copper. Cuprous halides in the presence of oxygen are reactive. So are finely dispersed cupric oxide, cupric oxyhalides or mixtures of cupric halides and cupric oxide. In the absence of any reducing agent part of the pigment formed assumes this function.

BOUND BROOK, NEW JERSEY
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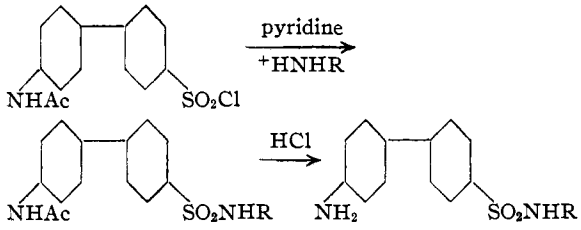
[CONTRIBUTION NO. 424 FROM THE DEPARTMENT OF CHEMISTRY, UNIVERSITY OF PITTSBURGH]

# *p*-(*p*-Aminophenyl)-benzenesulfonamide and Derivatives. II

BY C. T. VAN METER AND ALEXANDER LOWY

Utilizing methods analogous to those employed in the benzene series, the preparation of the parent molecule in the biphenyl series has been described in a previous article.[1] The purpose of this work was to prepare some derivatives in which one of the hydrogens on the sulfonamide nitrogen has been replaced.

In the benzene series, such substituted sulfanilamide derivatives are commonly prepared by coupling the *p*-acetamidobenzenesulfonyl chloride with amino compounds containing the desired substituents, and then deacetylating. Various methods have been utilized to effect removal of the hydrogen chloride from the coupling components.[2] The analogous sulfonyl chloride in the biphenyl series having been prepared in good yield,[1] the formation of such substituted derivatives was investigated. The general reaction may be represented as




The amino compounds used in preparing this series of derivatives were: (1) aniline, (2) benzylamine, (3) cyclohexylamine, (4) *p*-xenylamine, (5) sulfanilamide, and (6) *p*-(*p*-aminophenyl)-benzenesulfonamide.

## Experimental

Except for minor differences in concentrations of reactants and conditions for recrystallization and deacetylation, the procedure was essentially the same for all derivatives. The following experimental details for preparing the phenyl derivative are offered as typical.

Five grams of pure *p*-(*p*-acetamidophenyl)-benzenesulfonyl chloride[1] was dissolved by warming in a mixture of 180 cc. of dry acetone and 5 cc. of dry pyridine. After adding 1.6 g. of aniline dissolved in 20 cc. of acetone, the mixture was heated to 50° and set aside at room temperature for twenty-four hours. The reaction mixture was then diluted with three times its volume of cold water. The gelatinous material separating out soon coagulated to a granular precipitate which was filtered off and washed with cold water until the odor of pyridine was no longer perceptible. After drying on a water-bath, there remained 5.1 g. (86% yield) of a light pink product. The crude reaction product was dissolved in hot alcohol, hot water added until a slight turbidity developed, then a little decolorizing carbon added and the mixture refluxed for one-half hour. After filtering and cooling, *p*-(*p*-acetamidophenyl)-benzenesulfon-N-phenylamide separated in short white needles. The mother liquor yielded a small additional quantity on further dilution with water and cooling in an ice-bath. For analysis and melting point determination, a small sample was recrystallized from alcohol until no further change in melting point was observed.

To deacetylate, 1 g. of the above product was mixed with 30 cc. of alcohol and 10 cc. of concd. hydrochloric acid, and the mixture refluxed for one-half hour beyond the time necessary for complete solution. The reaction mixture was filtered and rendered ammoniacal at once by adding concd. ammonium hydroxide. The dense white crystalline precipitate was collected, washed well with water, and recrystallized from an alcohol–water mixture and decolorized as described above. There resulted 0.7 g. of *p*-(*p*-aminophenyl)-benzenesulfon-N-phenylamide representing a deacetylation efficiency of 80%. This sample was recrystallized from alcohol for analysis and melting point determination. A further recrystallization produced no change in melting point.

The following new compounds have thus been prepared:

I *p*-(*p*-acetamidophenyl)-benzenesulfon-N-phenylamide
II *p*-(*p*-aminophenyl)-benzenesulfon-N-phenylamide
III *p*-(*p*-acetamidophenyl)-benzenesulfon-N-benzylamide
IV *p*-(*p*-aminophenyl)-benzenesulfon-N-benzylamide
V *p*-(*p*-acetamidophenyl)-benzenesulfon-N-cyclohexylamide
VI *p*-(*p*-aminophenyl)-benzenesulfon-N-cyclohexylamide
VII *p*-(*p*-acetamidophenyl)-benzenesulfon-N-*p*-xenylamide

(1) C. T. Van Meter, J. A. Bianculli and A. Lowy, THIS JOURNAL, 62, 3146 (1940).
(2) E. H. Northey, *Chem. Rev.*, 27, 188 (1940).

TABLE I

| Compd. | Formula | M. p., °C. | Sulfonyl chloride, g. | Yield, % | Deacetylating efficiency, % | Analyses, % Nitrogen Calcd. | Nitrogen Found | | Sulfur Calcd. | Sulfur Found | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| I | $C_{20}H_{18}O_3N_2S$ | 237 | 5 | 86 | | 7.65 | 7.58 | 7.73 | 8.75 | 8.88 | 8.68 |
| II | $C_{18}H_{16}O_2N_2S$ | 186 | | | 80 | 8.64 | 8.73 | 8.69 | 9.88 | 9.81 | 10.04 |
| III | $C_{21}H_{20}O_3N_2S$ | 208 | 10 | 75 | | 7.36 | 7.41 | 7.48 | 8.43 | 8.52 | 8.42 |
| IV | $C_{19}H_{18}O_2N_2S$ | 184 | | | 80 | 8.28 | 8.36 | 8.39 | 9.47 | 9.47 | 9.57 |
| V | $C_{20}H_{24}O_3N_2S$ | 244 | 8 | 76 | | 7.52 | 7.60 | 7.69 | 8.61 | 8.79 | 8.58 |
| VI | $C_{18}H_{22}O_2N_2S$ | 219 | | | 89 | 8.48 | 8.39 | 8.48 | 9.70 | 9.68 | 9.89 |
| VII | $C_{26}H_{22}O_3N_2S$ | 250 | 6 | 70 | | 6.33 | 6.40 | 6.51 | 7.25 | 7.22 | 7.35 |
| VIII | $C_{24}H_{20}O_2N_2S$ | 216 | | | 80 | 7.00 | 7.05 | 6.93 | 8.00 | 8.12 | 8.04 |
| IX | $C_{20}H_{19}O_5N_3S_2$ | 274 | 6 | 80 | | 9.43 | 9.36 | 9.46 | 14.39 | 14.52 | 14.55 |
| X | $C_{18}H_{17}O_4N_3S_2$ | 252d | | | 72 | 10.42 | 10.35 | 10.60 | 15.89 | 16.05 | 16.01 |
| XI | $C_{26}H_{23}O_5N_3S_2$ | 299 | 5 | 90 | | 8.06 | 8.24 | 8.06 | 12.30 | 12.32 | 12.18 |
| XII | $C_{24}H_{21}O_4N_3S_2$ | 277d | | | 87 | 8.76 | 8.79 | 8.85 | 13.37 | 13.24 | 13.40 |

All compounds were recrystallized to constant melting point as follows: I and II as described; III, V, VII and X from alcohol; IV and IX from 50% alcohol; VI and VIII were dissolved in 8% alcoholic hydrochloric acid and reprecipitated with concd. ammonium hydroxide, then recrystallized once from alcohol; XI was dissolved in dioxane and reprecipitated by adding water; XII was dissolved in 30% alcohol containing 2% hydrochloric acid and reprecipitated with concd. ammonium hydroxide, then recrystallized once from alcohol.

VIII *p*-(*p*-aminophenyl)-benzenesulfon-N-*p*-xenylamide
IX $N^4$-[*p*-(*p*-acetamidophenyl)-benzenesulfonyl]-sulfanilamide
X $N^4$-[*p*-(*p*-aminophenyl)-benzenesulfonyl]-sulfanilamide
XI 4-[*p*-(*p*-acetamidophenyl)-benzenesulfonamido]-biphenyl-4′-sulfonamide
XII 4-[*p*-(*p*-aminophenyl)-benzenesulfonamido]-biphenyl-4′-sulfonamide

The molecular formulas, melting points, and results of analyses are given in Table I. All compounds are white and crystallize in short needles.


## Summary

*p*-(*p*-Acetamidophenyl)-benzenesulfonyl chloride has been coupled with the following amino compounds and the resulting compounds deacetylated: aniline, benzylamine, cyclohexylamine, *p*-xenylamine, sulfanilamide, and *p*-(*p*-aminophenyl)-benzenesulfonamide. The new compounds have been analyzed and reported.


PITTSBURGH, PENNA. RECEIVED JANUARY 18, 1941

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[CONTRIBUTION NO. 210 FROM THE CHEMICAL LABORATORY OF THE UNIVERSITY OF TEXAS]

# Isomerization in the Bouveault and Blanc Reduction of Methyl Hydrogen Camphorates

BY W. W. CROUCH AND H. L. LOCHTE

In investigations of the synthesis of certain naphthenic acids need arose for a procedure by which the ortho-methyl hydrogen ester (I) of isocamphoric acid could be reduced to *trans*-hydroxycampholic acid (II). Attempts to reduce this ester by catalytic hydrogenation at 250° and 5000 pounds pressure with copper chromite as catalyst failed. Reduction by sodium in absolute alcohol by the procedure followed by Haller and Blanc[1] in the reduction of *allo*-methyl hydrogen camphorate (X) gave a low yield of reduction product.

The reduction products were separated as a liquid mixture of acids from which not only *trans*-hydroxycampholic acid but also isocamphoric acid (IV), camphoric acid (V) and alpha-campholide (VIII), the lactone of *cis*-hydroxy campholic acid, were isolated.

As isomerization had evidently taken place the ortho-methyl ester of camphoric acid (IX) was treated in similar manner and yielded the same compounds. Since *allo*-methyl hydrogen camphorate (X) has no alpha hydrogen atom through which isomerization should be permitted, its reduction under the same conditions was also carried out. As expected, no *cis–trans* isomerization was observed and a yield of only 3% of beta-campholide (XI) was obtained along with *d*-camphoric acid and *allo*-ethylhydrogen camphorate (XII)

(1) Haller and Blanc, *Compt. rend.*, **141**, 697 (1905).