture with an equal volume of water and soon crystallizing. A portion was recrystallized twice from 85% alcohol, separating as hexagonal rhombs melting at 65.5–7.0° (corr.) with slight, preliminary softening. It is less soluble in alcohol and ligroin than in the other usual organic solvents.

Subs., 0.3200: (Kjeldahl), 14.7 cc. 0.1 *N* HCl.
Calc. for $C_{10}H_{12}O_2NCl$: N, 6.56. Found: 6.44.

Chloroacetyl-*m*-phenetidine.—The *m*-phenetidine used for the preparation of this substance was prepared from *m*-acetaminophenol and diethyl sulfate in the presence of alkali at 50–60°, but the yield was not as good as that reported by Reverdin and Lokietek[4] using ethyl bromide. Practically all of the base boiled at 144.5° under a pressure of 20 mm.

The chloroacetyl derivative was obtained in almost quantitative yield as in the preceding cases, separating from the reaction mixture at once and forming so thick a paste that the addition of more 50% acetic acid was found necessary in order to maintain fluidity. After diluting with water a portion of the collected solid was recrystallized from 85% alcohol,

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[1] *J. Biol. Chem.*, 21, 135 (1915).

[2] *Arch. Pharm.*, 253, 233 (1915).

[3] *Ber.*, 47, 1537 (1914).

[4] *Bull. soc. chim.*, [4] 17, 407 (1915).

then from toluene, forming flat, glistening needles, melting at 125.5–6.5°. The compound is readily soluble in acetone or chloroform, somewhat less easily in alcohol, ether or benzene at room temperature. It dissolves sparingly in cold toluene, easily on boiling, and is difficultly soluble in boiling water.

Subs., 0.2000: (Kjeldahl), 9.55 cc. 0.1 *N* HCl.
Calc. for $C_{10}H_{12}O_2NCl$: N, 6.56. Found: 6.69.

Chloroacetyl-*p*-phenetidine.[1]—This substance was also prepared in good yield as in the above cases.

3-Methyl-4-methoxy-acetanilide, $3,4\text{-}CH_3(CH_3O)C_6H_3NHCOCH_3$.—Nineteen g. of *p*-amino-*o*-cresol[2] were dissolved in 170 cc. of *N* hydrochloric acid and the solution treated with 24.5 g. of acetic anhydride, followed immediately by 100 cc. of saturated sodium acetate solution. The mixture was shaken vigorously for 10 minutes and the precipitate of *p*-acetamino-*o*-cresol then filtered off and washed with water. The yield was 20 g. The crude product was converted into the methyl ether by dissolving in 1.1 equivalents of *N* potassium hydroxide solution and shaking with one equivalent of dimethyl sulfate, filtering off the ether and repeating the process with the filtrate with $^1/_4$ of the original amounts of alkali and dimethyl sulfate. The fractions were combined and a portion recrystallized from 50% alcohol, separating as large, nacreous, hexagonal scales which melted at 103–3.5° with slight preliminary softening. The compound is readily soluble in alcohol, acetone, chloroform, or ether, and dissolves sparingly in cold benzene, easily on boiling. It also dissolves with difficulty in cold water, more easily on boiling, the undissolved portions melting to an oil.

Subs., 0.1714: (Kjeldahl), 9.6 cc. 0.1 *N* HCl.
Calc. for $C_{10}H_{13}O_2N$: N, 7.83. Found: 7.85.

3-Methyl-4-methoxy-aniline.—The crude acetamino ether was boiled for one-half hour with 5 parts of 1 : 1 hydrochloric acid. The solution was diluted with water, chilled, and made strongly alkaline with sodium hydroxide. The 3-methyl-4-methoxy-aniline immediately separated in crystalline form and was filtered off, washed with water, and recrystallized from 50% alcohol. The yield obtained as outlined above from 30 g. of *p*-acetamino-*o*-cresol was 13 g., an additional 1.4 g. being obtained by dilution of the mother liquors of the recrystallization. The melting point was 59–9.5°, as given by Bamberger and de Werra,[3] who obtained the base by decomposition of *m*-tolyl-hydroxylamine with methyl alcohol containing sulfuric acid. The amine is easily soluble in alcohol, acetone, benzene, or ether, and dissolves very sparingly in cold water, readily on

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[1] Bistrzycki and Ulffers, *Ber.*, 31, 2790 (1898); *Ger. pats.* 79,174, 84,654.

[2] Prepared according to THIS JOURNAL, 39, 2198 (1917).

[3] *Ann.*, 390, 175 (footnote) (1912).

boiling, separating as an oil which crystallizes on rubbing. It may also be obtained from hot ligroin as thick, almost colorless, hexagonal plates. An aqueous suspension slowly gives a deep blue-violet color with ferric chloride, and the base is readily diazotized, coupling with R-salt to give a deep red color.

3-Methyl-4-methoxy-chloroacetanilide.—The base was chloroacetylated as in the previous experiments, giving an excellent yield of the acyl derivative on diluting the reaction mixture with a little water and rubbing. A portion was recrystallized twice from 60% alcohol, then by dissolving in warm benzene and adding an equal volume of ligroin. It forms delicate needles melting constantly at 90–2° with preliminary softening, and dissolving readily in the usual organic solvents except ligroin.

Subs., 0.1524: (Kjeldahl), 7.15 cc. 0.1 *N* HCl.
Calc. for $C_{10}H_{12}O_2NCl$: N, 6.56. Found: 6.57.

2-Methyl-4-methoxy-aniline, 2,4-$CH_3(CH_3O)C_6H_3NH_2$.—Twenty g. of *p*-acetamino-*m*-cresol[1] were methylated as in the case of the *o*-compound. The yield of the acetamino ether was 14.5 g., agreeing in its properties with those recorded by Blangey,[2] who obtained the substance by acetylation of the amino compound. Thirteen g. of the acetamino ether were boiled for one hour with 65 cc. of 1 : 1 hydrochloric acid, diluted, chilled, and the solution made strongly alkaline with 25% sodium hydroxide solution. The oily base was extracted with ether, and after drying over sodium sulfate the solvent was distilled off and the residue fractionated *in vacuo*. Nine g. of 2-methyl-4-methoxyaniline were obtained, boiling at 144–52° (almost all at 146–7°) under a pressure of 23 mm. The almost colorless liquid crystallized as diamond-shaped platelets on chilling. These melted at 13–14° (corr.), the melting point being unchanged on recrystallization from ligroin. Bamberger and Blangey,[3] who obtained the base by treating *o*-tolyl-hydroxylamine with methyl alcohol containing sulfuric acid, give the melting point as 29–30°. In other respects their description was confirmed.

Subs., 0.1459: (Kjeldahl), 10.65 cc. 0.1 *N* HCl.
Calc. for $C_8H_{11}ON$: N, 10.22. Found: 10.23.

2-Methyl-4-methoxy-chloroacetanilide.—On treating 8.7 g. of 2-methyl-4-methoxy-aniline with a mixture of 45 cc. of glacial acetic acid and 45 cc. of saturated sodium acetate solution what appeared to be the acetate of the base crystallized at once. A clear solution was obtained, however, after adding an additional 110 cc. of 50% acetic acid. The solution was then chilled and treated cautiously with 7.2 cc. of chloroacetyl chloride, with continued cooling and vigorous shaking. Precipitation of the chloro-

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[1] THIS JOURNAL, 39, 2200 (1917).

[2] *Dissertation*, Zürich, 1903.

[3] *Ibid.*, also *Ann.*, 390, 174 (footnote) (1912).

acetyl derivative was completed by adding an equal volume of water. After recrystallization from 85% alcohol the yield was 11.5 g. Recrystallized again from toluene, in which the substance is very easily soluble at the boiling point and very sparingly so in the cold, it separates as hair-like needles which melt constantly at 134.5–5.5°. It is practically insoluble in cold water but dissolves appreciably on boiling. It is sparingly soluble in cold alcohol, easily on boiling, and dissolves readily in acetone or chloroform.

Subs., 0.1749: (Kjeldahl), 8.15 cc. 0.1 *N* HCl.
Calc. for $C_{10}H_{12}O_2NCl$: N, 6.56. Found: 6.53.

***m*-Nitro-*p*-anisidine (3-nitro-4-methoxy-aniline).**—This substance was prepared by nitrating acet-*p*-anisidide according to German patent 101,778 and saponifying by boiling the nitro derivative with 25% sulfuric acid for $^1/_2$ hour. The resulting solution was diluted with water, cooled somewhat, and made strongly alkaline. The base was extracted with ether, the solvent distilled off, and the residue dried on a porous plate. The crude product was dissolved in cold benzene and recrystallized by cautiously adding ligroin and rubbing. 16 g. of acet-*p*-anisidide gave 10.4 g. of the nitro-anisidine, melting at 55–7° and not at 50° as stated in the patent. Recrystallized twice from toluene, cooled, and treated with bone black the first time to remove a slight turbidity, the compound separated slowly as a hard crust of red prisms which melted constantly at 57–7.5° (corr.). As so obtained, the substance still contained a small amount of an amorphous residue which could be removed by dissolving in hot ether, filtering from the residue, adding ligroin, and letting the ether evaporate gradually. The nitro-anisidine gradually separated as orange-red prisms and plates which melted as above. It is readily soluble in the cold in acetone, alcohol, or ether, rather less so in benzene, and difficultly in cold toluene or water, readily on boiling. It dissolves in warm 10% hydrochloric acid with a pale yellow color, the hydrochloride separating on cooling as almost colorless, glistening platelets. It is readily diazotized, giving a sparingly soluble, orange-red dye with R-salt.

Subs., 0.1182: 16.6 cc. N (19.5°, 760 mm.).
Calc. for $C_7H_8O_3N_2$: N, 16.67. Found: 16.40.

3-Nitro-4-methoxy-chloroacetanilide.—Five g. of the nitro-anisidine were dissolved in 25 cc. of glacial acetic acid and chloroacetylated in the usual way after adding 25 cc. of saturated sodium acetate solution. The acyl derivative separated during the reaction and was filtered off after adding several volumes of water. The yield was 6.7 g. A portion was recrystallized from alcohol, then twice from ethyl acetate, in which it is rather difficultly soluble, forming golden yellow, flat needles melting at 149.5–51.5°. The substance dissolves quite readily in cold acetone and is somewhat soluble in cold chloroform, more easily on boiling. It is very difficultly soluble in cold water but dissolves appreciably on boiling.

Subs., 0.1284: 12.5 cc. N (19.5°, 766 mm.).
Calc. for $C_9H_9O_4N_2Cl$: N, 11.46. Found: 11.46.

3-Acetamino-6-methoxy-benzenesulfonic Acid.—Thirty g. of 3-amino-6-methoxy-benzenesulfonic acid (prepared by sulfonating *p*-anisidine[1]) were pulverized, dissolved in 147 cc. of *N* sodium hydroxide solution and shaken vigorously for 10 minutes with 18.2 cc. of acetic anhydride. The solution was then concentrated to dryness *in vacuo* and the residue taken up with acetone, filtered off, washed with acetone, and dried.[2] The yield of crude sodium 3-acetamino-6-methoxy-benzenesulfonate was 41.3 g.

A portion of the salt was dissolved in 2 parts of hot water and the solution treated with bone black and filtered. On adding to the filtrate an equal volume of 10% hydrochloric acid and rubbing the acid separated quickly as microscopic rhombs. These were filtered off, washed with a little 10% hydrochloric acid, and recrystallized from a small volume of water containing a few drops of acetic acid. The acid separated on cooling and seeding as minute, flat needles. When rapidly heated to 195°, then slowly, it intumesces at 197–8°, resolidifies, gradually turns yellow as the temperature is further raised, and finally melts again with gas evolution at about 250°. It is readily soluble in water and only sparingly in boiling methyl alcohol, ethyl alcohol, or acetic acid.

Subs., 0.1672: (Kjeldahl), 9.7 cc. 0.1 *N* HCl.
Calc. for $C_9H_{11}O_5NS$: N, 5.71. Found: 5.80.

3-Acetamino-6-methoxy-benzene-sulfonamide, $3,6\text{-}CH_3CONH(CH_3O)\text{-}C_6H_3SO_2NH_2$.—21.7 g. of the crude, dry sodium acetamino-methoxy-benzenesulfonate were intimately mixed in a mortar with 16.8 g. of phosphorus pentachloride, transferred to a flask with a drying tube attached, and heated for one hour at 50°. Hydrogen chloride was copiously evolved and at the end the flask was evacuated for about $^1/_2$ hour in order to remove as much of the phosphorus oxychloride as possible. The residue was then ground up with ice, filtered off when pulverulent, and the crude chloride allowed to stand for 2 days with 130 cc. of 1 : 1 ammonium hydroxide. Nine g. of crude amide were obtained in this way, and the product was sufficiently pure for conversion into the amino amide. Analysis showed that recrystallization from alcohol was insufficient to ensure a pure product. As obtained in this way the sulfonamide forms faintly yellow, radiating aggregates of minute, compact crystals which are only difficultly soluble in boiling alcohol. When rapidly heated to 230°, then slowly, the substance melts to a dark liquid at 233–5.5°, with slow gas evolution.

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[1] Bauer, *Ber.*, 42, 2110 (1909).

[2] Cf. THIS JOURNAL, 39, 2428 (1917).

Subs., 0.2510: (Kjeldahl), 19.35 cc. 0.1 *N* HCl.
Calc. for $C_9H_{12}O_4N_2S$: N, 11.48. Found: 10.80.

3-Amino-6-methoxy-benzene-sulfonamide.—6.5 g. of the crude acetamino amide were boiled for 1/2 hour with 35 cc. of 1:1 hydrochloric acid. After cooling the solution was made just alkaline with ammonia and the precipitated amino-sulfonamide recrystallized from 50% alcohol. The yield was 3.4 g. Recrystallized again from 50% alcohol it separated from the cold, supersaturated solution as radiating, branched aggregates of minute, cream-colored spindles which melted at 184.5–6.0° with preliminary softening. It is difficultly soluble in the usual neutral organic solvents but dissolves readily in boiling water or 50% alcohol, less easily in boiling 95% alcohol. It dissolves in dil. hydrochloric acid or sodium hydroxide solution, the acid solution diazotizing readily and coupling with R-salt to give a deep red color. An aqueous solution gives a slowly developing brownish pink color with ferric chloride.

Subs., 0.1532: (Kjeldahl), 15.05 cc. 0.1 *N* HCl.
Calc. for $C_7H_{10}O_3N_2S$: N, 13.87. Found: 13.77.

(B) Derivatives of the Ethers of 4-Amino-pyrocatechol.

3,4-Methylenedioxy-chloroacetanilide, 3,4-$CH_2O_2C_6H_3NHCOCH_2Cl$.—Four g. of 3,4-methylenedioxy-aniline hydrochloride (from the nitro compound with tin and hydrochloric acid in dilute alcohol) were dissolved in 40 cc. of 50% acetic acid and 20 cc. of saturated sodium acetate solution, chilled in ice-water, and treated with 3 cc. of chloroacetyl chloride. The resulting mixture was ground up in a mortar, diluted with an equal volume of water, and the precipitate filtered off and washed with water. After recrystallization from 85% alcohol the yield was 3.5 g., the substance forming both prismatic needles and glistening platelets. After 3 subsequent recrystallizations from toluene, in which it is easily soluble at the boiling point, but difficultly in the cold, the substance separated entirely as plumes of microscopic needles which melted constantly at 157.5–8.5° with preliminary softening. It is readily soluble in acetone, somewhat less easily in chloroform, and only sparingly in cold alcohol, readily, however, on warming. It also dissolves in boiling water and only very difficultly in the cold. The compound gives a pale yellow color with sulfuric acid.

Subs., 0.1503: (Kjeldahl), 7.0 cc. 0.1 *N* HCl.
Calc. for $C_9H_8O_3NCl$: N, 6.56. Found: 6.52.

4-Chloroacetylamino-guaiacol, 3,4-$CH_3O(HO)C_6H_3NHCOCH_2Cl$.—16.7 g. of 4-aminoguaiacol[1] were dissolved in a warm mixture of 100 cc. of acetic acid and 100 cc. of saturated sodium acetate solution, rapidly chilled, and cautiously treated with 15 cc. of chloroacetyl chloride. The resulting solution was concentrated to small bulk *in vacuo* and the crude, crystalline

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[1] THIS JOURNAL, 41, 467 (1919).

chloro-acetyl derivative recrystallized from a small volume of 50% alcohol. The yield was 17.5 g. Recrystallized from water with the aid of bone black, it forms slightly pinkish, thin, nacreous plates which melt at 113–4° with slight preliminary softening. The substance dissolves readily in acetone, alcohol, or hot water, less easily in hot benzene, and only sparingly in cold water or cold benzene. An aqueous solution gives a yellow-brown color with ferric chloride.

Subs., 0.1554: 8.8 cc. N (28.5°, 755 mm.).
Calc. for $C_9H_{10}O_3NCl$: N, 6.50. Found: 6.37.

5-Chloroacetylamino-guaiacol, $3,4\text{-}HO(CH_3O)C_6H_3NHCOCH_2Cl$. — 5-Nitroguaiacol (m. p. 104°) was reduced according to Mameli.[1] After concentrating the detinned solution *in vacuo* and washing with a little 1 : 1 hydrochloric acid, the 5-aminoguaiacol hydrochloride (N, 7.83; calc., 7.98) formed practically colorless crystals which melted to a semifluid mass at about 160° and became completely fluid and decomposed at about 180° when rapidly heated. An aqueous solution gives a deep brown-red color with ferric chloride.

Six g. of the hydrochloride were dissolved in 25 cc. of water and chloroacetylated in the usual way after adding 10 cc. of acetic acid and 30 cc. of saturated sodium acetate solution. The substance crystallized on shaking and rubbing and was recrystallized from water containing a few drops of acetic acid, forming slightly pinkish hexagonal plates and prisms melting at 128–48° with preliminary softening. The yield was only 2.7 g., owing to considerable loss during the recrystallization. Two subsequent recrystallizations from toluene gave the melting point 140–50°, with preliminary softening, the compound forming pale pink, nacreous platelets. It dissolves in alcohol, ethyl acetate, boiling toluene, or boiling water, and is almost insoluble in cold toluene or benzene.

Subs., 0.1512: (Kjeldahl), 6.9 cc. 0.1 *N* HCl.
Calc. for $C_9H_{10}O_3NCl$: N, 6.50. Found: 6.39.

***p*-Sulfophenylazo-*o*′-ethoxy-phenol,** $p\text{-}HO_3SC_6H_4N:NC_6H_3(OC_2H_5)\text{-}OH(3',4'\text{-})$.—23.1 g. of air-dry sodium sulfanilate (0.1 mol.) were dissolved in 400 cc. of ice and water, 7 g. of sodium nitrite added, and 60 cc. of 1 : 1 hydrochloric acid run in, with stirring. The resulting mixture was slowly added to a solution of 13.8 g. of *o*-ethoxyphenol (guethol), keeping the temperature at 20° by adding ice.[2] After stirring for 15 minutes, the deep orange-brown solution was acidified strongly with conc. hydrochloric acid. On rubbing and stirring the dye separated quickly as glistening, coppery aggregates of platelets. After letting stand overnight in the ice box the dye was filtered off and washed with 10% hydrochloric acid and then with acetone. The yield was 26.3 g. A portion was recrys-

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[1] *Chem. Centr.*, 1908, I, 25.

[2] Cf. the analogous preparation of 4-aminoguaiacol, *Loc. cit.*

tallized from water, in which it is difficultly soluble in the cold, easily on boiling, forming dark red platelets with a purple reflex. After washing with a little water, then with acetone, and air-drying, the substance contained approximately 2 molecules of water of crystallization. When rapidly heated the anhydrous compound melts and evolves gas at about 220°, with preliminary decomposition, while if the heating is slow above 200° it merely softens and gradually decomposes as the temperature is raised. The dye is readily soluble in methyl alcohol, less easily in absolute alcohol, changing to orange. It is somewhat soluble in boiling acetic acid, difficultly in cold water, the color changing to bright orange-red owing to formation of the hydrate. It dissolves readily in boiling water and gives a bright red color with conc. sulfuric acid.

Subs., air-dry, 0.3140: loss, 0.0338 *in vacuo* at 100° over H_2SO_4.
Calc. for $C_{14}H_{14}O_5N_2S.2H_2O$: H_2O, 10.06. Found: 10.76.
Subs., anhydrous, 0.1364: 10.55 cc. N (30.5°, 755 mm.).
Calc. for $C_{14}H_{14}O_5N_2S$: N, 8.70. Found: 8.64.

4-Amino-6-ethoxy-phenol, 4,6-$H_2N(C_2H_5O)C_6H_3OH$.—Seventy-two g. of the crude dye were dissolved in 720 cc. of 10% aqueous ammonia and treated with a rapid stream of hydrogen sulfide. The solution became hot, suddenly decolorized, and then began to deposit the aminophenol. After passing in hydrogen sulfide for $^1/_2$ hour the mixture was cooled with ice-water and the aminophenol filtered off and dried. The yield was 29 g. Recrystallization from 85% alcohol yielded an impure product, apparently owing to partial oxidation, so a portion of the substance was suspended in a little water, dissolved by adding hydrochloric acid, and the solution treated with sodium acetate. The resulting precipitate of dark, flocculent material was filtered off with the aid of bone black and the filtrate neutralized with sodium hydrogen carbonate. Under these conditions the compound separated as almost colorless, minute, glistening, hexagonal platelets melting to a deep brown liquid at 186–8° with preliminary darkening and softening. The aminophenol is readily soluble in hot acetone, less easily in the cold, and dissolves in boiling alcohol and only sparingly in the cold. It is rather sparingly soluble in boiling water and dissolves in alkali with a gray lilac color, changing to deep violet. An alcoholic solution gives an olive color with ferric chloride. The substance also turns purple with sulfuric acid, but dissolves with very little color.

Subs., 0.1493: (Kjeldahl), 9.7 cc. 0.1 *N* HCl.
Calc. for $C_8H_{11}O_2N$: N, 9.15. Found: 9.10.

4-Acetamino-6-ethoxy-phenol.—Twenty-nine g. of the crude aminophenol were dissolved in 145 cc. of warm 50% acetic acid, chilled in ice-water, and shaken with 23 g. (1.2 mols.) of acetic anhydride. The acetyl derivative crystallized on rubbing, and after diluting with a little water and letting stand in the ice box the collected product was recrystallized from 50% alcohol. The yield was 23.4 g. Recrystallized first from water containing a few drops of acetic acid, using bone black, then from 50% acetic acid, the acetaminophenol forms practically colorless, nacreous platelets which melt at 165.5–6.5° with preliminary softening. It is readily soluble in alcohol at room temperature, the solution giving an olive color with ferric chloride. It is very difficultly soluble in cold water, easily on boiling, an aqueous suspension giving an orange color with ferric chloride. The substance is soluble in warm acetone, sparingly in the cold, and is also slightly soluble in boiling benzene.

Subs., 0.1875: (Kjeldahl), 9.8 cc. 0.1 *N* HCl.
Calc. for $C_{10}H_{13}O_3N$: N, 7.19. Found: 7.32.

4-Chloroacetylamino-6-ethoxy-phenol.—In this case it was necessary to add 6 additional parts of 50% acetic acid to the usual acetic acid-sodium acetate mixture before a clear solution could be obtained. The crude chloroacetyl derivative was recrystallized from 50% alcohol, in which it is easily soluble at the boiling point and only sparingly so a few degrees below. The yield was equal to the amount of aminophenol taken. Recrystallized again from boiling toluene it forms woolly needles which melt at 155–6° with preliminary softening. It dissolves readily in acetone and in boiling chloroform or alcohol, less easily in the last two in the cold. It also dissolves in cold methyl alcohol or boiling water, and is rather sparingly soluble in boiling toluene.

Subs., 0.1546: (Kjeldahl), 6.55 cc. 0.1 *N* HCl.
Calc. for $C_{10}H_{12}O_3NCl$: N, 6.11. Found: 5.93.

4-Acetamino-guaiacol.—Forty g. of 4-aminoguaiacol[1] were dissolved in 200 cc. of 50% acetic acid and shaken with 1.2 molecular equivalents of acetic anhydride. The resulting solution was concentrated to dryness *in vacuo* and taken up in the minimum amount of water. The acetyl derivative crystallized on rubbing and letting stand, and was filtered off, dried, and recrystallized by dissolving in hot ethyl acetate, treating with bone black, and precipitating with the aid of ether. The yield was 25 g., the substance corresponding in its properties with that reported in the literature.[2] An additional amount was recovered by concentrating the mother liquors and adding ether.

4-Amino-veratrol.—12.5 g. of 4-acetaminoguaiacol were methylated in the usual way with dimethyl sulfate and potassium hydroxide solution, saturating with salt at the end to complete the separation of the acetamino-veratrole. This was filtered off, washed with a little ice-water, and saponified by boiling for 50 minutes with 25% sulfuric acid. The solution was chilled, made strongly alkaline, and the crystalline base fil-

[1] *Loc. cit.*

[2] *Ber.*, 39, 3340; *Chem. Zentr.*, 1911, II, 1437.

tered off and washed first with saturated sodium chloride solution, then with a little ice-water. The yield was 7.5 g., corresponding in its properties with those recorded in the literature.

3,4-Dimethoxy-chloroacetanilide.—Five g. of 4-amino-veratrol were chloroacetylated as in previous experiments. After recrystallization from 50% alcohol the yield was 6.2 g. Recrystallized from benzene it forms long, silky needles which melt constantly at 133.5–4.5° with slight preliminary softening. The compound dissolves readily in chloroform or acetone, rather sparingly in cold alcohol, easily on warming, and also dissolves in boiling water or boiling benzene.

Subs., 0.1655: (Kjeldahl), 7.35 cc. 0.1 *N* HCl.
Calc. for $C_{10}H_{12}ONCl$: N, 6.11. Found: 6.22.

3-Methoxy-4-ethoxy-acetanilide, $3,4\text{-}CH_3O(C_2H_5O)C_6H_3NHCOCH_3$.—16.7 g. of 4-acetamino-guaiacol were dissolved in the minimum amount of boiling water and treated with 95 cc. of *N* potassium hydroxide solution, the temperature dropping to 45°. Twelve g. of diethyl sulfate were then added in small portions, with vigorous shaking, the temperature remaining at 45–50° and the ether separating before all of the diethyl sulfate had been added. After shaking for a few minutes longer 50 cc. more of *N* potassium hydroxide solution were added, the temperature was raised to 50°, and the mixture then shaken with an additional 6 cc. of diethyl sulfate. After treating with aqueous ammonia to decompose any unchanged diethyl sulfate, the mixture was cooled, allowed to stand, and the product filtered off and dried. The yield was 15.8 g. A portion was recrystallized first from water, in which the colored impurities remained insoluble, and then from toluene, separating as long, narrow, nacreous plates which melt at 148.5–50° with slight preliminary softening. The compound separates from water as thick plates and columns. It also dissolves in alcohol or acetone at room temperature, and dissolves readily in hot benzene and freely, but slowly, in boiling toluene.

Subs., 0.1518: (Kjeldahl), 7.4 cc. 0.1 *N* HCl.
Calc. for $C_{11}H_{15}O_3N$: N, 6.70. Found: 6.83.

As stated in the introduction, this substance appears to have been obtained by Freyss.[1]

3-Methoxy-4-ethoxy-aniline.—14.5 g. of the acetamino compound were boiled for 55 minutes with 70 cc. of 25% sulfuric acid. The mixture was cooled, causing the sulfate to separate as large plates, and was made strongly alkaline and shaken out with ether. After drying the ethereal extract, concentrating, and fractionating the residue *in vacuo*, 6 g. of the base were obtained. It is a faintly yellow, very viscous liquid, which boils at 175–6° under a pressure of 20 mm. and soon solidifies to a mass of prismatic needles which show a solidification point of 55° (corr.) when

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[1] *Loc. cit.*

the thermometer is placed in the crystallizing liquid. A few of the crystals, crushed on a porous plate, melted with preliminary softening at 55° to a turbid liquid which cleared completely at 59°. The crystalline base dissolves readily at room temperature in alcohol, benzene, or ether, and only sparingly in ligroin. It is difficultly soluble in water, the solution turning brown with ferric chloride and changing through wine-red to reddish purple on standing. From a solution in an excess of dil. hydrochloric acid the hydrochloride separates on chilling as very thin, nacreous scales. It is readily diazotizable, the purple-red diazo solution (brownish green in thin layers) coupling with R-salt to give an intense purple-red color.

Subs., 0.1337: (Kjeldahl), 7.8 cc. 0.1 *N* HCl.
Calc. for $C_9H_{13}O_2N$: N, 8.39. Found: 8.19.

3-Methoxy-4-ethoxy-chloroacetanilide.—3.5 g. of the base were chloroacetylated in a mixture of 45 cc. of 50% acetic acid and 15 cc. of saturated sodium acetate solution. After diluting with water and washing the collected product the yield was 4 g. Recrystallized from a small volume of 50% alcohol, in which it is easily soluble at the boiling point and very much less so on cooling even a few degrees, the substance forms long, silky needles which melt slowly at 133–4° with slight preliminary softening. It dissolves readily in acetone or chloroform, less easily in the cold in alcohol or benzene, and is fairly readily soluble in boiling water.

Subs., 0.1586: (Kjeldahl), 6.7 cc. 0.1 *N* HCl.
Calc. for $C_{11}H_{14}O_3NCl$: N, 5.75. Found: 5.92.

4-Methoxy-5-ethoxy-acetanilide, 4,5-$CH_3O(C_2H_5O)C_6H_3NHCOCH_3$.—Eighteen g. of 4-acetamino-6-ethoxy-phenol (see p. 1459) were dissolved in 100 cc. of *N* potassium hydroxide solution and the deep blue solution methylated in the usual way by means of dimethyl sulfate. The methyl ether separated almost at once and the yield of crude product was 18.3 g. A portion was recrystallized first from water, containing a few drops of acetic acid, using bone black, then from toluene, forming slightly purple, very thin, nacreous scales which melt slowly and constantly at 145–6° with preliminary softening. A mixture with the 3,4-isomer, which melts only a few degrees higher, softens and gradually melts above 115°, becoming entirely clear at 138°. The compound dissolves freely at room temperature in alcohol, acetone, or chloroform, and is sparingly soluble in cold toluene, easily on boiling. It is also difficultly soluble in cold water, but fairly readily so at the boiling point.

Subs., 0.1495: (Kjeldahl), 7.15 cc. 0.1 *N* HCl.
Calc. for $C_{11}H_{15}O_3N$: N, 6.70. Found: 6.70.

4-Methoxy-5-ethoxy-aniline.—17.5 g. of the acetamino compound were boiled with 10 parts of 25% sulfuric acid. The clear, dark purple solution was cooled in a freezing mixture, made strongly alkaline, and extracted with ether. After drying and concentrating, the crystalline residue was taken up in boiling benzene and the solution treated with ligroin until the initial turbidity barely disappeared. 10.2 g. of the base crystallized on seeding. Recrystallized from water with the aid of bone black, then from 50% alcohol, the substance separates slowly as faintly pinkish, rhombic crystals which melt constantly at 81.5–2° (corr.), with slight preliminary softening. It dissolves very easily in acetone or benzene, somewhat less readily in alcohol or ether, and only sparingly in 50% alcohol at 0°, but readily on warming. It is quite soluble in boiling water and rather difficultly in the cold, the aqueous solution gradually giving an intense violet color with ferric chloride. A solution of the base in 1 : 1 hydrochloric acid soon deposits the hydrochloride as delicate, colorless needles. In a dil. hydrochloric acid solution of the amine sodium nitrite gives a transient purple color, brown in thin layers, changing to brownish gray, and the substance couples with R-salt to give a deep red color.

Subs., 0.1688: (Kjeldahl), 10.3 cc. 0.1 *N* HCl.
Calc. for $C_9H_{13}O_2N$: N, 8.39. Found: 8.55.

4-Methoxy-5-ethoxy-chloroacetanilide.—5.1 g. of the base were dissolved in a mixture of 50 cc. of 50% acetic acid and 25 cc. of saturated sodium acetate solution, diluted with 100 cc. of 25% acetic acid, and treated with 4.3 cc. of chloro-acetyl chloride, with chilling and stirring. The chloro-acetyl derivative, which separated immediately, was filtered off and recrystallized from alcohol, the yield being 5.6 g. Recrystallized again from toluene it forms delicate, woolly needles which melt constantly at 135.5–6° with slight preliminary softening. It dissolves readily in acetone or chloroform, less easily in alcohol, and difficultly in cold toluene or benzene, but readily on boiling. It is rather sparingly soluble in boiling water. In its properties, therefore, it closely resembles the 3-methoxy-4-ethoxy isomer.

Subs., 0.1578: (Kjeldahl), 6.4 cc. 0.1 *N* HCl.
Calc. for $C_{11}H_{14}O_3NCl$: N, 5.75. Found: 5.68.

Diacetyl-4-amino-pyrocatechol.—Twenty-five g. of crude 4-aminopyrocatechol hydrobromide[1] were purified by solution in water containing a few drops of hydrobromic acid, treating with a few grams of stannous chloride, detinning with hydrogen sulfide, and concentrating the solution to dryness *in vacuo*. The residue was taken up in 75 cc. of water, treated with 90 cc. of saturated sodium acetate solution, and shaken with 14 cc. (1.1 mols.) of acetic anhydride. The resulting mixture was cooled and filtered and the filtrate treated with solid sodium acetate and again shaken with 5 cc. of acetic anhydride. An additional amount of the diacetyl derivative separated and was filtered off, washed with a little water, and combined with the first fraction, the total yield being 14.4 g. Recrys-

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[1] THIS JOURNAL, 41, 467 (1919).

tallized twice from 50% alcohol containing a few drops of acetic acid, the substance separates as thin, glistening, faintly pinkish, hexagonal platelets which melt constantly at 187.5-92°. The compound dissolves readily in acetone, rather sparingly in 50% or 95% alcohol at room temperature, and difficultly in cold water, readily on boiling. An aqueous solution gives a grayish brown color with ferric chloride. An aqueous suspension dissolves on adding a drop of dil. sodium carbonate or ammonia, the solution in the latter case turning rose-brown on shaking. When an aqueous suspension is warmed with sodium nitrite and a few drops of acetic acid the resulting clear solution deposits, on cooling and scratching, golden yellow platelets of a nitroso derivative which dissolves in alkalies with a brown-red color, changing rapidly to purple-red.

Subs., 0.1598: (Kjeldahl), 7.85 cc. 0.1 *N* HCl.
Calc. for $C_{10}H_{11}O_4N$: N, 6.70. Found: 6.88.

3,4-Diethoxy-acetanilide, 3,4-$(C_2H_5O)_2C_6H_3NHCOCH_3$.—Thirteen g. of diacetyl-4-amino-pyrocatechol were suspended in about 150 cc. of water in a flask provided with a 3-hole stopper through which passed a gas delivery tube, an exit tube, and a dropping funnel. After the air in the flask had been displaced by hydrogen, 110 cc. of 2 *N* potassium hydroxide solution (a little over 3 mols.) were added through the dropping funnel, followed, after complete solution had taken place, by 16.5 cc. (2 mols.) of diethyl sulfate. The mixture was then warmed on the water bath, shaking continuously and passing in a stream of hydrogen. The diethoxy-acetanilide finally separated in crystalline form, after which 20 cc. of 5 *N* potassium hydroxide solution and 9 cc. of diethyl sulfate were added and the mixture again shaken and heated. After all of the diethyl sulfate had apparently been used up ammonia was added and the mixture allowed to cool slowly. It was finally chilled in ice, filtered, and the crude product recrystallized from a small volume of 50% alcohol. The yield was 4.9 g., agreeing in all of its properties with the substance as obtained by the alternative method described below and causing no sensible depression of the melting point when mixed with this.

4-Acetamino-6-ethoxy-phenol (see p. 1459) was ethylated in exactly the same manner as described for the ethylation of 4-acetamino-guaiacol (see p. 1460). The yield of crude 3,4-diethoxy-acetanilide obtained in this way was slightly more than the amount of starting material used, and this method is therefore recommended when guethol is available, as it is more direct and the yield is better. Recrystallized from 50% alcohol it forms nacreous platelets which melt at 124-5.5° with slight preliminary softening, thus agreeing with the description given by Wisinger,[1] who obtained the compound by reduction of nitro-pyrocatechol diethyl ether, acetylation of the amine hydrochloride, and saponification of the diacetyl

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[1] *Monatsh.*, **21**, 1015 (1900).

derivative so obtained. Wisinger was unable to isolate the free base in a state of purity, but as will be seen below, this offers little difficulty.

Subs., 0.1740: (Kjeldahl), 7.75 cc. 0.1 *N* HCl.
Calc. for $C_{12}H_{17}O_3N$: N, 6.28. Found: 6.24.

3,4-Diethoxy-aniline.—6.8 g. of the diethoxy-acetanilide were boiled for 15 minutes with 35 cc. of 1 : 1 hydrochloric acid, diluted with 2 parts of water, cooled somewhat, made strongly alkaline, chilled rapidly, and the mixture extracted with ether. The ethereal solution, when dried and concentrated, yielded 4.8 g. of the base as a crystalline residue. Recrystallized first by dissolving in benzene, adding ligroin, and letting stand in the ice box, then from a relatively large volume of ligroin, it separates as cream colored prisms, rhombs, thick plates, and needles which melt constantly at 47.5–8.5° (corr.). It is readily soluble in the cold in the usual neutral organic solvents with the exception of ligroin, and is also appreciably soluble in cold water. The aqueous solution gives an intense violet color with ferric chloride. When the base is dissolved in warm, dil. hydrochloric acid, the hydrochloride separates on cooling as delicate needles. A solution of the salt gives a purple color with sodium nitrite, coupling with R-salt to give a purple-red color.

Subs., 0.1513: (Kjeldahl), 8.4 cc. 0.1 *N* HCl.
Calc. for $C_{10}H_{15}O_2N$: N, 7.74. Found: 7.78.

3,4-Diethoxy-chloroacetanilide.—The base was dissolved in a mixture of 15 parts of 50% acetic acid and 3 parts of saturated sodium acetate solution and chloroacetylated in the usual way. Precipitation of the chloroacetyl derivative was completed by dilution with water. Recrystallized first from 85% alcohol, then from toluene, it forms hair-like needles which melt at 122.5–4.5° with slight preliminary softening and resolidification a few degrees below the melting point. The substance dissolves readily in acetone or chloroform, less easily in cold alcohol, and only sparingly in cold toluene although very readily on boiling. It is practically insoluble in cold water, appreciably so on boiling, and dissolves in conc. sulfuric acid with a faint greenish yellow color.

Subs., 0.1529: (Kjeldahl), 6.15 cc. 0.1 *N* HCl.
Calc. for $C_{12}H_{16}O_3NCl$: N, 5.44. Found: 5.63.

(C) Derivatives of the Ethers of Resorcinol.

***p*-Sulfophenylazo-*m*-methoxy-phenol,** p-$HO_3SC_6H_4N : NC_6H_3(OCH_3)OH(o',p'$-).—This substance was prepared exactly in the same way as was the *p*-sulfophenylazo-*o*-ethoxy-phenol described above (p. 1458), using 12.4 g. of resorcinol monomethyl ether. 25.2 g. of the dye separated as an orange-red crystalline precipitate on strongly acidifying the reaction mixture with hydrochloric acid. A portion of the dye was recrystallized from water, in which it is sparingly soluble in the cold, quite easily on boiling, separating as lustrous, brown-orange, lenticular platelets. After washing with water, then with acetone, and air-drying, the compound retained approximately one molecule of water of crystallization. The anhydrous substance forms a brick red powder which gradually darkens on heating and chars and swells at about 250°. It is fairly readily soluble in absolute alcohol, finally crystallizing out again on warming as short, thick, orange, microscopic plates. It is rather sparingly soluble in boiling acetic acid, a portion separating from the hot solvent in this case as well, apparently owing to combination with the solvent. The dye dissolves in conc. sulfuric acid with a yellow orange color, in dil. carbonates or alkalies with a reddish orange color.

Subs., air-dry, 0.2534: loss, 0.0163 *in vacuo* at 100° over H_2SO_4.
Calc. for $C_{13}H_{12}O_5N_2S.H_2O$: H_2O, 5.52. Found: 6.43.
Subs., anhydrous, 0.1293: 9.8 cc. N (24.5°, 770 mm.).
Calc. for $C_{13}H_{12}O_5N_2S$: N, 9.09. Found: 8.82.

4-Amino-5-methoxy-phenol, 4,5-$H_2N(CH_3O)C_6H_3OH$.—Twenty-four g. of *p*-sulfo-phenylazo-*m*-methoxy-phenol were dissolved in 240 cc. of 10% ammonium hydroxide and treated with a rapid stream of hydrogen sulfide until the solution became brown and the aminophenol was precipitated. After cooling, the precipitate, white at first, was filtered off and washed with water, rapidly turning gray on exposure to air. After drying *in vacuo* the yield was 7.6 g. Recrystallized from boiling toluene, in which it is sparingly soluble, the base separates as delicate, pale purple-brown needles which darken when heated, blacken markedly at about 160°, and then soften, finally melting at 175–80° to a purple-black liquid. The substance dissolves in alcohol, but is very sparingly soluble in cold water, although readily on boiling, the solution turning purple in the air. An aqueous suspension gives a slowly developing brownish purple color with ferric chloride.

Subs., 0.1500: (Kjeldahl), 10.8 cc. 0.1 *N* HCl.
Calc. for $C_7H_9O_2N$: N, 10.07. Found: 10.08.

The hydrochloride of this substance was obtained by Henrich and Rhodius[1] by reduction of nitroso-resorcinol monomethyl ether with stannous chloride, but the free base was not isolated. The isomeric resorcinol derivative containing the amino group in the position *para* to the methoxy group, was obtained by Bechhold[2] by reduction of the phenol-azo-resorcin monomethyl ether formed on methylation of phenyl-azo-resorcinol.

4 - Acetamino - 5 - methoxy - phenol.—4-Amino-5-methoxy-phenol was acetylated in 50% acetic acid solution by means of acetic anhydride. The resulting solution was concentrated to dryness *in vacuo* and the residue taken up in hot water and the solution treated with bone black and filtered. The acetyl derivative separated on standing overnight.

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[1] *Ber.*, 35, 1485 (1902).

[2] *Ibid.*, 22, 2378 (1889).

Recrystallized with the aid of bone black from water containing a few drops of acetic acid, then from toluene, which removes a black impurity, the acetaminophenol separates as pale pink aggregates of minute needles which begin to melt above 140° when slowly heated and finally melt completely at 169–71.5°. When rapidly heated the substance melts at 150–5°, resolidifies in a few moments, and then melts again at 169–71°. It is soluble in cold alcohol or acetone and dissolves rather sparingly in cold water, readily on boiling, separating on cooling as radiating masses or spears.

Subs., 0.1571: (Kjeldahl), 8.70 cc. 0.1 *N* HCl.
Calc. for $C_9H_{11}O_3N$: N, 7.74. Found: 7.76.

4-Chloroacetyl-amino-5-methoxy-phenol.—Five g. of crude 4-amino-5-methoxy-phenol were dissolved in 60 cc. of 50% acetic acid and treated with bone black. The filtrate was treated with 25 cc. of saturated sodium acetate solution and chloroacetylated in the usual way. After recrystallization from 50% alcohol the yield of the acyl derivative was 5.1 g. Recrystallized again from ethyl acetate it forms practically colorless, nacreous platelets which melt constantly at 165.5–6.5° with preliminary softening. The substance is easily soluble in cold alcohol or acetone, also in boiling ethyl acetate or water, but sparingly in the cold. It is also very difficultly soluble in boiling chloroform.

Subs., 0.1534: (Kjeldahl), 7.25 cc. 0.1 *N* HCl.
Calc. for $C_9H_{10}O_3NCl$: N, 6.50. Found: 6.53.

***p*-Sulfophenylazo-*m*′-ethoxy-phenol.**—This substance was prepared exactly as given for the analogous dyes already described, using 13.8 g. of resorcinol monoethyl ether. The product separated slowly on acidifying strongly with hydrochloric acid, and was filtered off after standing in the refrigerator overnight, washed with ice-water and acetone, and dried. The yield was 25.4 g. Recrystallized from water, it forms flat, minute, glistening, brown orange, pointed needles and narrow plates with bevelled edges. After washing with acetone and air-drying, the substance contained approximately one molecule of water of crystallization. The anhydrous substance forms a brick-red powder which blackens at about 250–5° and softens on further heating, but does not melt below 285°. It is difficultly soluble in boiling absolute alcohol or acetic acid and is practically insoluble in boiling acetone. In sulfuric acid it gives a bright orange color. It dissolves rather sparingly in cold water with the same color, becoming slightly more red on adding alkali.

Subs., air-dry, 0.5054: loss, 0.0306 *in vacuo* at 100° over H_2SO_4.
Calc. for $C_{14}H_{14}O_5N_2S.H_2O$: H_2O, 5.30. Found: 6.06.
Subs., anhydrous, 0.1197: 9.05 cc. N (23.5°, 759 mm.).
Calc. for $C_{14}H_{14}O_5N_2S$: N, 8.70. Found: 8.70.

4-Amino-5-ethoxy-phenol. — *p*-Sulfo-phenylazo-*m*′-ethoxy-phenol was reduced by hydrogen sulfide in ammoniacal solution as in previous experiments. The yield of aminophenol was about 40% of the dye used. A portion was rapidly recrystallized from water containing hydrogen sulfide to suppress the oxidation which otherwise occurred, forming gray, glistening, microscopic leaflets which melt at 152–4° with preliminary softening and blackening. The compound dissolves readily in alcohol, less easily in cold acetone, readily on boiling, and is sparingly soluble in hot chloroform. It dissolves in boiling toluene with the exception of a few dark flocks, but on attempting to purify a portion of the substance by this method it darkened rapidly owing to oxidation. An aqueous suspension gives a purple color with ferric chloride, deepening to an intense violet, while a solution of the compound in dil. alkali rapidly turns dark purple and gives a dark purple precipitate.

Subs., 0.1530: (Kjeldahl), 10.0 cc. 0.1 *N* HCl.
Calc. for $C_8H_{11}O_2N$: N, 9.15. Found: 9.16.

4-Acetamino-5-ethoxy-phenol.—Twenty g. of 4-amino-5-ethoxy-phenol were dissolved in 240 cc. of 50% acetic acid, treated with bone black, and the filtrate shaken with 15.2 cc. of acetic anhydride. After several hours in the cold the acetaminophenol was filtered off and washed with water. The yield was 20.6 g., an additional 2.1 g. being obtained on concentration of the mother liquors. A portion was recrystallized first from 60% alcohol, then from 50% acetic acid, separating on seeding as pointed prisms of various shapes which melt slowly at 172.5–4.5° with preliminary softening, the melting point being unchanged by a subsequent recrystallization. The substance is fairly readily soluble in cold alcohol, acetone, or ethyl acetate, and is very difficultly soluble in cold water, although quite soluble on boiling.

Subs., 0.1839: (Kjeldahl), 9.3 cc. 0.1 *N* HCl.
Calc. for $C_{10}H_{13}O_3N$: N, 7.19. Found: 7.09.

4-Chloroacetyl-amino-5-ethoxy-phenol.—4-Amino-5-ethoxy-phenol was chloroacetylated exactly as in the case of the 4,6-isomer (p. 1460). Recrystallized first from 50% alcohol containing a few drops of acetic acid, using bone black, the substance separates as gray, felted needles, while after a subsequent recrystallization from toluene it forms nacreous, feathery aggregates of gray plates which melt slowly at 158.5–61°. It dissolves readily in alcohol or acetone, less easily in chloroform, and is rather difficultly soluble in boiling water and practically insoluble in the cold. An alcoholic solution gives an olive color with ferric chloride.

Subs., 0.1523: (Kjeldahl), 9.45 cc. 0.714 *N*[1] HCl.
Calc. for $C_{10}H_{12}O_3NCl$: N, 6.11. Found: 6.20.

2,4-Dimethoxy-aniline, 2,4-$(CH_3O)_2C_6H_3NH_2$.—This substance was pre-

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[1] Equal to $^1/_{14}$ normal.

pared by methylating 4-acetamino-5-methoxy-phenol with aqueous alkali and dimethyl sulfate and hydrolyzing the resulting 2,4-dimethoxy-acetanilide by boiling for $^1/_2$ hour with 1 : 1 hydrochloric acid, just as was done in the preparation of 4-amino-veratrole from 4-acetamino-guaiacol. The solution was made strongly alkaline and the base extracted with ether. After drying, this was concentrated to small bulk, the residue crystallizing in a freezing mixture. The product was melted, taken up in several volumes of ligroin, and the solution chilled and seeded. The base separated as nacreous, pinkish platelets which melted at 32.5–3.5° (corr.), the melting point being unchanged by subsequent recrystallization from a mixture of benzene and ligroin with the aid of a freezing mixture. According to Bechhold,[1] who prepared the base by reduction of phenyl-azo-resorcinol dimethyl ether, it melts at 39–40°. An aqueous solution gives a deep purple color with ferric chloride, while an alcoholic solution gives a green color, gradually changing to violet-brown.

Subs., 0.1226: (Kjeldahl), 7.9 cc. 0.1 *N* HCl.
Calc. for $C_8H_{11}O_2N$: N, 9.15. Found: 9.03.

The hydrochloride of this substance was also prepared by Kauffmann and Kugel[2] by reduction of the nitro compound with tin and hydrochloric acid.

2,4-Dimethoxy-chloroacetanilide.—This compound was prepared from the base as in previous examples and recrystallized from 50% alcohol, the yield being almost quantitative. It forms delicate needles which melt at 89.5–90° (corr.) with slight preliminary softening. It dissolves readily in the usual organic solvents in the cold, with the exception of ligroin, in which, however, it is appreciably soluble in the cold and readily on heating. It is almost insoluble in cold water but dissolves fairly readily on boiling.

Subs., 0.1310: (Kjeldahl), 5.7 cc. 0.1 *N* HCl.
Calc. for $C_{10}H_{12}O_3NCl$: N, 6.11. Found: 6.09.

2-Methoxy-4-ethoxy-acetanilide, 2,4-$CH_3O(C_2H_5O)C_6H_3NHCOCH_3$.—4-Acetamino-5-methoxy-phenol was ethylated by means of diethyl sulfate and aqueous potassium hydroxide in warm solution as described in previous examples. Recrystallized first with the aid of bone black from 25% alcohol containing a few drops of acetic acid, then by dissolving in hot benzene and treating the solution with an equal volume of ligroin, the substance forms pale pink, glistening platelets which melt slowly and constantly at 117.5–8.5° with slight preliminary softening. It dissolves readily in the cold in alcohol, acetone or chloroform, less easily in ether or benzene, and difficultly in ligroin or water. It is quite soluble in boiling water and dissolves in conc. sulfuric acid with a faint pink color.

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[1] *Loc. cit.*

[2] *Ber.*, **44**, 2387 (1911).

Subs., 0.1536: (Kjeldahl), 10.25 cc. 0.0714 *N* HCl.
Calc. for $C_{11}H_{15}O_3N$: N, 6.70. Found: 6.67.

2-Methoxy-4-ethoxy-aniline.—The acetamino compound was hydrolyzed by boiling for 1/2 hour with 1 : 1 hydrochloric acid and the base isolated by shaking out the alkaline solution with ether and fractionating the residue *in vacuo.* The yield was good. The amine forms a very viscous, practically colorless oil, which boils at 151.5–2.5° under a pressure of 12 mm. and solidifies on chilling and rubbing. A portion was dissolved in a little benzene, diluted with ligroin, chilled, and let stand in the ice-box after seeding, separating as faintly pinkish rhombs which melt at 27.5–8.5° (corr.). It dissolves readily in the usual organic solvents, less easily in ligroin. It is quite soluble in water, the aqueous solution giving a violet-purple color with ferric chloride, finally depositing purple, microscopic needles. The base dissolves in dil. hydrochloric acid, separating from a sufficiently concentrated solution on rubbing as needles and short prisms. It is readily diazotized, coupling with R-salt to give a deep, purple-red color.

Subs., 0.1860: (Kjeldahl), 15.35 cc. 0.0714 *N* HCl.
Calc. for $C_9H_{13}O_2N$: N, 8.39. Found: 8.25.

2-Methoxy-4-ethoxy-chloroacetanilide.—This compound was prepared as in previous examples. Recrystallized twice from a small volume of 85% alcohol, then from ligroin, it forms flat, narrow, striated plates which soften slightly at 97° and melt slowly at 97.5–8.0°. It is very easily soluble at room temperature in acetone, chloroform, benzene, or toluene, less readily in alcohol, and is almost insoluble in cold water, more easily on boiling.

Subs., 0.1615: (Kjeldahl), 9.15 cc. 0.0714 *N* HCl.
Calc. for $C_{11}H_{14}O_3NCl$: N, 5.75. Found: 5.66.

4-Methoxy-6-ethoxy-acetanilide, 4,6-$CH_3O(C_2H_5O)C_6H_3NHCOCH_3$.—4-Acetamino-5-ethoxy-phenol (p. 1468) was methylated in the usual way with dimethyl sulfate and aqueous potassium hydroxide. When recrystallized first from 25% alcohol containing a few drops of acetic acid, with the aid of bone black, then from ligroin, the substance separates as faintly pink, silky needles which melt at 100.5–1.0° with slight preliminary softening. It dissolves readily in alcohol, benzene, or acetone, less easily in ether, and is very difficultly soluble in cold ligroin, more easily on boiling. It dissolves sparingly in cold water, quite readily on boiling. The substance gives a faint yellow color with conc. sulfuric acid.

Subs., 0.2209: (Kjeldahl), 14.9 cc. 0.0714 *N* HCl.
Calc. for $C_{11}H_{15}O_3N$: N, 6.70. Found: 6.75.

4-Methoxy-6-ethoxy-aniline.—11.3 g. of the acetamino compound were hydrolyzed with 1 : 1 hydrochloric acid. The chilled solution was decanted from the crystals of the amine hydrochloride, which were taken up in hot water and the solution cooled, made strongly alkaline, and shaken out with ether. After drying over potassium hydroxide and concentrating, the residue was fractionated *in vacuo*. 7.5 g. were obtained as a pale straw-colored, viscous liquid which boils at 144–4.5° under a pressure of 9 mm. and solidifies when chilled to a mass of thin platelets which melt at 22.5°. It is readily soluble in the usual organic solvents and dissolves appreciably in water at room temperature, readily on heating. An aqueous solution gives a brownish color with ferric chloride, changing to dark purple and giving a precipitate of the same color. In dil. hydrochloric acid it gives a bluish solution with sodium nitrite, but the solution contains the diazo salt, as it couples with R-salt to give a red color.

Subs., 0.1455: (Kjeldahl), 11.75 cc. 0.0714 *N* HCl.
Calc. for $C_9H_{13}O_2N$: N, 8.39. Found: 8.08.

4-Methoxy-6-ethoxy-chloroacetanilide.—The base was chloroacetylated in the usual way. Recrystallized from 50% alcohol, then from toluene, it forms thick, almost colorless, glistening platelets which melt at 126–7° with slight preliminary softening. It is very easily soluble in chloroform, quite soluble in acetone, and rather sparingly in cold alcohol, but readily on boiling.

Subs., 0.1517: (Kjeldahl), 8.45 cc. 0.0714 *N* HCl.
Calc. for $C_{11}H_{14}O_3NCl$: N, 5.75. Found: 5.57.

2,4-Diethoxy-acetanilide, 2,4-$(C_2H_5O)_2C_6H_3NHCOCH_3$. — 6.8 g. of 4-acetamino-5-ethoxy-phenol were ethylated as in previous experiments. The yield was 4.6 g., melting at 117–8°. Recrystallized from 50% alcohol, the diethyl ether forms silky needles of the same melting point. Will and Pukall,[1] who prepared the substance by reduction of phenyl-azo-resorcinol diethyl ether and acetylation of the amine hydrochloride, give 120.5° as the melting point. The compound is very difficultly soluble in cold water but dissolves quite freely on boiling, the undissolved portion melting to an oil.

2,4-Diethoxy-aniline.—The crude acetamino compound was hydrolyzed and the free base isolated as in previous examples. The residue from the ether extraction solidified on letting stand in a freezing mixture with occasional rubbing. It was again melted, taken up in a very little benzene, and diluted with several volumes of ligroin, chilled in a freezing mixture, and seeded. The base separated as pale brownish pink, flat needles and narrow platelets which melt at 33.5–4.0° (corr.) with preliminary softening. Will and Pukall give 32° as the melting point. The base seems quite stable in the air, and is smoothly diazotizable, coupling with R-salt to give a purplish red color. An aqueous solution gives a slowly developing, deep violet color with ferric chloride, followed by a precipitate of dark violet microscopic needles.

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[1] *Ber.*, 20, 1127 (1887).

Subs., 0.1330: (Kjeldahl), 7.3 cc. 0.1 *N* HCl.
Calc. for $C_{10}H_{15}O_2N$: N, 7.74. Found: 7.69.

2,4-Diethoxy-chloroacetanilide.—One g. of the base was dissolved in a mixture of 5 cc. of acetic acid and 5 cc. of saturated sodium acetate solution, diluted with 30 cc. of 50% acetic acid, and chloroacetylated in the usual way. After dilution the product was filtered off and recrystallized from 85% alcohol, separating as delicate, woolly needles, which melt at 102–3° with slight preliminary softening. The substance is quite soluble in alcohol at room temperature, very readily in acetone, chloroform, or benzene. It is difficultly soluble in cold ligroin, readily on heating, and also dissolves sparingly in boiling water.

Subs., 0.1541: (Kjeldahl), 5.85 cc. 0.1 *N* HCl.
Calc. for $C_{12}H_{16}O_3NCl$: N, 5.44. Found: 5.32.

NEW YORK CITY.

NOTE.

Correction.—In the paper on the "Constitution of Capsaicin," appearing in the July number,[1] vanillyl amine is by error described as 3-hydroxy-4-methoxy-benzylamine on pp. 1118, 1119, 1121, instead of 4-hydroxy-3-methoxy-benzylamine. E. K. NELSON.

NEW BOOKS.

An Advanced Course in Quantitative Analysis. By HENRY FAY, PH.D., D.SC. John Wiley & Sons, Inc., New York, 1917. Pp. vi + 111.

Text books on quantitative analysis may usually be placed in one of two groups; either the author has selected methods with reference primarily to the training of the student in the principles of quantitative analysis and in stoichiometry and has ignored the practicability of the methods described or else he has based his text book upon current and so-called "standard methods." In the latter case, too often, simplified manipulation, rapidity and occasionally great accuracy are the reasons for the selection of the material and the question of the effect upon the student of such a course is apt to be overlooked; the main idea being to have the student become proficient in the methods of analysis used in the industries.

Professor Fay has tried to produce a text which falls in neither extreme group. The material he has selected has been "chosen to illustrate principles and to train the student in manipulation." Since the author's work and interests lie mainly in iron, steel and commerical alloys, in which field he is a recognized authority, it is not surprising to find the bulk of the book devoted to the analysis of steel and closely associated raw and finished materials. Although the methods given have been selected

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[1] THIS JOURNAL, 41, 1115 (1919).