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NEW INVESTIGATIONS ON THE CHEMICAL BEHAVIOR OF 4-KETO-1H-4,5-DIHYDRO-1,2,5-BENZOTRIAZEPINES[a]

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Abstract—The chemical behavior of 4-keto-1H-4,5-dihydro-1,2,5-benzotriazepines towards basic reagents has been investigated. Evidence is given that 4-keto-1H-4,5-dihydro-1,2,5-benzotriazepines unsubstituted at position 3 are cleaved by sodium hydroxide and alkoxides furnishing sodium cyanide and 2-amino-3-keto-quinoxalines. The same benzotriazepines substituted by a carbamidoximo- or a carbohydrazino-group at position 3 undergo, when treated with the same reagents, isomerization reactions yielding 3-amino-4-arylazo-isoxazolin-5-ones and 4-arylazo-pyrazolidin-3,5-diones respectively. The structure of these products is demonstrated and a mechanism for their formation is proposed.

In a preceding paper[1] were described a general synthesis of 4 - keto - 1H - 4,5 - dihydro - 1,2,5 - benzotriazepines and the chemical behavior of some of these compounds on catalytic hydrogenation and in the reaction with warm hydrochloric acid.

The results of an investigation concerning the reactions of these heterocycles with basic reagents will be presented here. After heating 4 - keto - 5 - methyl - 1H - 4,5 - dihydro - 1,2,5 - benzotriazepine (**1**) for a short time with aqueous - alcoholic sodium hydroxide, the presence of cyanide ion was detected in the reaction mixture and 1 - methyl - 2 - keto - 3 - amino - 1,2 - dihydroquinoxaline (**2**) was isolated and identified by comparison with an independently prepared sample.[3] Together with **2** was also obtained a mixture of two substances that, on heating with sodium ethoxide, furnished 1 - methyl - 2 - benzimidazolinone (**4**) as the only product. Compound **4** was also identified by comparison with an independently prepared sample[4] and the mixture, upon examination by TLC, appeared to comprise N - methyl - N - carbethoxy - *o* - phenylenediamine (**3**) and the 1 - methyl - 2 - benzimidazolinone (**4**) (Chart 1). The *o* - phenylenediamine derivative (**3**) was prepared by reduc-

[a]Third paper in the series: *Studies on 7-membered, benzo condensed heterocycles.*

For the preceding papers see Refs 1 and 2.

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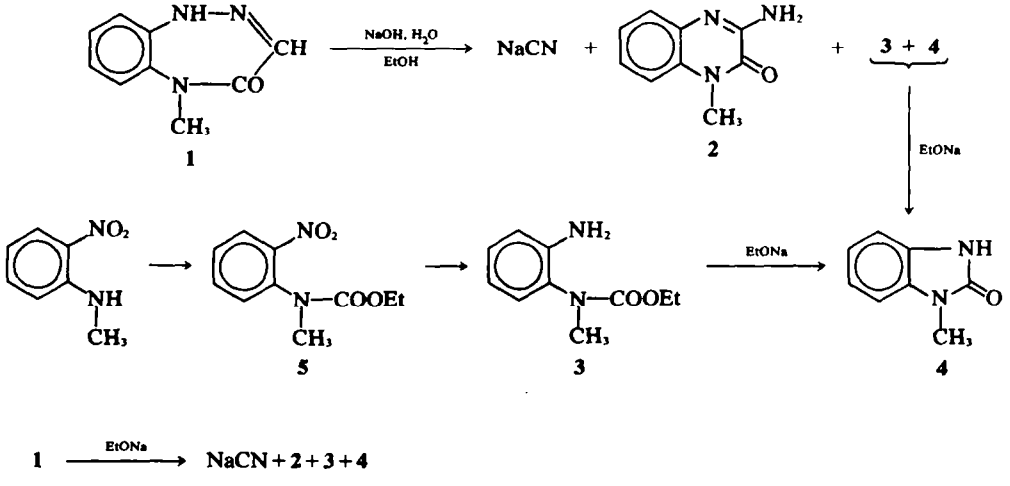


CHART 1.

tion of N - methyl - N - carbethoxy - *o* - nitroaniline (**5**) and it yielded quantitatively **4** on heating with sodium ethoxide.

The behavior of **1** in the reaction with sodium hydroxide was better understood when the benzotriazepine was heated in an alcoholic solution containing a little more then one equivalent of sodium ethoxide. From this reaction were isolated and identified: sodium cyanide, 1 - methyl - 2 - keto - 3 - amino - 1,2 - dihydroquinoxaline (**2**), N - methyl - N - carbethoxy - *o* - phenylenediamine (**3**) and 1 - methyl - 2 - benzimidazolinone (**4**). The reactions of **1** with sodium ethoxide and hydroxide can be interpreted considering as the first step the deprotonation at the 3 - C atom. Subsequent cleavage of the 7 - membered ring* could give rise to all the isolated products through transformations of the intermediate carbanion (Chart 2).

The study of the reactions with basic reagents was subsequently extended to some 5 - methyl - 4 - keto - 1H - 4,5 - dihydro - 1,2,5 - benzotriazepines substituted at position 3.

The 3 - carbamidoxime derivatives (**10**) were prepared by reaction of hydroxylamine with the corresponding nitriles (**9**) and the latter could be obtained through a variation of the original 1,2,5 - benzotriazepine synthesis[1] involving intramolecular coupling of N - substituted *o* - cyanacetamino - benzenediazonium salts (Chart 3). 5 - Methyl - 4 - keto - 1H - 4,5 - dihydro - 1,2,5 - benzotriazepine - 3 - carbamidoxime (**10**, R = Me), when briefly heated

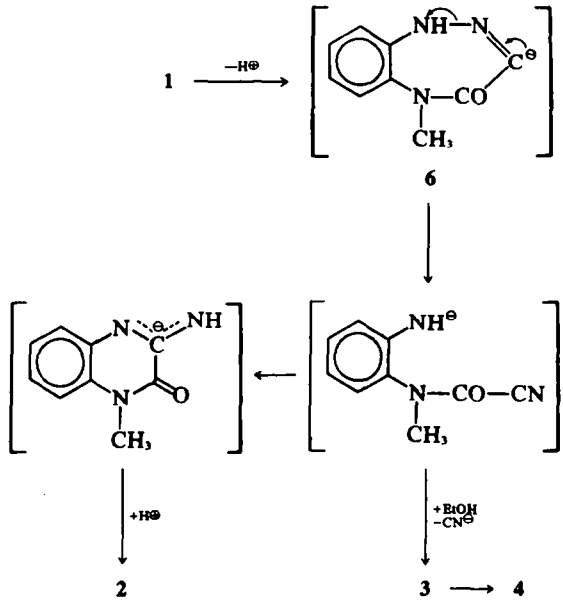


CHART 2.

in an aqueous - alcoholic solution containing sodium hydroxide, furnished in high yields a bright-red precipitate. To this product was assigned the structure of 3 - amino - 4 - (*o* - methylamino)phenylazo - isoxazolin - 5 - one (**11**) according to the following evidence:

(1) Elemental analysis and molecular weight determination showed **11** to be an isomer of **10** (R = Me).

(2) The bright colour of **11** was in accordance with the presence of a strong chromophore group.

(3) On reaction with acetic anhydride the red isomer furnished a monoacetyl derivative† namely 3 - amino - 4 - (*o* - acetyl - methylamino - phenylazo) - isoxazolin - 5 - one (**12**), the structure

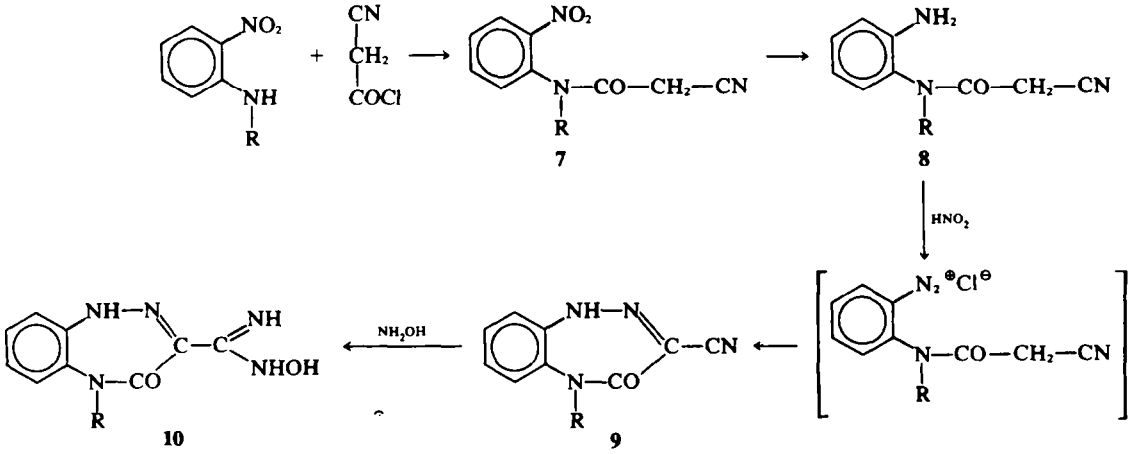


CHART 3.

*This reaction closely resembles other examples of heterolytic fission of N–N bonds operated by basic reagents as, for example, the reaction of the quaternary salts of aldehydes - alkylhydrazones described by Smith *et al.*[5] and the cleavage of nitrogen containing heterocyclic rings studied by R. Fusco *et al.*[6,7]

†The lack of reactivity of 3 - amino - isoxazolin - 5 - ones towards amino - acylating agents has also been observed by other Authors.[8,9]

of which was demonstrated by independent synthesis (Chart 4).

The synthesis of **12** was accomplished by coupling *o* - acetylmethyl - phenyldiazonium chloride with ethyl cyanacetate and reacting the resulting arylhydrazone (**13**) with hydroxylamine. When the hydroxylamine condensation was carried out in presence of sodium ethoxide **12** was directly formed,* whereas without alcoholate the reaction yielded amidoxime **14** which could be eventually cyclized on heating with the alkoxide.

A behavior comparable to that of **10** (R = Me) was also observed with 5 - methyl - 4 - keto - 1H - 4,5 - dihydro - 1,2,5 - benzotriazepine - 3 - carbohydrazide (**15**) that was prepared by interaction of the corresponding ethyl ester[1] with one equivalent of hydrazine hydrate.

Reaction with diluted aqueous sodium hydroxide transformed **15** into a red coloured isomer which was demonstrated to be 4 - (*o* - methylamino - phenylazo) - pyrazolidin - 3,5 - dione (**16**) as outlined in Chart 5. Treatment of **16** with acetic anhydride yielded, depending on reaction conditions, a di - or a tri - acetyl derivative (**17** and **18**)† which could be independently prepared by coupling *o* - acetyl - methylamino - phenyldiazonium chloride with diethyl malonate, treating the resulting arylhydrazone (**19**) with hydrazine, cyclizing the di - hydrazide (**20**) to the corresponding pyrazolidin - dione (**21**) and reacting the latter with acetic anhydride. The mechanism of the isomerization reactions of benzotriazepines **10** and **15** is obviously different from that proposed for the reactions of **1** under similar conditions.

The hypothesis of a mechanism involving open-chain intermediates does not appear in this case to be convincing since it would not account for the peculiar lability of the amidic linkage.

A concerted mechanism comprising intramolecular nucleophilic attack by the deprotonated intermediates **22** and **23** may represent a more satisfactory interpretation for these reactions.

Supporting this interpretation is the behavior of the corresponding 3 - carbethoxy - 1,2,5 - benzotriazepines that, under basic hydrolitic conditions, furnished in high yields the corresponding carboxylic acids[1] without undergoing cleavage at the 4–5 bond.

*While studying this reaction the behavior of intermediate **13** was noted to be different from that reported for other variously substituted cyanacetic esters[9] in that alternative formation of 5 - amino - isoxazolin - 3 - one derivatives was never observed. This may be due to the arylhydrazonic group which deactivates the carbethoxyl function with respect to condensation with hydroxylamine.

†To compounds **17** and **18** the structures of N - acetylderivatives have been assigned in accordance to the results already reported for other pyrazolidin - 3,5 - diones.[10]

‡M. ps are not corrected.

EXPERIMENTAL‡

N - Methyl - N - carbethoxy - o - nitro - aniline (**5**)

N - methyl - *o* - nitroaniline[11] (15·2 g) ethyl and chloroformate (22 g) were dissolved into 50 ml anhyd

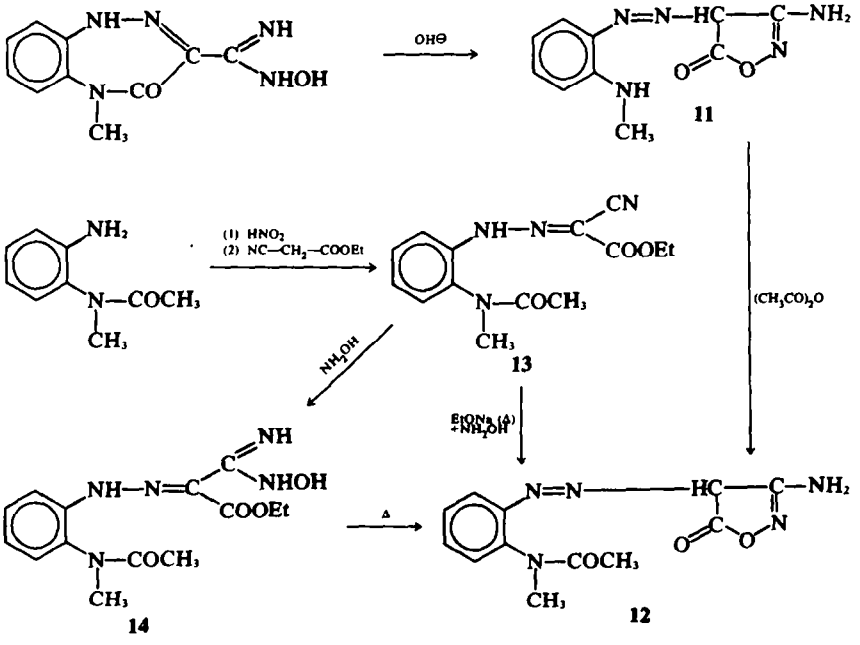


CHART 4.

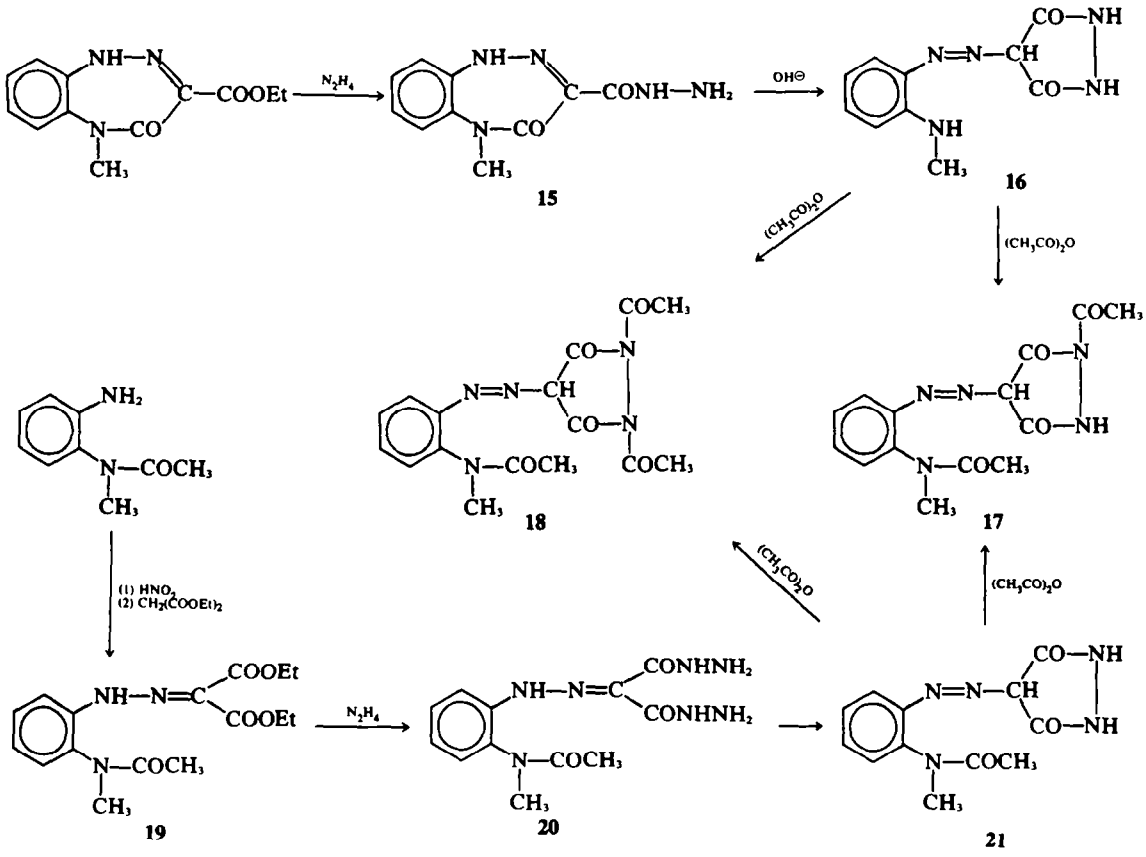
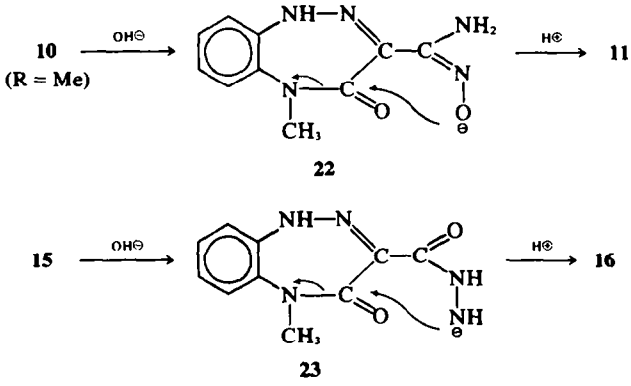


CHART 5.



xylene and refluxed 6 h. The cold soln was filtered, the solvent evaporated and the residue rectified, yielding 12 g (53·5%) of a yellow oil, b.p. 138–140° (0·5 mm) (Found: C, 53·23; H, 5·43; N, 12·54. $C_{10}H_{12}N_2O_4$ requires: C, 53·57; H, 5·39; N, 12·49).

N - *Methyl* - N - *carbethoxy* - o - *phenylenediamine* (3)

Compound **5** (11·2 g) was dissolved into 95% EtOH (75 ml) and hydrogenated at room temp and atmo pressure after addition of 0·3 g 10% Pd-C. The catalyst was filtered off, the solvent removed under reduced pressure and the oily residue was taken up in anhyd ethyl ether and treated with an ethereal soln of HCl. The ppt hydrochloride was crystallized from EtOH - ethyl ether, yield: 9·2 g (80%) m.p. 150–154°. (Found: C, 51·90; H, 6·54; N, 12·04. $C_{10}H_{14}N_2O_2$. HCl requires: C, 52·06; H, 6·55; N, 12·14.

1 - *Methyl* - 2 - *benzimidazolinone* (4)

Compound 3 (1·94 g) was heated 3 h at reflux in a soln prepared by dissolving 0·46 g of Na into 50 ml anhyd EtOH. The solvent was evaporated under reduced pressure and the residue was taken up into 15 ml water; the

soln acidified with dil HCl and the ppt collected and crystallized from water, yield 1·3 g (88%) m.p. 188–89° (reported: 191–192°)[4].

Reaction of 4 - *keto* - 5 - *methyl* - 4,5 - *dihydro* - 1*H* - 1,2,5, - *benzotriazepine* (1) *with sodium hydroxide*

Compound **1** (0·43 g) was dissolved in 90% EtOH (15 ml), 1 ml of 10% NaOH was added and the mixture refluxed 3 h. 0·5 ml more of 10% NaOH were added and heating was resumed for 6 h. The solvent was evaporated under reduced pressure, the residue taken up with anhyd EtOH (5 ml) and filtered. The insoluble material (51 mg) was treated with water (2 ml) and again filtered yielding a residue which was identified as **2** by comparison with an authentic sample;[3] in the aqueous filtrate sodium cyanide was detected.

The alcoholic filtrate was evaporated to dryness under reduced pressure, the residue taken up with water (10 ml) and extracted with chloroform. By complete evaporation of the solvent 0·2 g of an oily residue were obtained that was examined by TLC* and identified as a mixture of **3** (R_f 0·4) and **4** (R_f 0·15) by comparison with authentic samples. The oily residue by briefly heating with an alcoholic NaOEt soln, was completely converted into **4**.

Reaction of 4 - *keto* - 5 - *methyl* - 4,5 - *dihydro* - 1*H* - 1,2,5 - *benzotriazepine* (1) *with sodium ethoxide*

A soln of NaOEt prepared by dissolving 1·15 g of Na into 50 ml anhyd EtOH was mixed with an ethanolic soln (150 ml) of **1** (5·25 g) and refluxed 4 h. After cooling the undissolved solid (0·8 g) was removed by filtration and treated with water (10 ml). In the aqueous soln NaCN was detected and the insoluble solid was crystallized from 50% EtOH yielding 0·5 g of a solid, m.p. 260–65°, that was identified as **2** by comparison (IR) with an authentic sample.[3]

The filtrate was acidified with 2N HCl, evaporated to dryness under reduced pressure, and the residue (1·2 g) was taken up with water (20 ml) filtered and crystallized from water, furnishing a colourless crystalline solid, m.p. 189–191°, that was identified as 1 - methyl - 2 - benzimidazolinone by comparison (IR) with an authentic sample.[4] The aqueous filtrate was evaporated to 5 ml under reduced pressure, made alkaline with Na_2CO_3, and the soln extracted with chloroform. Evaporation of the solvent yielded an oily residue that was dissolved in ethyl ether and treated with an ethereal soln of HCl furnishing 3·5 g of **3** m.p. 154–155°, that was identified by comparison (IR) with an authentic sample.

N - *Methyl* - N - *cyanacetyl* - o - *nitroaniline* (7)

N - methyl - *o* - nitroaniline[11] (14·1 g) was dissolved in 100 ml dry benzene and cyanacetic acid (7·9 g) was added. The stirred soln was treated in portions with 20 g PCl_5 with external cooling to keep the temp at 20–25°. Stirring was protracted at room temp for 3 h, then the soln was refluxed 2 h. After cooling, 150 g of crushed ice were added, the soln filtered, the organic layer decanted, dried and evaporated under reduced pressure. The residue, together with the material collected by filtration, was crystallized from 95% EtOH (60 ml); 15·7 g (77%) of a yellow crystalline product were obtained, m.p. 125–27°. (Found: C, 54·67; H, 4·26; N, 19·00. $C_{10}H_9N_3O_3$ requires: C, 54·79; H, 4·14; N, 19·17).

N - *Methyl* - N - *cyanacetyl* - o - *phenylenediamine* (8)

To a mixture of **7** (100 g), 95% EtOH (600 ml), conc HCl (850 ml), and crushed ice (1200 g), 175 g of Zn powder was added in portions under stirring during 3 h. After completing the addition, stirring was protracted at room temp for 2 h more. The soln was filtered, the filtrate was made alkaline with NH_4OH (1000 ml), while keeping the temp under 30° by external cooling. The ppt was collected by filtration, washed with water and crystallized from 95% EtOH (1000 ml), yielding 48 g (55·5%) of pure product, m.p. 167–69°. (Found: C, 63·74; H, 6·03; N, 21·97. $C_{10}H_{11}N_2O$ requires: C, 63·47; H, 5·86; N, 22·21).

3 - *Cyano* - 4 - *keto* - 5 - *methyl* - 4,5 - *dihydro* - 1*H* - 1,2,5 *benzotriazepine* (9)

Compound **8** (90 g) was dissolved into a mixture of 95% EtOH (250 ml), conc HCl (150 ml) and crushed ice (1000 g) and a soln of 39 g $NaNO_2$ in 200 ml water was added dropwise to the stirred mixture. After addition was complete, stirring was protracted for 5 h, the ppt was collected by filtration, washed with water and crystallized from 40 parts of toluene, yielding 52 g (54·5%) of an orange crystalline product, m.p. 165–66°. (Found: C, 59·85; H, 4·26; N, 27·70. $C_{10}H_6N_4O$ requires: C, 59·99; H, 4·03; N, 27·99).

4 - *Keto* - 5 - *methyl* - 4,5 - *dihydro* - 1*H* - 1,2,5 - *benzotriazepine* - 3 - *carbamidoxime* (10)

A stirred mixture of **9** (12 g), hydroxylamine hydrochloride (5 g) and dry EtOH (300 ml) was heated to 40–50° and a NaOEt soln prepared from 1·4 g Na and 100 ml dry EtOH was added in 30 min. Stirring was protracted for 5 h at 50°, the mixture was cooled and the ppt collected by filtration, washed with some EtOH and then with water to complete removal of the chloride ion. Crystallization from 50% EtOH yielded 12 g (86%) of a yellow product, m.p. 186–88° (dec) (Found: C, 51·40; H, 4·75; N, 30·29. $C_{10}H_{11}N_5O_2$ requires: C, 51·50; H, 4·75; N, 30·03).

3 - *Amino* - 4 - (o - *methylamino*) *phenylazo* - *isoxazolin* - 5 - 1 (11)

Compound **10** (1 g) was suspended into 1N NaOH (10 ml), 2 ml of 95% EtOH were added and the mixture was heated at 60–70° for 30 min until soln was complete. After cooling 10 ml of water were added and the product was precipitated on acidification with 2N HCl; 0·6 g (60%) of a bright - red product were obtained, m.p. 155–56° (from 95% EtOH). (Found: C, 51·18; H, 4·81; N, 29·88. $C_{10}H_{11}N_5O_2$ requires: C, 51·50; H, 4·75; N, 30·03).

Ethyl (*o* - *acetyl* - *methylamino*) *phenylazo* - *cyanacetate* (13)

o - Acetyl - methylamino - aniline[12] (11·5 g) was dissolved into 1N HCl (175 ml) and treated with a water soln (35 ml) of $NaNO_2$ (5·4 g) at 0°. The cold soln of the diazonium salt was slowly added under stirring to a mixture of 8 g ethyl cyanacetate, 8 g anhyd NaOAc, 70 ml water and 35 ml 95% EtOH. After 30 min at 0° the mixture was kept 30 min more at room temp, the ppt was collected on a suction filter, washed with water, dissolved in $CHCl_3$ and purified by precipitation with light petroleum, yielding a yellow crystalline powder. 19 g (94%), m.p. 139–42° from light petroleum. (Found: C, 58·23; H, 5·48; N, 19·30. $C_{14}H_{16}N_4O_3$ requires: C, 58·32; H, 5·59; N, 19·44). This

*Layer of 250 μ of silica gel GF_{254} (purchased from Merck, A. G.) activated for 2 h at 80°.
Solvent: benzene: EtOAc (50 : 20) (by volume)-Developer: UV light (254 mμ).

material was a mixture of the α- and β-isomers* which could be obtained in a pure state as follows: 1 g of **13** was dissolved in a water (20 ml) soln of 1N NaOH (10 ml). The soln was filtered and slowly neutralized with 1N HCl (10 ml). The ppt (**13** - α) was collected by filtration, throughly washed with water and crystallized from 95% EtOH (10 ml), yield 1 g, m.p. 128–30°. (Found: C, 58·58; H, 5·66; N, 19·45. $C_{14}H_{16}N_4O_3$ requires: C, 58·32; H, 5·59; N, 19·44.) By operating in the same way but neutralizing the alkaline solution with carbon dioxide **13** - β was obtained in quantitative yield; m.p. 144–45° (from 95% EtOH). (Found: C, 58·58; H, 5·57; N, 19·41. $C_{14}H_{16}N_4O_3$ requires: C, 58·32; H, 5·59; N, 19·44).

Ethyl 2 - (o - *acetyl* - *methylamino*) *phenylazo* - 2 - *carbamidoxime acetate* (**14**)

To hydroxylamine hydrochloride (3·85 g) dissolved in dry EtOH (100 ml), a NaOEt soln, prepared from 1·27 g of Na and 50 ml of EtOH, was added. NaCl was removed by filtration and the filtrate was mixed with an EtOH (75 ml) soln of **13** (14·4 g). The mixture was stirred 2 h at room temp, then heated 1 h, at reflux. The solvent was removed under reduced pressure, the residue taken up with ethyl ether and crystallized from $CHCl_3$-light petroleum; 8·2 g (51%) of a yellow crystalline powder were obtained, m.p. 145–7°. Soluble into 2N HCl, 2N NaOH, 95% EtOH and benzene. Sparingly soluble in water and ethyl ether. (Found: C, 52·12; H, 5·82; N, 21·50. $C_{14}H_{19}N_5O_4$ requires: C, 52·33; H, 5·96; N, 21·80).

3 - *Amino* - 4 - (o - *acetyl* - *methylamino*) *phenylazo* - *isoxazolin* - 5 - *one* (**12**)

(A) From **11**. 0·85 g of **11** were suspended into 8·5 ml of Ac_2O and heated at 60–70° until soln was complete. The product which separated on cooling was filtered, washed with light petroleum and crystallized from 95% EtOH yielding 0·8 g (80%) of an orange crystalline powder, m.p. 196–97° (dec). Soluble in 2N NaOH and in 2N HCl. Sparingly soluble in water, 95% EtOH, benzene and diethyl ether. (Found: C, 52·49; H, 4·73; N, 25·16. $C_{12}H_{13}N_5O_3$ requires: C, 52·36; H, 4·76; N, 25·44).

(B) From **13**. 3·85 g of hydroxylamine hydrochloride were dissolved into dry EtOH (100 ml) and mixed with a NaOEt soln prepared from 1·27 g of Na and 50 ml of dry EtOH. NaCl was removed by filtration and the filtrate was mixed under stirring with an EtOH (75 ml) solution of **13**. After stirring 2 h at room temp the mixture was heated 1 h at reflux, then treated with an additional 50 ml of the ethanolic NaOEt soln (prepared from 1·15 g of Na), heated 1 h more at reflux. The solvent was completely removed under reduced pressure, the residue taken up with water and acidified with 2N HCl. The ppt was collected, washed with water and crystallized from 95% EtOH yielding 10 g (72·5%) of **12**, m.p. 196–97° (dec). The product was identical in all respects to that prepared by method A.

(C) From **14**. Compound **12** was also prepared from **14** (1·6 g) by heating it at 145–150° in an oil bath for about 10 min. The yellow starting material discoloured to red without melting. The product was washed with warm 95% EtOH (30 ml) and dried, yielding 0·9 g (68%) of pure **12** (m.p. 196–97° dec) identical in all respects to that prepared by method A).

4 - *Keto* - 5 - *methyl* - 4,5 - *dihydro* - 1*H* - 1,2,5 - *benzotriazepine* - 3 - *carbohydrazide* (**15**)

3 - Carbethoxy - 4 - keto - 5 - methyl - 4,5 - dihydro - 1H - 1,2,5 - benzotriazepine[1] (36 g) was dissolved into 1500 ml of 95% EtOH and treated with 24 ml of 98% hydrazine hydrate. The mixture was heated at 50–60° for 20 h under stirring. The solvent was removed under reduced pressure, the residue was collected by filtration, washed with water (300 ml) and crystallized from 95% EtOH yielding 19 g (55%) of a yellow crystalline powder, m.p. 186–88° (dec). (Found: C, 51·69; H, 4·79; N, 30·32. $C_{10}H_{11}N_5O_2$ requires: C, 51·50; H, 4·75; N, 30·00).

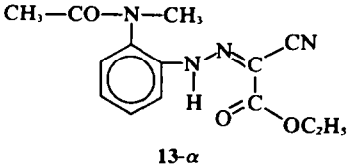
4 - (o - *Methylamino*) *phenylazo* - *pyrazolidin* - 3,5 - *dione* (**16**)

Compound **15** (5 g) was suspended into 50 ml of 10% NaOH and stirred at room temp until completely dissolved. The soln was made slightly acidic with dil HCl and, after 30 min standing, the ppt was collected by filtration, washed with water and crystallized from 95% EtOH yielding 4·5 g (90%) of a deep red crystalline powder, m.p. 217–18° (dec). (Found: C, 49·57; H, 4·74; N, 29·24. $C_{10}H_{11}N_5O_2 \cdot \frac{1}{2} H_2O$ requires: C, 49·58; H, 4·99; N, 28·91). Dissolved into 20% HCl the product precipitated after a short time as the hydrochloride, yellow crystalline powder, m.p. 200°. (Found: C, 44·70; H, 4·54; N, 26·27. $C_{10}H_{11}N_5O_2 \cdot HCl$ requires: C, 44·52; H, 4·48; N, 25·97).

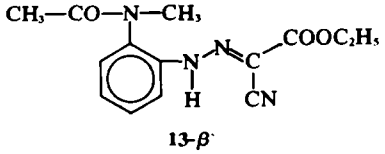
Diethyl (o - *acetyl* - *methylamino*) *phenylazo* - *malonate* (**19**)

o - Acetylmethylamino - aniline[12] (9·84 g) was dissolved into 1N HCl (150 ml) and treated in 10 min with a water soln (30 ml) of $NaNO_2$ (4·62 g) at 0° under stirring. The cold soln of the diazonium salt was added in 10 min to a mixture of 9·6 g diethyl malonate, 12·3 g anhyd NaOAc, 60 ml water and 30 ml 95% EtOH. Stirring was continued for 30 min at 0° and 30 min at room temp. The ppt was

*Ester **13** presented the same ethylenic isomerism already reported for ethyl phenylazo - cyanacetate[13] and the procedure here described for obtaining the two forms in a pure state is the same already applied to this compound.[14] A comparison of the NMR spectra ($CDCl_3$, TMS = 0) of α and β ethyl phenylazo - cyanacetate was carried out by us, permitting assignment of the *cis* structure to the α and of the *trans* structure to the β-isomer. In the α - spectrum the NH signal was recorded at a distinctly lower field (9·6 δ against 13 δ for β), suggesting a kelate structure consistent only with the *cis* arrangement.[15] By analogy we assigned the *cis* configuration to the higher melting α - isomer (**13** - α) of our ester and the *trans* to the lower melting one (**13** - β).



13-α



13-β

Both forms afforded **12** in the same yields following the procedure here outlined.

collected on a suction filter, washed with water, dried and crystallized from cyclohexane affording 14·2 g (71%) of a pure product, m.p. 94–97°. (Found: C, 57·58; H, 6·42; N, 12·67. $C_{16}H_{21}N_3O_5$ requires: C, 57·30; H, 6·31; N, 12·53).

(o - *Acetyl - methylamino*) *phenylazo - malonylhydrazide* (**20**)

Compound **19** (9·6 g) and 50 ml of 98% hydrazine hydrate were heated at 50° under stirring for a few min. The solid dissolved quickly and precipitation of the hydrazide followed. After cooling at room temp the mixture was diluted with 100 ml water, the solid collected by filtration and crystallized from 95% EtOH yielding 6·4 g (73%) of a yellow crystalline powder, m.p. 214–15° (dec). (Found: C, 46·61; H, 5·38; N, 31·64. $C_{12}H_{17}N_7O_3$ requires: C, 46·90; H, 5·58; N, 31·91).

4 - (o - *Acetyl - methylamino*) *phenylazo - pyrazolidin - 3,5 - dione* (**21**)

Compound **20** (11 g) was dissolved into glacial AcOH (110 ml) and heated at reflux for 30 min. The solvent was removed under reduced pressure, the residue taken up with 95% EtOH, the solid collected by filtration, washed with water and EtOH and dried in a vacuum oven, yield 7·2 g (73%), m.p. 267–69°. (Found: C, 52·61; H, 4·69; N, 25·20. $C_{12}H_{13}N_5O_3$ requires: C, 52·40; H, 4·76; N, 25·40). Yellow crystalline powder soluble into 2N NaOH and 2N HCl.

4 - (o - *Acetyl - methylamino*) *phenylazo - 1 - acetyl - pyrazolidin - 3,5 - dione* (**17**)

(A) From **16**. 9·32 g of **16** were dissolved into 90 ml pyridine. The temp of the stirred soln was lowered to 5° by external cooling, 9·18 g of Ac_2O were added and stirring protracted for 60 min. All solvent was evaporated under reduced pressure, the residue was taken up with hot 95% EtOH (100 ml) and the product collected by filtration and washed with cold alcohol, yield 8 g (63%), m.p. 250° (dec). (Found: C, 52·55; H, 4·66; N, 21·60. $C_{14}H_{15}N_5O_4$ requires: C, 52·99; H, 4·76; N, 22·08). Soluble at room temp into 1N NaOH in which was in part transformed after some time, into **21**.

(B) From **21**. 1·38 g of **21** were treated as above with 125 ml pyridine and 0·765 g of Ac_2O affording 1·3 g (82·5%) of pure product. The material was identical in all respects to that prepared by method A.

4 - (o - *Acetyl - methylamino*) *phenylazo - 1,2 - diacetyl - pyrazolidin - 3,5 - dione* (**18**)

(A) From **16**. A soln of **16** (9·32 g) in 90 ml pyridine was treated with 20·4 g of Ac_2O and heated at reflux for 15 min. The solvent was evaporated under reduced pressure, the residue taken up with water, collected by filtration and crystallized from 95% EtOH affording 5·8 g (46%) of product melting at 230° (dec). (Found: C, 53·49; H, 4·56; N, 19·49. $C_{16}H_{17}N_5O_5$ requires: C, 53·48; H, 4·77; N, 19·49).

(B) From **21**. 1·38 g of **21** were treated as above with 50 ml of pyridine and 2·55 g of Ac_2O yielding 0·7 g (45%) of pure product, m.p. 230° (dec). The material was identical in all respects to that prepared by method A.

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