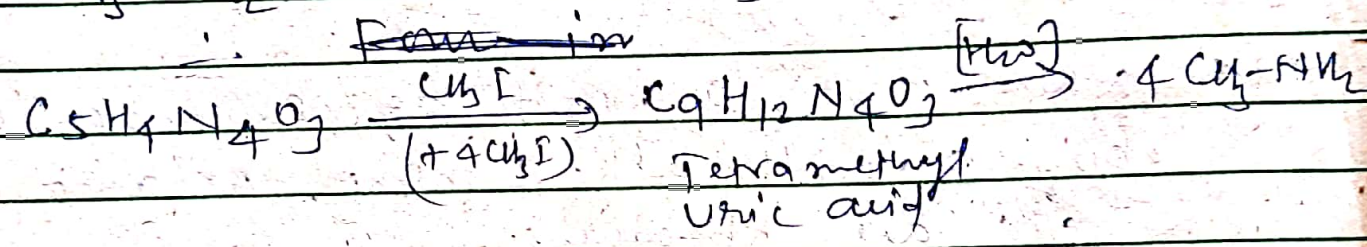


Ureides / Uric Acid.

Structure.

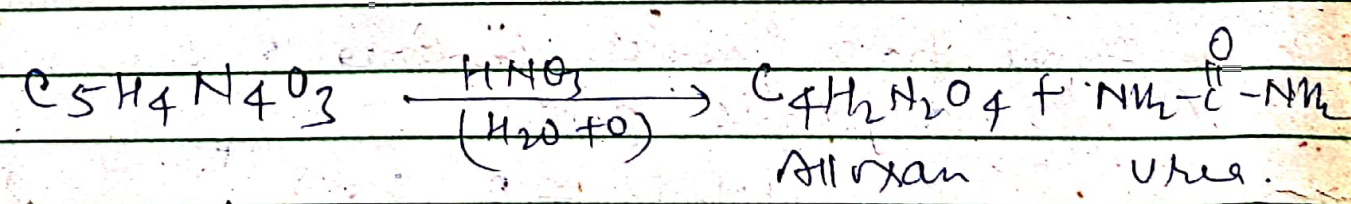
(1) From elemental analysis & mol. wt. determination, the molecular formula of uric acid is found to be $C_5H_4N_4O_3$.

2. Nature of Nitrogen: - on exhaustive methylation, tetramethyl uric acid is formed which on hydrolysis gives four moles of CH_3-NH_2 but no NH_3 .



∴ Four imino groups ($C=NH$) is present.

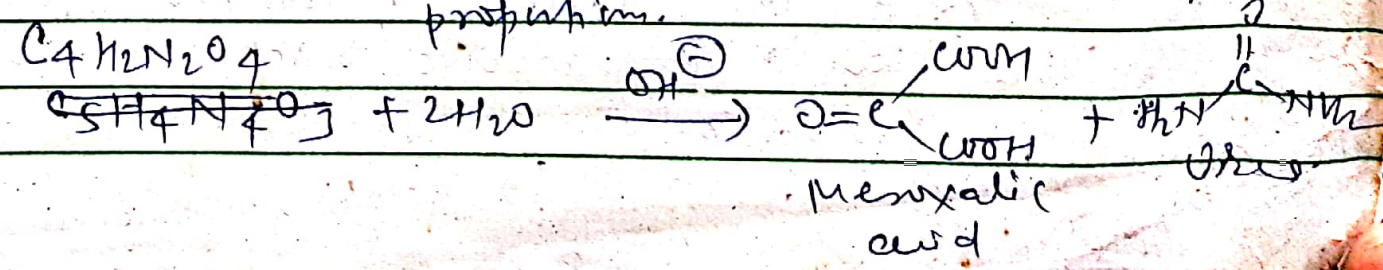
(3) on oxidⁿ with dil. HNO_3 ; Alloxan & urea are obtained in equimolar proportions.



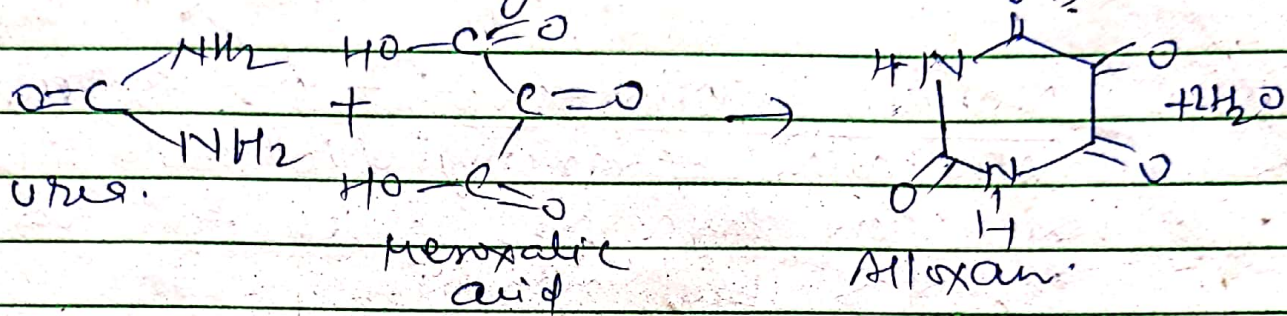
The oxidation does not involve any loss of carbon atom.

Structure of Alloxan.

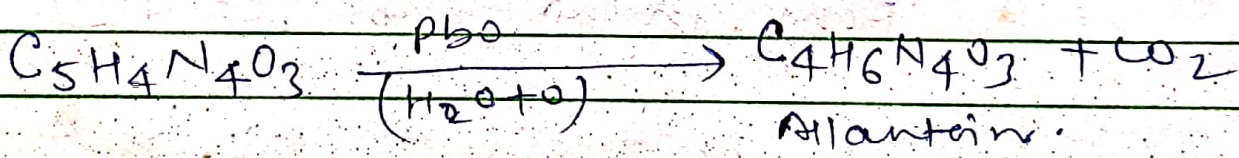
(i) ~~when~~ on alkaline hydrolysis, Alloxan gives mesoxalic acid & urea in equimolar proportion.



∴ Allouan contains no free -NH₂ or -COOH group, so it must be mesoxalyl urea (cyclic ureide). The fact has been confirmed by its direct synthesis from urea & mesoxalic acid (Leibig & Wohler in 1828).

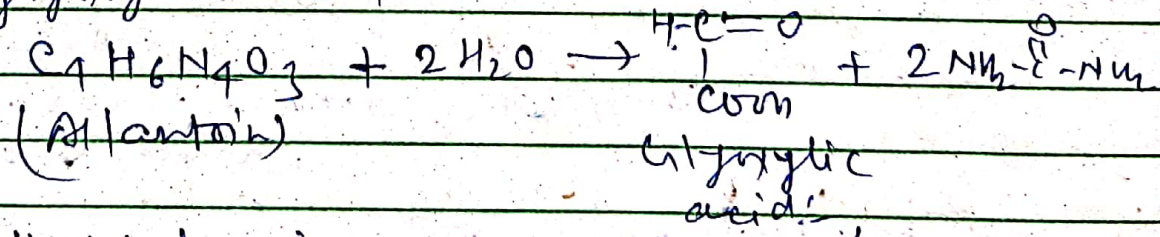


(4) when oxidised with aq. suspension of PbO₂ or with alk. KMnO₄, Allantoin & CO₂ are obtained.



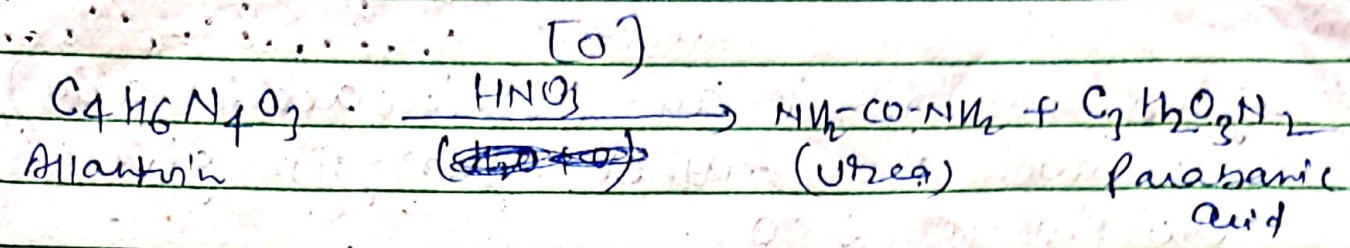
Structure of Allantoin

(i) when hydrolysed with alkali, Allantoin forms two moles of urea & one mole of glyoxylic acid.



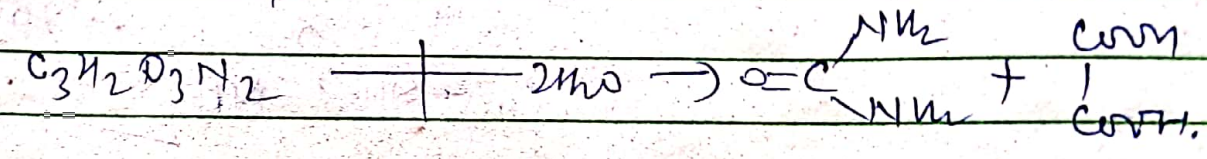
∴ Allantoin is a diureide of glyoxylic acid.

(ii) on oxidn with HNO₃, Allantoin gives urea and parabanic acid in equimolar proportions.

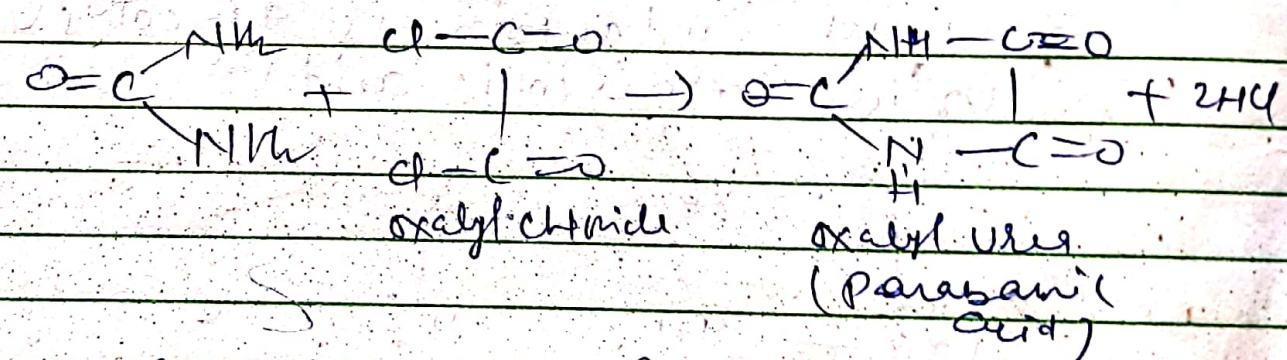


Struct. of Parabanic acid

This acid has no free -NH₂ gr. or -COOH gr. & on hydrolysis it gives oxalic acid & urea.



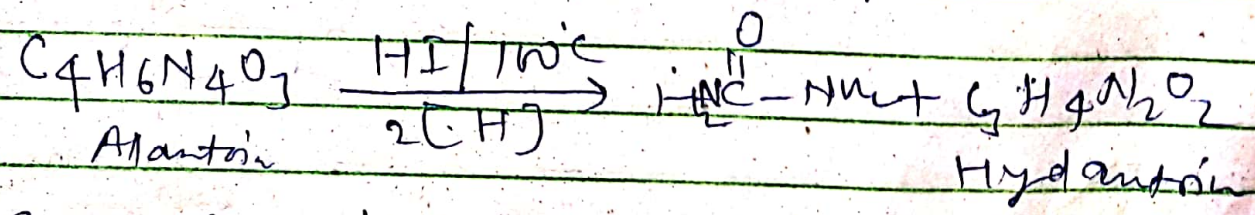
It is a oxalyl urea, confirmed by its synthesis (Bornmeyer 1912) as -



In Allantoin, Parabanic acid is joined to a molecule of urea.

Point of attachment of Parabanic acid to urea

When reduced with conc. HI at 100°C, Allantoin forms Urea & hydantoin.

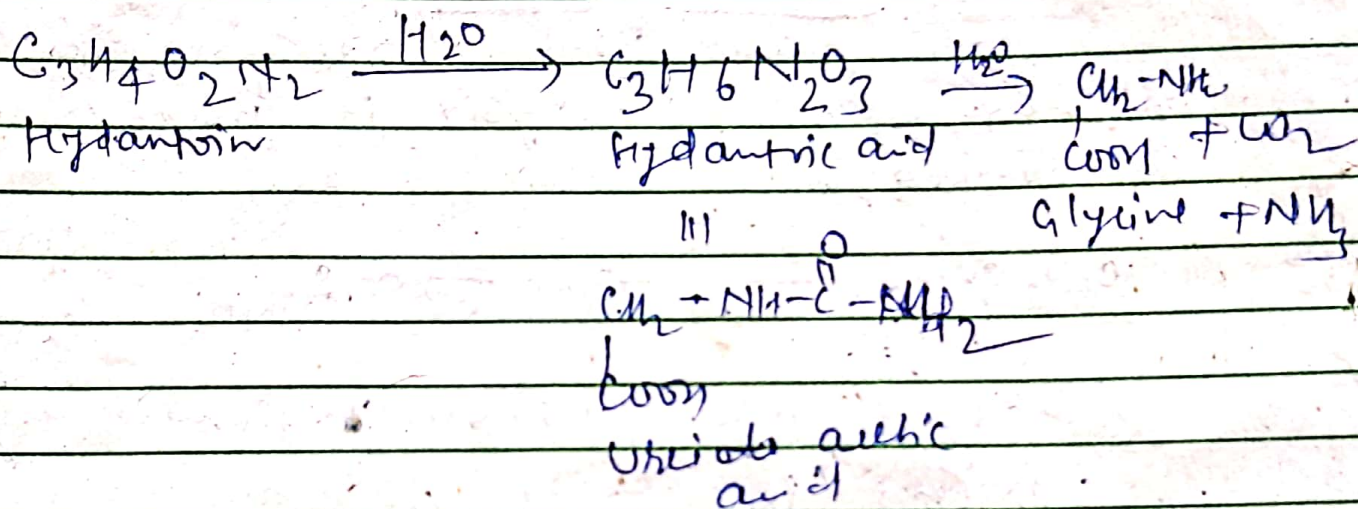


Struct. of Hydantoin

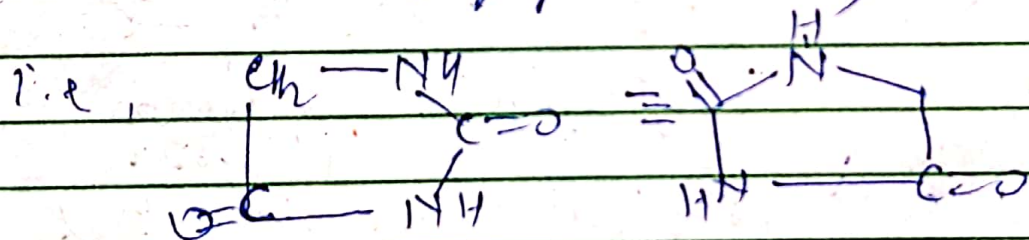
Hydantoin on control \rightarrow hydrolysis

(4)

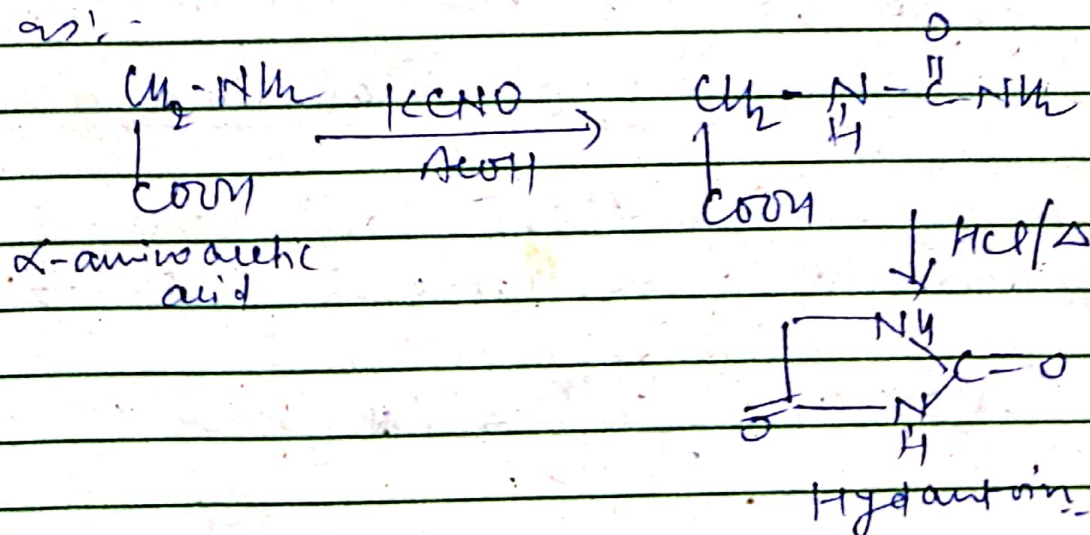
gives hydantonic acid (ureidoacetic acid),
which on further hydrolysis gives,
glycine, NH_3 & CO_2 .



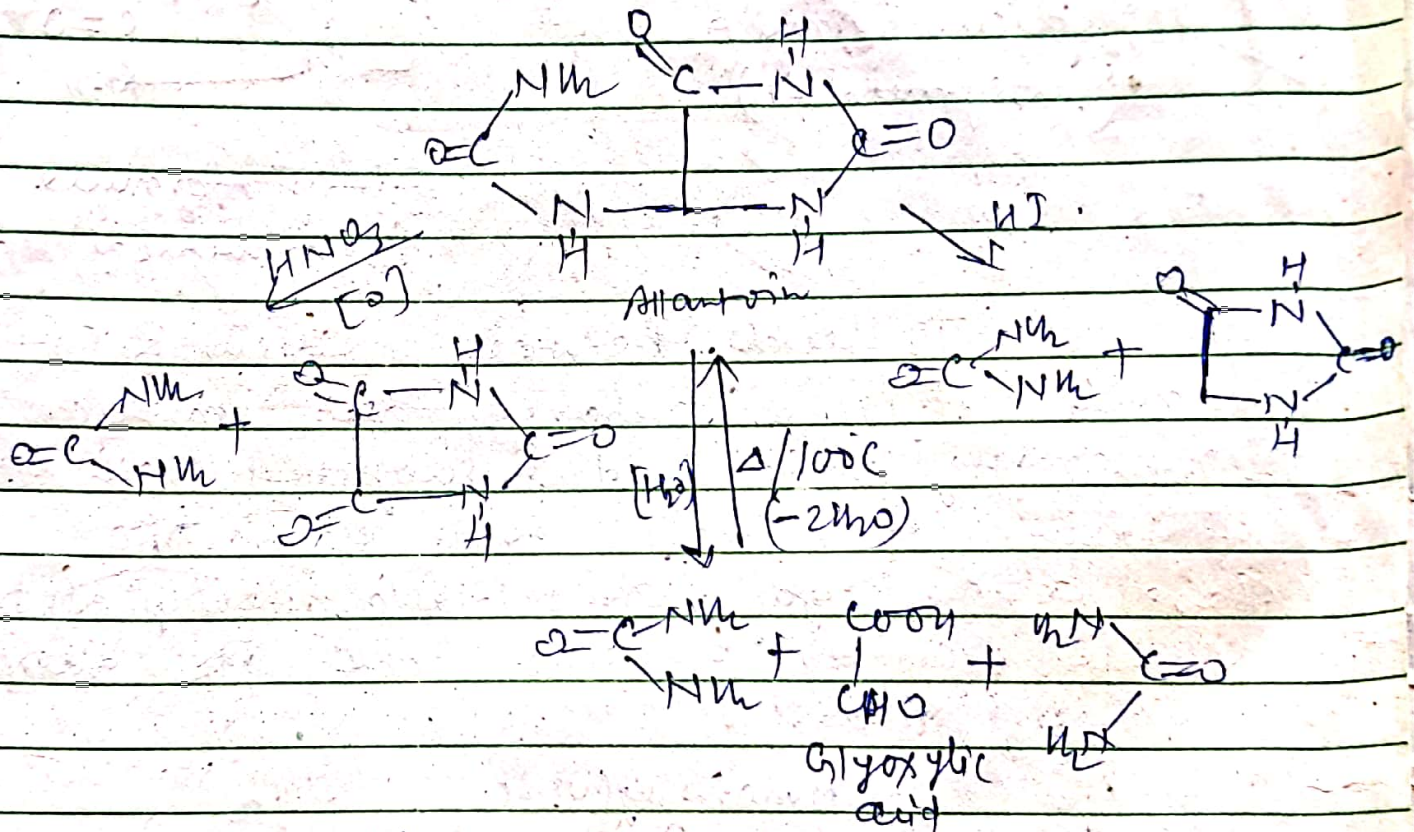
Thus hydantoin is glycolyl urea
(i.e., ureide of glycolic acid)



Its structure has been confirmed by its synthesis
as:-



Thus foregoing structure of Allantoin would account for all the foregoing results.



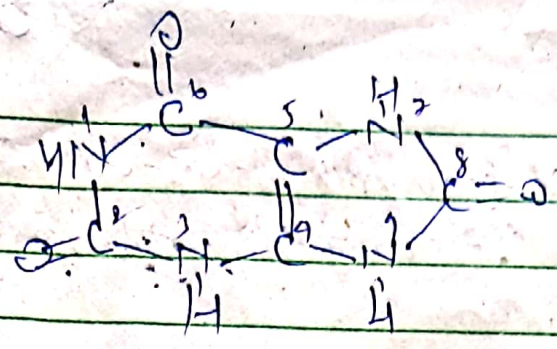
The structure has been confirmed by its synthesis from urea & glyoxylic acid at 100°C (Grimaux, 1876).

In the formation of Allantoin from uric acid, by oxidation, one carbon atom is lost as CO_2 . Thus this carbon atom must be fitted into Allantoin structure. It must also include the Alloxan skeleton (in order to account its formation) & four imino groups.

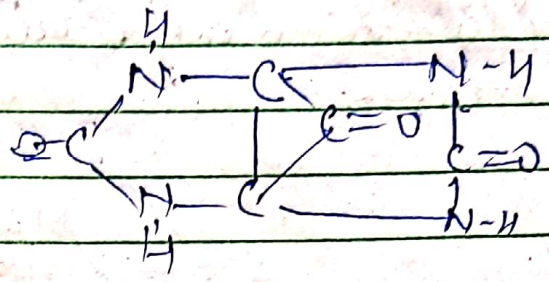
Two structures were proposed to account for all these facts: -

$\text{C}_4\text{H}_6\text{N}_4\text{O}_4$
 $\text{C}_4\text{H}_6\text{N}_4\text{O}_4$

(6)



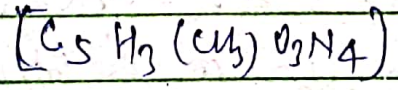
Medicus formula
(unsymmetrical)



Fittig formula
(symmetrical)

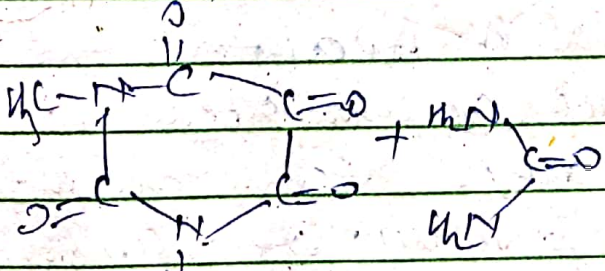
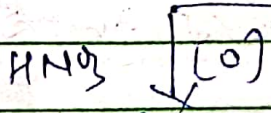
To decide between medicus & Fittig formula, Fischer prepared four isomeric monomethyl uric acid & subjected each one of them to oxidation with HNO_3 . Two of these acids gave on oxidation methylalloxan & urea whereas other two isomers gave alloxan & methyl urea.

Monomethyl uric acid

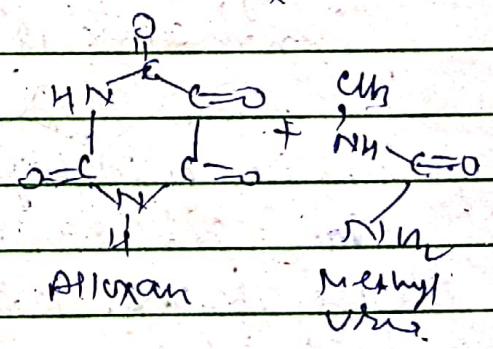
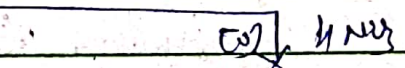


Two isomers

Two isomers



Methyl alloxan



Alloxan

Methyl urea

This shows that - alloxan &

urea are linked together to form uric acid in such a manner that uric acid possesses an unsymmetrical str. (i.e. medicus str.)

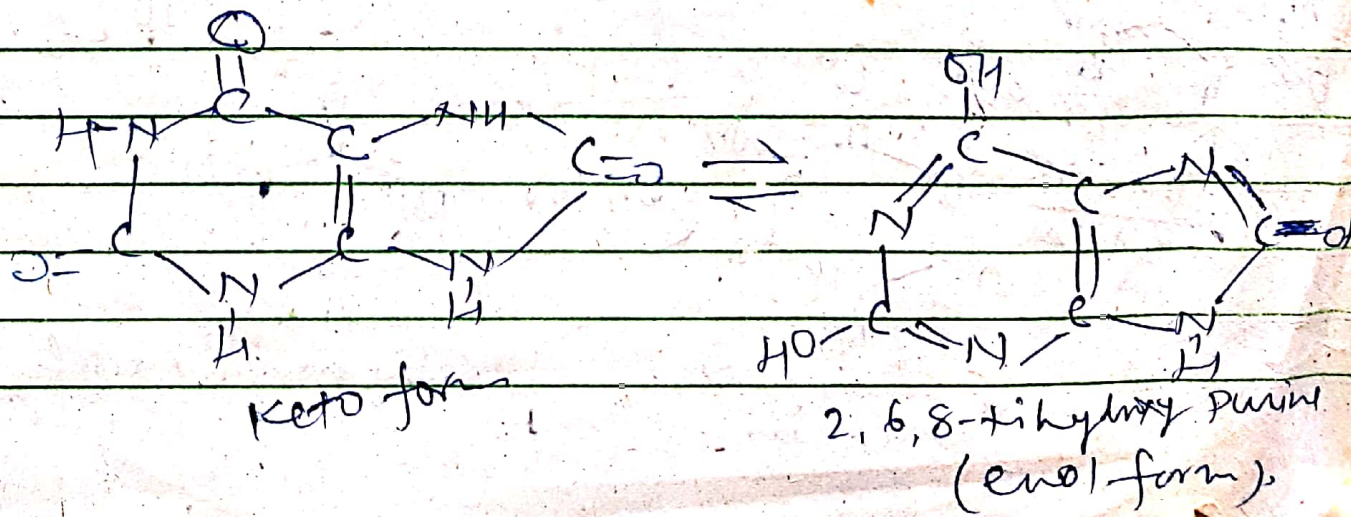
~~The Fittig formula~~

At

The Fittig formula, being symmetrical will give only one monomethyl derivative while Medicus formula satisfies the existence of at least two isomeric monomethyl derivatives, one methyl group in the Pyrimidic nucleus (at position 1 or 3) & other in the imidazole nucleus (at position 7 or 9). Further six dimethyl & four trimethyl derivatives of uric acid were also prepared by Fischer, which ~~gives~~ supports the Medicus formula.

Medicus structure also ~~explains~~ explains the formation of all the reactions sequence discussed above.

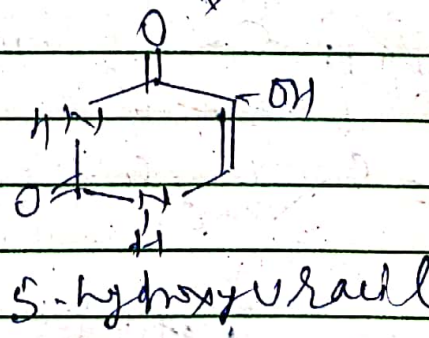
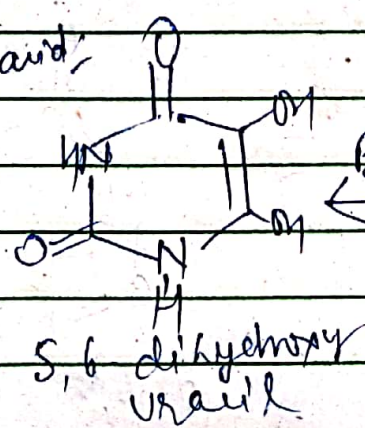
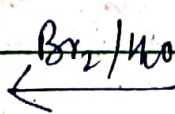
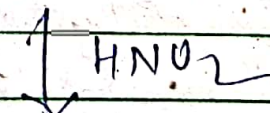
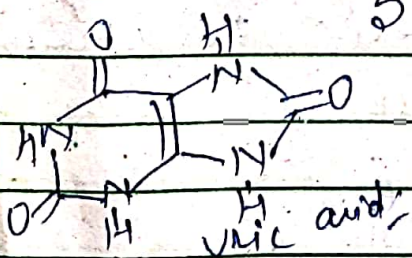
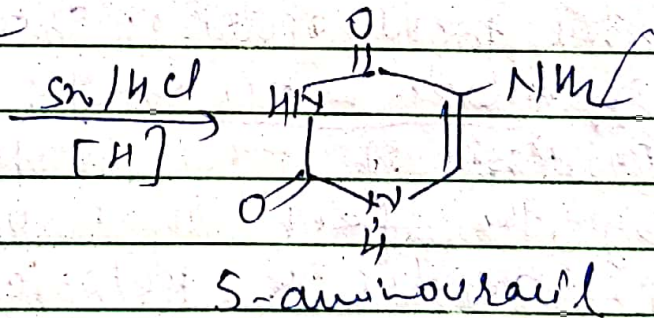
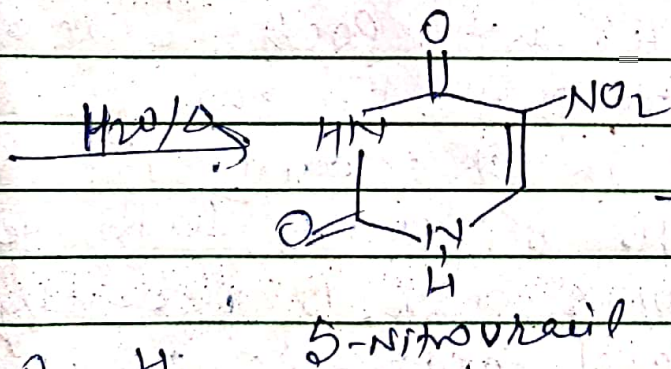
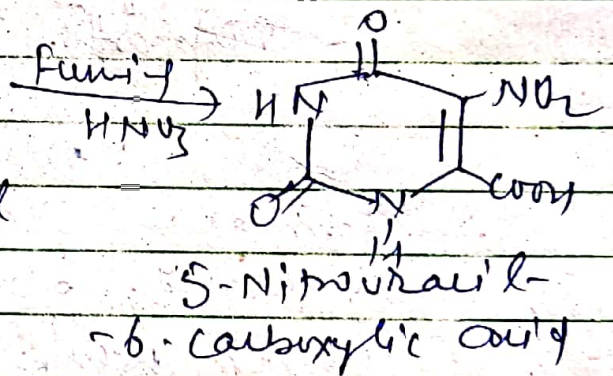
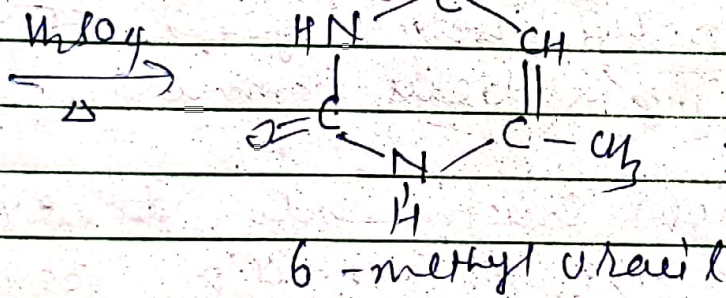
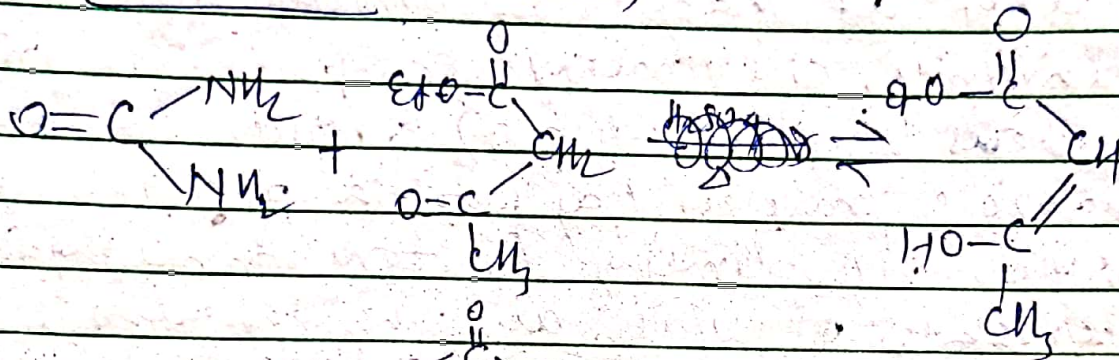
When treated with $POCl_3$, uric acid forms dichloropurine, showing the presence of three -OH groups in uric acid. The existence of -OH groups is further supported by the fact that uric acid is weakly acidic & Keto-enol tautomeric structures ~~exists~~ exists as: -



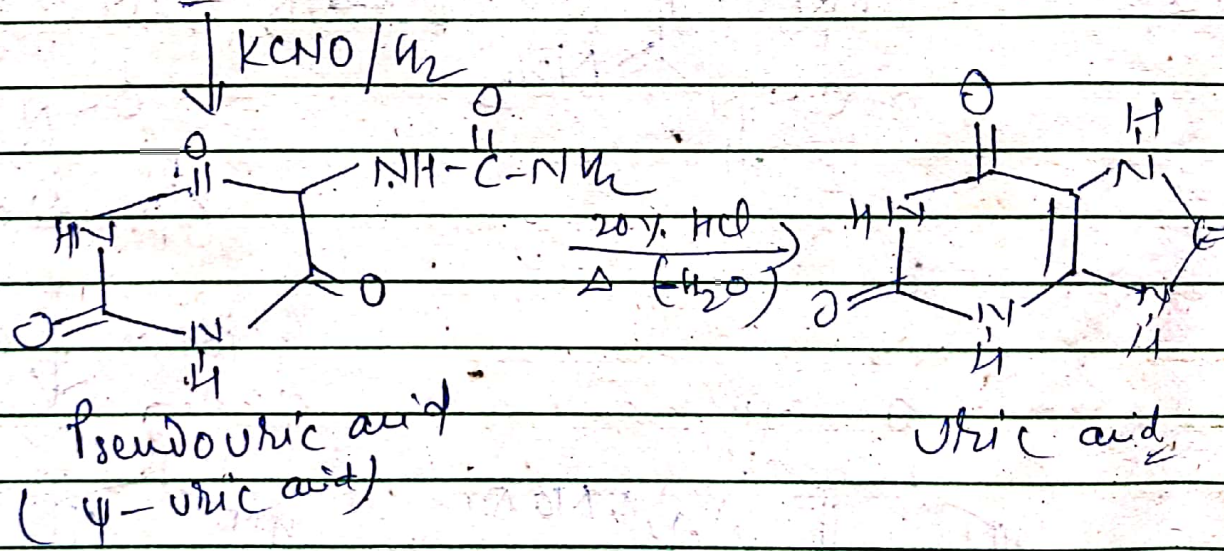
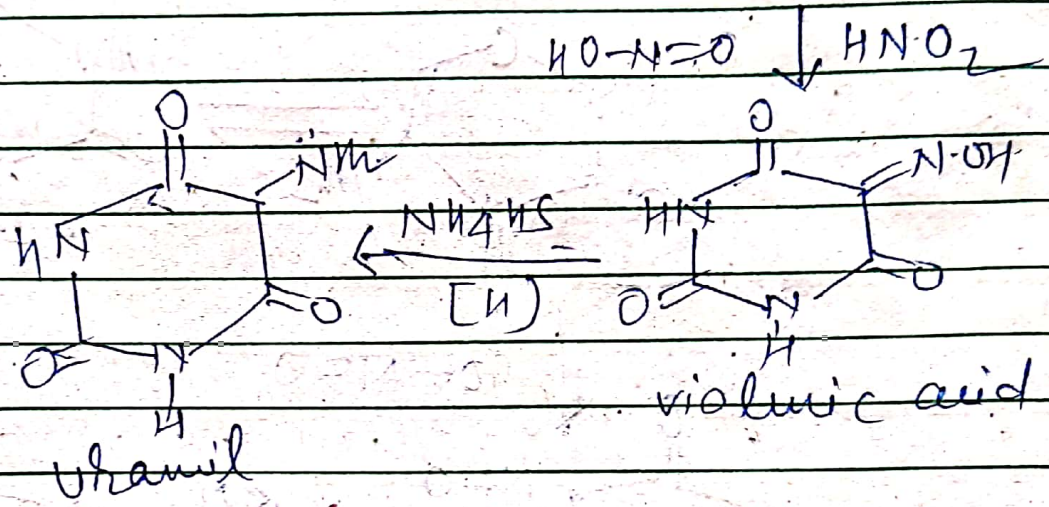
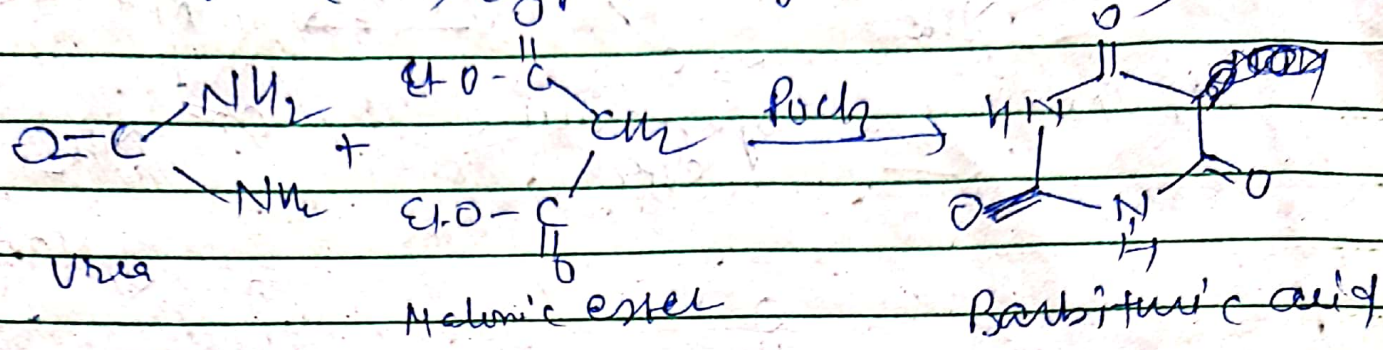
(8)

This structure of uric acid is further supported by its synthesis

(1) Behrend & Roosen (1888)



(11) Baeyer's (1869) Completed by Pischer (1895)



Imp. (11)

Trübner's synthesis (1900) \rightarrow The most important method, since it can be used to prepare any purine derivative, also a commercial method for purines preparation, synthetically

