

tion in a mixture of acetone and bromoform are given below.

Space group  $P 2_1 2 2_1$   
 $a = 8.89 \pm 0.02$ ,  $b = 11.84 \pm 0.02$ ,  $c = 21.41 \pm 0.02$  Å.

Volume of the unit cell  $2253.57 \text{ Å}^3$ .

Measured density  $1.576 \pm 0.005 \text{ gm/cc}$ .

Calculated density for four molecules of CMP, four molecules of arginine and eight water molecules in the unit cell  $1.572 \text{ gm/cc}$ .

It may be mentioned that the unit cell might contain four chloride ions or four sodium ions and four water molecules instead of the eight water molecules indicated above. These possibilities cannot be distinguished at this stage from the crystal data.

The complete structure determination of this complex and also the crystallization and X-ray analysis of other complexes involving nucleic acid components and amino acids are in progress.

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## STRUCTURE OF PHTHALAMIC ACIDS FROM 4-SUBSTITUTED PHTHALIC ANHYDRIDES AND AROMATIC AMINES

### ABSTRACT

The Phthalamic acids obtained directly from 4-nitro and 4-chlorophthalic anhydrides and aniline in cold benzene medium have been characterised as 4-nitro and 4-chloro-N-phenyl phthalamic-2-acids respectively by way of decarboxylation and identification of the resulting *p*-substituted benzanilides.

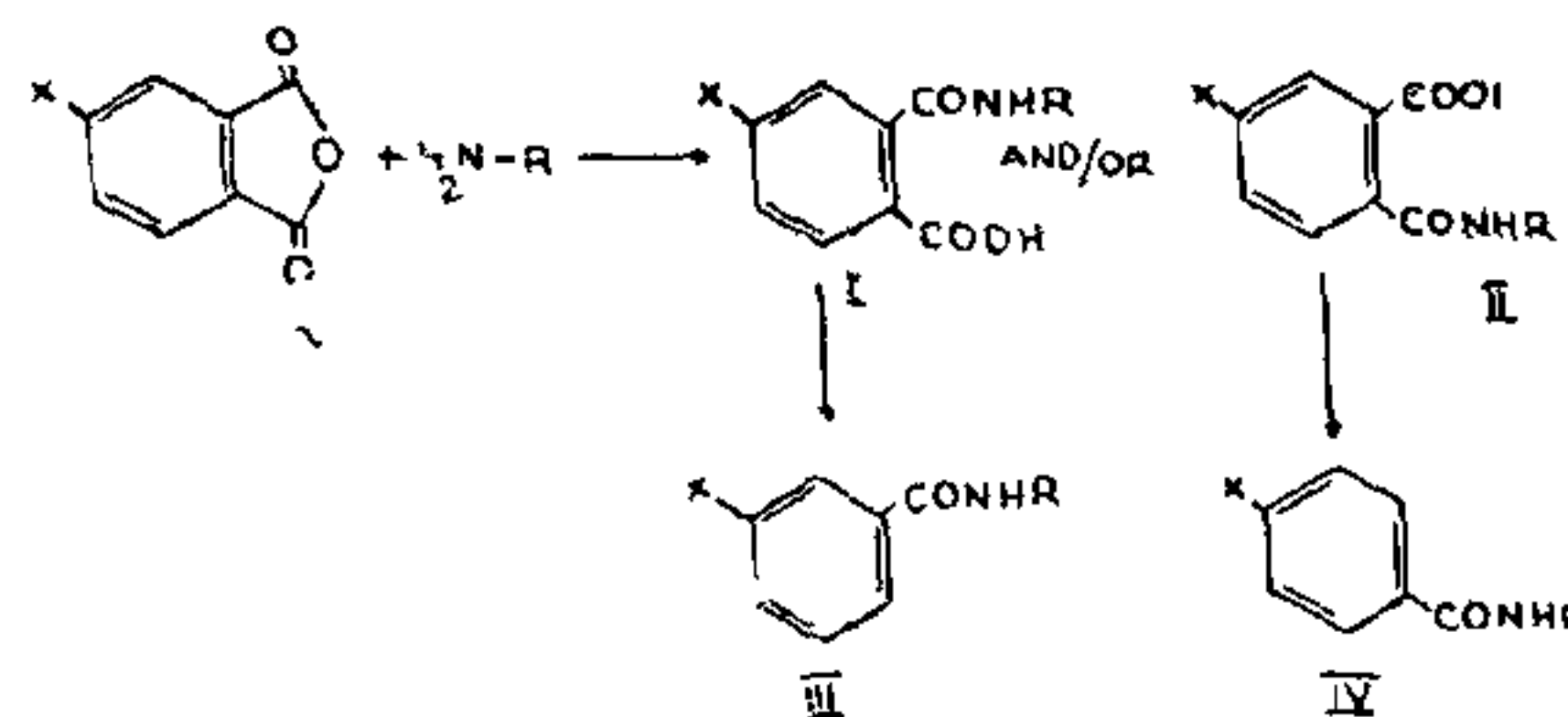
DURING our investigations on the synthesis of phthalamic acids as plant growth substances, we had occasion to condense 4-nitro and 4-chlorophthalic anhydrides with aromatic amines. The corresponding phthalamic acids were obtained directly in quantitative yields, when the reaction was carried out in cold benzene medium. These compounds were soluble in dilute sodium bicarbonate solution and could be reprecipitated by acidification.

The phthalamic acid obtained from a 4-substituted phthalic anhydride and an aromatic amine may have the structure I or II or a mixture of both.

As representative cases the structures of phthalamic acids obtained from 4-nitro and 4-chlorophthalic anhydrides and aniline have been deter-

mined by decarboxylation method as in the case of 3-nitrophthalamic acids<sup>1</sup>.

The phthalamic acid (m.p.  $140^\circ$ ) obtained from aniline and 4-nitrophthalic anhydride has been decarboxylated by copper oxide and quinoline to give a pure product after crystallisation from benzene. It was found to be identical with *p*-nitrobenzanilide. Accordingly this phthalamic acid is assigned 4-nitro-N-phenyl phthalamic-2-acid (II;  $X = \text{NO}_2$ ,  $R = \text{Ph}$ ) structure.



Decarboxylation of the phthalamic acid (m.p.  $139^\circ$ ) obtained from 4-chlorophthalic anhydride and aniline yielded a colourless crystalline compound, identified as *p*-chlorobenzanilide. Based on this observation this phthalamic acid has been assigned 4-chloro-N-phenyl phthalamic-2-acid structure (II;  $X = \text{Cl}$ ,  $R = \text{Ph}$ ).

In 4-nitrophthalic anhydride, the carbonyl group para to nitro is more reactive and thus is the site of attack by aniline, leading to the formation of 4-nitro-N-phenyl phthalamic-2-acid. The inductive effect of the chloro group in 4-chlorophthalic anhydride appears to be responsible for the formation of 4-chloro-N-phenyl phthalamic-2-acid by reaction with aniline.

On the basis of the above observations, the phthalamic acids obtained from various aromatic amines and 4-nitro and 4-chlorophthalic anhydrides have been assigned similar structures (II;  $X = \text{NO}_2$  or  $\text{Cl}$ ).

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