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CONDENSATION OF YNAMINES OR KETENE-N,N-ACETALS WITH AMINOESTERS

SYNTHESES OF 5- AND 6-MEMBERED NITROGEN-CONTAINING HETEROCYCLES

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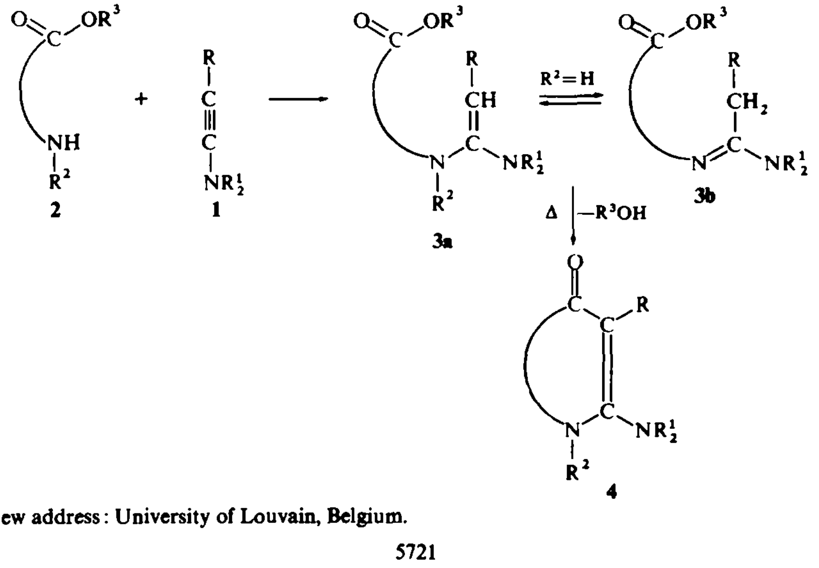
Abstract—The addition of primary or secondary aminoesters to ynamines leads to N,N,N'-trisubstituted amidines or to ketene-N,N-acetals. Both these classes cyclise on heating by an intramolecular acylation. Starting from α- or β-aminoesters 5- or 6-membered nitrogen-containing heterocycles are obtained. The same heterocycles have been also prepared from ketene-N,N-acetals and aminoesters via transamination. Under these reaction conditions γ-aminoesters form γ-lactams.

Reaction principle[1]

It has already been reported that ynamines react with primary[2] or secondary[2,3] amines to produce trisubstituted amidines or ketene-N,N-acetals. The corresponding adducts from appropriate aminoesters **2** can be cyclized through intramolecular acylation giving **4**, probably via the ketene-N,N,-acetal structure **3a**. Intramolecular acylation of enamine-esters is known.[4–16] Expectedly ketene-N,N-acetal esters react similarly well. Furthermore cyclization of N,N,N'-trisubstituted amidine esters via their ketene-N,N-acetal tautomer is described now as a useful extension of this reaction principle. Thus, α- or β-aminoesters give good yields of 5- or 6-membered N-containing heterocycles. This reaction does not work with γ-aminoesters which do not condense as such with ynamines because of lactam formation.



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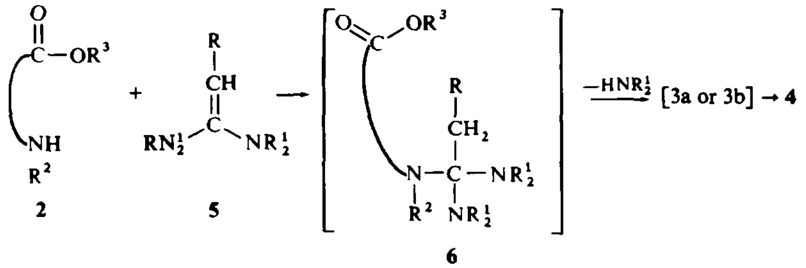
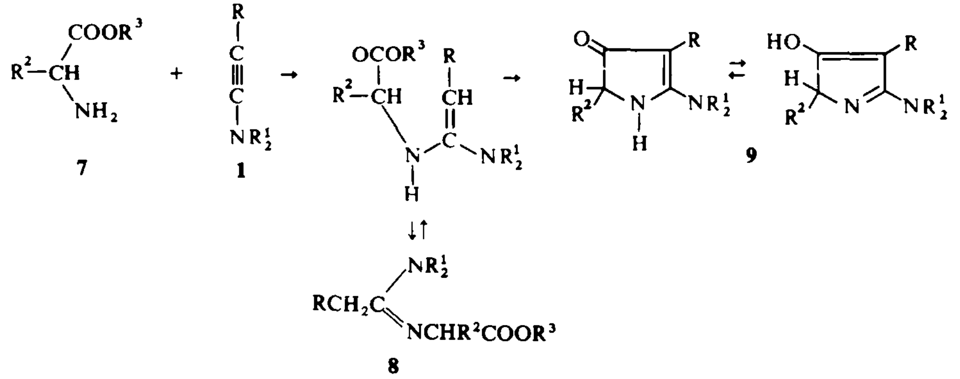
Instead of using ynamines for the formation of **4** ketene-N,N-acetals **5** have been applied successfully. It is supposed that the reaction proceeds by transamination as known for enamines[17–22] via the intermediate **6**.



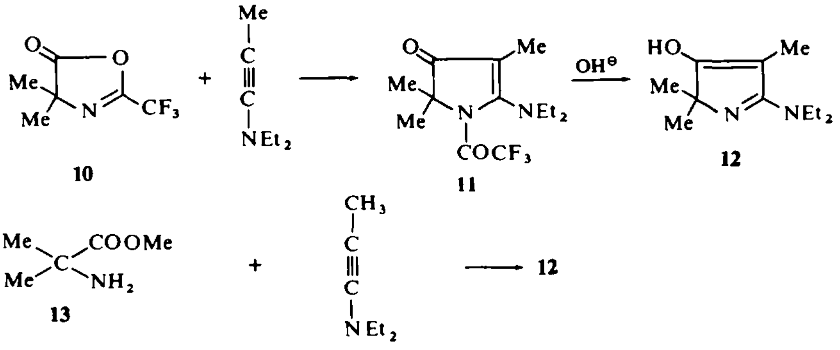
RESULTS

1. *Reaction of ynamines with α-aminoesters*

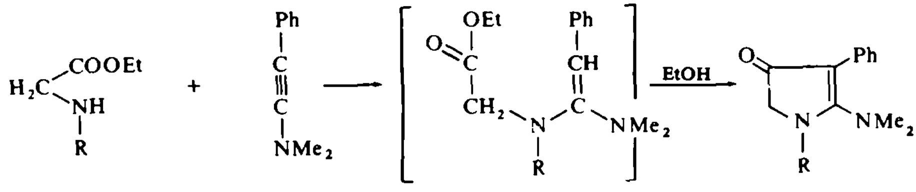
According to the principle above, primary α-aminoesters **7** add to ynamines **1** at room temperature to give the amidine derivatives **8**. Since these are partially transformed into **9** during their purification by distillation, the crude material **8** was refluxed in toluene for 1–5 hr providing in good yield the cyclization product **9**.



The reaction of ynamines with 4,4-disubstituted-5-oxazolones **10** was recently reported[23] to give N-acyl-2,3-dihydro-3-pyrrolones **11**. The hydrolysed product **12** was also obtained starting from the same ynamine and methyl α-aminoisobutyrate **13** following our reaction principle.[23]



Secondary α-aminoesters react with ynamines to give cyclic compounds via the ketene-N,N-acetals **15**. However, in these cases the intramolecular acylation takes place almost spontaneously in the course of the addition process. Thus from ethyl N-methyl or N-phenylglycinate **14a** or **14b** and ynamine **1a** 2,3-dihydro-3-pyrrolones **16a** and **16b** are obtained usually in good yields.



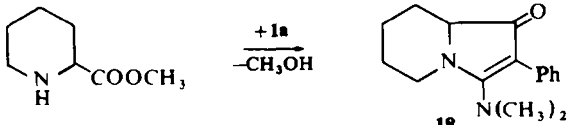
14a: R = Me
b: R = Ph

1a

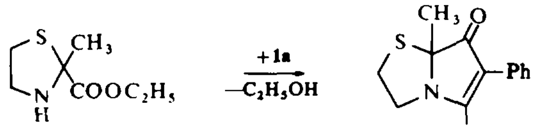
15

16a: R = Me
b: R = Ph

When the secondary α-aminoester is incorporated in a cyclic system, nitrogen bridgehead compounds are formed. This is illustrated by the reaction of phenyl-N,N-dimethylaminoacetylene **1a** with methyl piperidine-2-carboxylate **17** leading to pyrrocoline derivative **18**, and with ethyl 2-methyl-2-thiazolidine-carboxylate **19** leading to pyrrolo[2,1-b]thiazole derivative **20**.

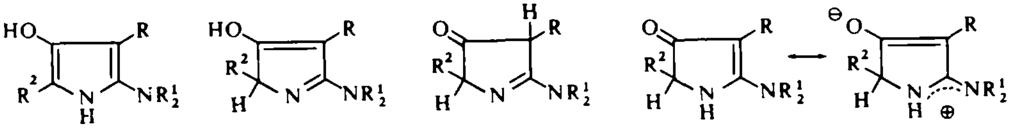


17 **18**



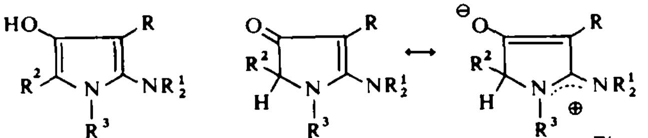
19 **20**

Enondiamine-enolamidine tautomerism. The 3-hydroxy-5-aminopyrrole derivatives **9** can exist in four potential tautomeric forms A–D. E is an alternative limiting form of D.



A B C D E

The N-substituted derivatives such as **16** or **18** can exist in the tautomeric forms A′ or D′.



A′ D′ E′

Table 1. Physical data of 3-hydroxy-5-amino-2H-pyrrole derivatives 9 (enolamidine form b)

No.	R	R¹	R²	IR (μ) KBr			UV methanol		NMR : τ a : $CDCl_3$ b : CD_3OD c : CCl_4	
							$\lambda_{max}^{m\mu}$ (ε 10^{-3})		O—H	$\mathrm{C}\langle^{\mathrm{H}}_{\mathrm{R}}$
					*					
9a	C_6H_5	CH_3	H	3·12;	6·24;	6·40	287 (19·8);	222 (12·0)	3·28[a]	6·35
9b	C_6H_5	CH_3	CH_3	3·18;	6·24;	6·40	287 (17·8);	222 (12·0)	3·53[a]	6·35
9c	C_6H_5	CH_3	$CH_3(CH_2)_2$	3·18;	6·24;	6·39	287 (19·5);	223 (13·6)	3·97[a]	6·37
9d	C_6H_5	CH_3	$(CH_3)_2CHCH_2$	3·16;	6·24;	6·41	288 (17·5);	225 (12·0)	§ —[b]	6·22
9e	C_6H_5	CH_3	$C_6H_5CH_2$	3·10;	6·24;	6·39	290 (15·3);	225 (12·0)	§ —[b]	6·02
9f	C_6H_5	CH_3	$C_2H_5O_2C(CH_2)_2$	3·18;	6·24;	6·39†	287 (21·0);	224 (15·0)	3·8[a]	6·3
9g	C_6H_5	CH_3	$C_6H_5CH_2O_2C(CH_2)_2$	3·14;	6·24;	6·36‡	287 (16·9);	225 (12·0)	4·08[a]	6·3
9h	CH_3	C_2H_5	CH_3	3·17;	6·2;	6·44	289 (19·4);	228 (9·9)	3·9[a]	~6·4
9i	CH_3	C_2H_5	$CH_3CH_2CH_2$	3·1 ;	6·09;	6·5	289 (19·4);	228 (10·0)		~6·4
12[23]				3·20;	6·2;	6·5	287 (22·2);	226 (10·0)	2·29[c]	—

* Shoulder medium to weak.

† $\nu_{C=O}$ of ester 5·78 μ.

‡ $\nu_{C=O}$ ester 5·75 μ.

§ Exchange with the solvent.

A recent study of potential enonamine-enolimine tautomerism shows that the enonamine form predominates. Exceptions are only observed in cases where the enolimine form is stabilized by special factors, such as aromaticity.[24] In the particular case of β-hydroxy-pyrroles[28] a zwitterion formulation (e.g. E) was suggested which is supported by a broad ν_{NH} band at 3·1–3·3 in IR as well as high m.p. and water solubility.[25] However, an electron-withdrawing substituent in α-position seems to favour the hydroxy form (e.g., A).[25, 26] Furtheron it has been recently reported that according to the NMR spectrum 3-hydroxy-4,5-dimethylpyrrole (no. 21 in Table 2) exists as the ketone (e.g., D) [τ = 6·42 (2H) doublet].[27]

TABLE 2. PHYSICAL DATA OF N-SUBSTITUTED-4-OXO-2-AMINO-Δ^2-PYRROLINE (ENONDIAMINE FORM D')

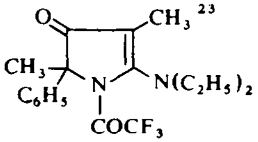
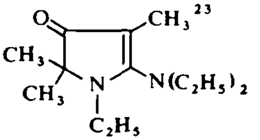
No.	IR* μ (KBr)	UV methanol $\lambda_{max}^{m\mu}$(ε 10^{-3})	NMR $CDCl_3$ $C{<}^{R}_{H}$
16a	6·06 m; 6·24 (sh, m); 6·39 s	302 (12·6); 263 (9·5); 243 (9·5)	6·23
16b	6·07 s; 6·30 s; 6·39 s	306 (18·4); 261 (14·4)	5·9
18	6·10 s; 6·23 m; 6·44 s	308 (12·8); 249 (14·7)	6–7
21[27]	6·16 s; 6·42 s	318 (10·8)	6·42

* s strong; m medium; w weak; sh shoulder

Derivatives of 3-hydroxy-1-phenylpyrrole in which the α-positions are unsubstituted so that interannular conjugation is possible appear to exist in the enolic hydroxy form (e.g., A') and the α-substituted in the oxo-form (e.g., D').[29]

The tautomerism of compounds **9**, **16** and **18** has been studied using IR, UV and NMR spectroscopy. Table 1 summarizes these data for the reaction products of ynamines with primary α-aminoesters (potential tautomeric forms A to D). Table 2 and 3 show the corresponding data for the reaction products of ynamines with

TABLE 3. PHYSICAL DATA OF N-SUBSTITUTED-4-OXO-2-AMINO-Δ^2-PYRROLINES (FIXED ENONDIAMINE FORM)

No.	IR (μ)	UV $\lambda_{max}^{m\mu}$ (ε 10^{-3})
20	6·02 m 6·34 s	316 (10·6); 260 (12·8); 243 (12·9)
11[23]	5·88; 5·92; 6·26	305 (11·8); 266 (11·5)
	5·83; 5·98; 6·35	311 (10·1); 274 (10·7)
	6·06; 6·48	

secondary α-aminoesters (potential tautomeric forms A′ or D′ in Table 2 and fixed enondiamine form in Table 3).

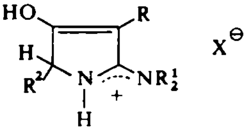
The $\nu_{C=O}$ IR band at 5·9–6·1 μ present in the fixed enondiamine (Table 3) is also found in compounds **16a**, **16b** and **18** (Table 2) revealing thus that they exist in the 2-amino-4-oxo-Δ^2-pyrroline form D′ and not as hydroxypyrroles A′. This is further confirmed by NMR showing a CH_2 peak at τ = 6·23 and 5·9 for **16a** and **16b** (Table 2).

Compounds of Table 1 show a strong and broad IR absorption at ~6·4 μ and one of medium intensity at 3·1–3·3 μ. The absence of absorption in the $\nu_{C=O}$ region at 5·9–6·1 μ led us to the conclusion that forms C and D are excluded. The presence of a CH_2 peak in NMR at τ = 6·35 in compound **9a** and a $\mathrm{C}{<}^{\mathrm{H}}_{\mathrm{R}^2}$ (coupled with the hydrogens in α in R^2) in the same region for the compounds **9b** to **9i** eliminates the form A. In conclusion we have to ascribe to the compounds of Table 1 the 3-hydroxy-5-amino-2H-pyrrole form B.

Protonation. The hypsochromic shift in UV observed passing from the enondiamine form (Tables 2 and 3) to the enolamidine form (Table 1) is still stronger when the UV spectrum is taken up in acidic medium (Table 4). The IR of some hydrochlorides shows a strong absorption band at ~6·1 μ as well as broad bands at 3·1–3·3 μ and ~4 μ. The CH_2 and CHR^2 peaks (τ ~ 5·5) are still present in NMR of the protonated molecules. Taking all these data into account the general formula **27** appears to represent the major contribution to the structure of the protonated salts **9**.

TABLE 4. IR AND UV OF THE SALTS

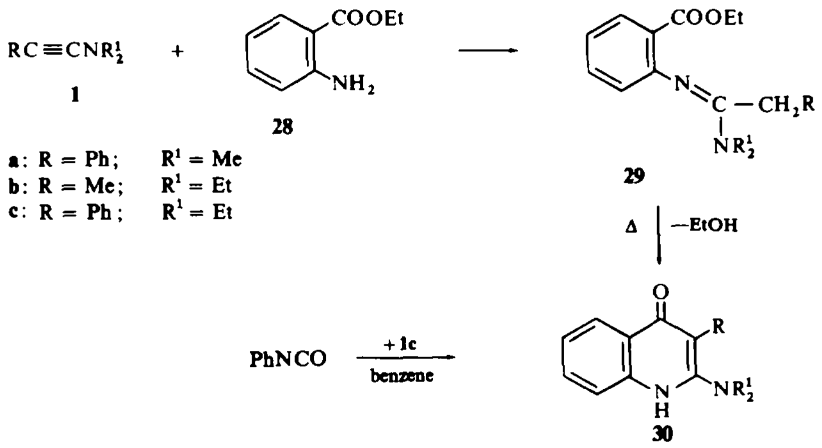
No.	IR μ (KBr)	UV $\lambda_{max}^{m\mu}$ (ε 10^{-3}) methanol-HCl
9a	3·1–3·3 br. sh.; ~4 br; 6·1 s; 6·24 w	241 (16·2)
9b	3·1–3·3 br; ~4 br; 6·08 s; 6·24 w. sh	240 (17·0)
9c		242 (18·0)
16a	~4 br; 6·17 s	240–260 (14·1)
18	—	240–260 (14·1)



27

2. *Reaction of ynamines with β-aminoesters*

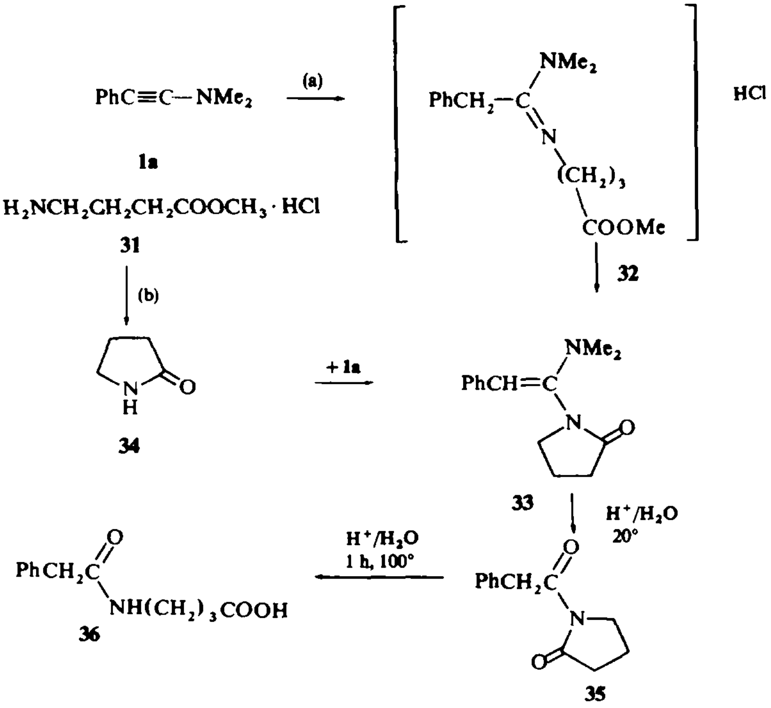
According to the general principal, from reaction of ynamines **1** with β-aminoesters such as ethyl anthranilate **28** the 2-amino-4-quinolone derivatives **30** have been prepared. Here the ring closure of the amidine intermediate **29** needed higher temperature (boiling ethyleneglycol or nitrobenzene). The same quinolone was prepared independently from ynamine **1c** and phenylisocyanate in benzene solution.[30] The similarity of IR spectrum in the 6–6·5 μ region with 1-methyl-3-phenyl-4-quinolone[31, 32] shows that **30** exists in the enondiamine form.



a: R = Ph; R^1 = Me
b: R = Me; R^1 = Et
c: R = Ph; R^1 = Et

3. *Reaction of ynamines with γ-aminoesters*

Phenyldimethylaminoacetylene **1a** does not react with methyl γ-aminopropionate **31**. But when the hydrochloride of **31** is mixed with **1a** in CH_2Cl_2 as solvent, the ynamine is consumed. The only reaction products identified after working up are the ketene-N,N-acetals **33** and phenyl-N,N-dimethylacetamide. It was not possible to decide whether the amidine derivative **32** was the intermediate (route a) since route b (formation of the butyrolactam **34** from **31** and then addition of the latter to the



ynamine **1a**) is an alternate possibility. The structure **33** was confirmed by an independent synthesis from pure **34** and **1a** and also by the hydrolysis products **35** and **36**.

4. *Reaction of ketene*-N,N-*acetals with α-, or β-aminoesters*

1,1-Bis-dimethylamino-2-phenyl-ethylene **5** (R = Ph, R^1 = Me) has been successfully condensed with some primary α-aminoesters and ethyl anthranilate under the acylation conditions used with ynamines. Although the experimental conditions are more severe and yields are lower (Table 5).

This method can be helpful when the ketene-N,N-acetal is easier to be prepared than the corresponding ynamine.

TABLE 5. REACTION OF YNAMINES **1** OR KETENE-N,N-ACETAL **5** (R = Ph, R^1 = Me) WITH PRIMARY α-AMINOESTERS TO **9**

Comp.	From ynamine 1		From ketene-N,N-acetal		m.p. °C	m.p. a: HCl b: maleate
	Δ toluene hours	yield %	Δ xylene hours	yield %		
9a	1	82	16	traces	214	163a
9b	3	66	—	—	174	156a
9c	—	—	8	57	180	hygr. a
9d	2	77	—	—	186	104b
9e	3	64	16	55	168	120a
9f	5	66	16	46	137	169a
9g	2	40	—	—	115	—
9h	6	61	—	—	114	—
9i	5	70			120	

EXPERIMENTAL

With the assistance of M. A. Hartemink.

2-R-3-*Hydroxy-4-phenyl-5-dimethylamino*-2H-*pyrroles* **9**.

General method from ynamines **1** *and the α-aminoesters* **7** (Table 5). Except for **7f** where R^3 = Et, in all the other cases R^3 = Me. The hydrochloride of **7** (0·01M) was suspended in 6 ml ether, then 0·013 mole of $N(Et_3)$ was added and the mixture agitated 30 min. Then a soln of 0·011 mole of ynamine **1** in 6 ml ether was added to the mixture and allowed to react at room temp until **1** disappeared (followed by the IR band of C≡C at 4·55 μ). This takes usually 30 min. The solid $N(Et_3)$. HCl was separated from the soln, which was then concentrated to dryness. The oily crude amidine **8** was dissolved in about 10 ml toluene and refluxed from 1 to 6 hr (Table 5). On cooling, the pure end-product **9** crystallized (yield in Table 5). For the analysis it was recrystallized from a mixture of MeOH-acetone-ether for **9a**–**9g** and acetone-ether-light petroleum for **9h** and **9i**. The salts were prepared in the usual way and recrystallized from MeOH-MeOAc for **9a**, **9e**, **9f**: acetone-ether for **9b** and from MeOAc-hexane for **9d**. Elementary analyses are given in Table 6 and UV, IR and NMR spectra in Table 1.

General method from 1,1-*bis-dimethylamino-2-phenyl-ethylene* **5** (R^1 = Me; R = Ph) and *α-aminoesters* The hydrochloride of **7** (0·01M) was suspended in 10 ml xylene, then $N(Et_3)$ (0·013M) was added and the mixture agitated 30 min. The white crystalline ppt of $N(Et_3)$. HCl was separated and **5** (R^1 = Me; R = Ph) was added to the soln which was then brought to the b.p. About 3 ml were distilled off, then heated under reflux for 8 to 16 hr (Table 5). The soln was then partially concentrated and the crystalline product was identical to that obtained from **1a**.

2-*Dimethylamino*-1-*methyl-4-oxo*-3-*phenyl*-Δ^2-*pyrroline* **16a**

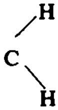
Ethyl sarcosinate **14a** (1·4 g; 0·01M) was liberated from its HCl salt as above. Then 1·6 g (0·011M) of

TABLE 6. ELEMENTARY ANALYSES OF COMPOUNDS **9a** TO **9i** AND OF THEIR SALTS

Compd.		Calc. %						Found %					
		C	H	N	O	Cl	M.W.	C	H	N	O	Cl	M.W.
9a	$C_{12}H_{14}N_2O$	71·26	6·98	13·85	7·91	—	202	70·87	6·91	13·75	8·09	—	255
9b	$C_{13}H_{16}N_2O$	72·19	7·46	12·95	7·40	—	216	72·04	7·46	13·06	7·93	—	—
9c	$C_{15}H_{20}N_2O$	73·73	8·25	11·47	6·55	—	244	73·62	8·35	11·33	6·72	—	—
9d	$C_{16}H_{22}N_2O$	74·39	8·59	10·85	6·18	—	258	74·22	8·56	10·56	6·50	—	262
9e	$C_{19}H_{20}N_2O$	78·05	6·90	9·58	5·47	—	292	77·77	6·89	9·73	6·07	—	296
9f	$C_{17}H_{22}N_2O_3$	67·52	7·33	9·27	15·88	—	302	67·30	7·35	9·45	15·98	—	317
9g	$C_{22}H_{24}N_2O_3$	72·5	6·64	7·69	13·17	—	364	62·39	6·82	7·34	13·46	—	—
9h	$C_{10}H_{18}N_2O$	65·89	9·96	15·37	8·78	—	182	65·69	10·17	15·28	9·28	—	204
9i	$C_{12}H_{22}N_2O$	68·53	10·54	13·32	7·61	—	210	68·16	11·08	13·30	8·05	—	221
Salts of													
9a	$C_{12}H_{15}N_2OCl$	60·38	6·34	11·74	6·70	14·86	239	60·45	6·43	11·37	7·03	14·75	—
9b*	$C_{13}H_{19}N_2O_2Cl$	57·67	7·08	10·35	11·82	13·09	271	57·63	7·16	10·26	11·69	13·23	—
9c	Hygroscopic	—	—	—	—	—	—	—	—	—	—	—	—
9d	$C_{20}H_{26}N_2O_5$	64·15	7·00	7·48	21·37	—	374	63·99	6·91	7·24	21·22	—	—
9e*	$C_{19}H_{23}N_2O_2Cl$	65·73	6·68	8·08	9·22	10·23	347	65·91	6·59	8·40	9·20	10·91	—
9f	$C_{17}H_{23}N_2O_3Cl$	60·27	6·84	8·26	14·17	10·46	339	59·61	6·70	8·78	14·33	11·10	—

* Crystallized with 1 mole of H_2O.

1a was added to the mixture at room temp. After 30 min the ynamine had disappeared. The $N(Et_3) \cdot HCl$ was separated and the ethereal soln concentrated to dryness. The residue was distilled at 145–155°/0·1 Torr giving a semi-solid, unstable, yellow compound **16a**, yield 65%; UV methanol $\lambda_{max}^{m\mu}$ (ε): 302 (12,600); 263 (9,500); 243 (9,500) IR $\nu_{C=O}$: 6·06 μ; $\nu_{C=C}$: 6·39 μ; NMR $CDCl_3$ τ[H]: $N(Me_2)$: 7·2 [6]: N-Me: 7·1 [3];


CH_2

: 6·23 [2], Ph: 2·78 [5]. (Found: C, 61·04; H, 6·69; N, 10·91; O, 6·49; Cl, 13·69. Calc. for $C_{13}H_{17}N_2OCl$. M.W. 252·74 (HCl of **16a**, m.p. 153° for acetone-ether: C, 61·78; H, 6·78; N, 11·08; O, 6·33; Cl, 14·03%).

2-*Dimethylamino*-1,3-*diphenyl*-4-*oxo*-Δ^2-*pyrroline* **16b**

Compound **14b** (7·2 g; 0·04M) and **1a** were dissolved in 20 ml ether and traces of dry HCl added. After 3 days at room temp, the solvent was evaporated to dryness and the residue heated at 160° for 6 hr. the product solidified on cooling and was crystallized in acetone ether giving 8·5 g of **16b**, m.p. 170° (Table 2). (Found: C, 77·24; H, 6·34; N, 10·21; O, 6·41; M.W. 275. Calc. for $C_{18}H_{18}N_2O$: C, 77·67; H, 6·52; N, 10·07; O, 5·75% M.W. 278).

1-*Dimethylamino*-2-*phenyl*-3-*oxo*-3,4,5,6,7,8-*hexahydropirrocoline* **18**

Prepared as above from the HCl of **17** (1·8 g 0·01 M) and **1a** (1·6 g; 0·011M). But when ether was distilled off, the oily residue crystallized spontaneously with evolution of heat. It was recrystallized from EtOH, m.p. 149–153° (dec.), yield 74%; UV methanol $\lambda_{max}^{m\mu}$ (ε): 308 (12,800), 249 (14,800); IR (KBr) $\nu_{C=O}$ 6·09; $\nu_{C=C}$ 6·23 (w) and 6·43 (s). (Found: C, 74·64; H, 7·88; N, 10·93; O, 6·63. M.W. 287. Calc. for $C_{16}H_{20}N_2O$: C, 74·96; H, 7·86; N, 10·93; O, 6·24% M.W. 286·94).

5-*Dimethylamino*-8-*methyl*-7-*oxo*-6-*phenyl*-2,3,7,8-*tetrahydropyrrolo*[2.1-b]*thiazole* **20**

Compound **19**[33] (3·5 g; 0·02M) and **1a** (3 g; 0·022M) in 10 ml of a 1:1 mixture $CHCl_3$-ether and traces of dry HCl was heated under reflux for 6 hr. The solvents were distilled off and the residue crystallized in $CHCl_3$-acetone-ether, m.p. 172° (58% yield) (Table 3). (Found: C, 65·49; H, 6·60; N, 10·09; O, 6·39; S, 11·46. M.W. 263. Calc. for $C_{15}H_{18}N_2OS$: C, 65·67; H, 6·61; N, 10·21; O, 5·83; S, 11·76% M.W. 274).

2-*Dimethylamino*-3-*phenyl*-4-*quinolone* **30a**

From phenyl-dimethylaminoacetylene **1a** *and ethyl anthranilate* **28**. A mixture of **1a** (1·6 g; 0·011M) and **28** (1·5 g; 0·01M) in anhyd benzene was refluxed and then two drops of BF_3-etherate added. Heating was continued until the ynamine disappeared (about 1·5 hr). Benzene was then evaporated and to the yellow oily residue (**29a**) 3 ml ethylene glycol were added and the mixture heated under relux during 30 min. The soln was cooled and alcohol added (10 ml) giving a crystalline mass. The solid was filtered off and crystallized from ethylene glycol-alcohol, m.p. 256°, 1·6 g (61%); UV EtOH $\lambda_{max}^{m\mu}$ (ε): 320 (14,000); 258 (22,900); 238 (24,800). IR (KBr) μ: 3·3; 6·14; 6·30; 6·44. (Found: C, 77·56; H, 6·27; N, 10·60; O, 6·14. M.W. 280·7. Calc. for $C_{17}H_{16}N_2O$: C, 77·25; H, 6·11; N, 10·60; O, 6·06% M.W. 264·32).

The hydrochloride was prepared from HCl aq and was recrystallized from alcohol–ether, m.p. 244–248. (Found: C, 67·87; H, 5·95; N, 8·59; O, 5·50; Cl, 12·16. Calc. for $C_{17}H_{17}N_2OCl$. M.W. 300·8: C, 67·88; H, 5·69; N, 9·32; O, 5·32; Cl, 11·79%).

From 1,1-*bis-dimethylamino*-2-*phenylethylene* **5**. (R^1 = Me; R = Ph) *and ethyl anthranilate* **28**. A mixture of **28** (1·5 g; 0·01M) and 1,1-bisdimethylamino-2-phenylethylene (1·9 g; 0·01M) was warmed at 210° during 30 min without solvent. The mixture was cooled and EtOH added giving a crystalline mass purified as above 1·1 g (43%).

2-*Diethylamino*-3-*methyl*-4-*quinolone* **30b**

A mixture of **1b** (3·3 g; 0·03M) and **28** (4·5 g; 0·03M) was refluxed in 10 ml toluene and 3 drops BF_3-etherate. Heating was continued 20 hr. The toluene was distilled off and 5 ml nitrobenzene added to the residue (crude **29b**) and heated 20 min at 200°. The soln was cooled, ether added, giving a crystalline mass which was filtered off and recrystallized from EtOH as pure **30b**, yield: 46·5%, m.p. 290–291°; UV MeOH $\lambda_{max}^{m\mu}$ (ε): 322 (14,000); 260 (16,000); 230 (21,000); IR (KBr) μ: 3·3; 3·41; 6·14; 6·34; 6·44. (Found: C, 73·19; H, 8·11; N, 12·15; O, 7·13. M.W. 231. Calc. for $C_{14}H_{18}N_2O$: C, 73·01; H, 7·88; N, 12·17; O, 6·97%. M.W. 230·3.

The hydrochloride prepared as for **30a** was crystallized from alcohol–ether, m.p. 170°. (Found: C, 62·83;

H, 7·19; N, 10·35; O, 6·07; Cl, 13·24. Calc. for $C_{14}H_{19}N_2OCl$, M.W. 266·8: C, 63·02; H, 6·18; N, 10·50; O, 6·00; Cl, 13·29%).

2-Diethylamino-3-phenyl-4-quinolone **30c**

As before, from **1c** and **28**, a yield of 64%, m.p. 256–259° (crystallized in DMF), was obtained, identical m.p., IR and UV with the compound prepared from **1c** and phenyl isocyanate in benzene as solvent.[30]

Reaction of phenyldimethylaminoacetylene **1a** *with butyrolactam* **34**

A mixture of 3·6 g (0·025M) of **1a** and 2·1 g (0·025M) of **34** was refluxed in 10 ml benzene and 3 drops BF_3. The reflux was continued until all **1a** disappeared (5 hr). The solvent was evaporated and the residue distilled at 0·4 Torr in a 3-ball tube. The fraction collected in the range of 120–140° was **33**. The NMR, UV and IR agreed with the structure but it was too unstable for a good elementary analysis; UV hexane: $\lambda_{\max}^{m\mu}$ (ε): 295 (12,700); 220 (10,300); IR: 5·86 μ; 6·14 μ.

Reaction of phenyldimethylaminoacetylene **1a** *with methyl γ-aminopropionate hydrochloride* **31**

To a suspension of 3 g (0·02M) of **31** in 10 ml CH_2Cl_2 2·9 g (0·02M) of **1a** was added. An exothermal reaction occurred providing an homogeneous soln and the disappearance of the ynamine. The solvent was evaporated. The oily residue was treated with 5% Na_2CO_3 aq and extracted with ether. The organic phase dried over Na_2SO_4 and concentrated to dryness gave 2·3 g of a residue containing about a 1:1 mixture of N,N-dimethyl-phenylacetamide and **33** (by vapor-phase chromatography).

Hydrolyses of **33**

An ethereal soln of **33** was agitated 2 min in a separatory funnel with HCl (about 0·1N). The organic layer was then washed with water, dried and concentrated. The residue was almost pure **35**. Recrystallized from a mixture of ether-light petroleum, m.p. 57–58°. (Found: C, 70·88; H, 6·49; N, 6·78; O, 16·10; M.W. 203. Calc. for $C_{12}H_{13}NO_2$: C, 70·93; H, 6·45; N, 6·89; O, 15·74% M.W. 203); IR: 5·7 μ; 5·9 μ.

1 g (0·00435M) of **33** was treated in HCl (16%) during 1 hr on the steam-bath. The cooled reaction mixture was extracted 5 times with ether. The collected organic layer was dried over Na_2SO_4 and concentrated. The residue recrystallized twice from CH_2Cl_2 was pure **36**, m.p. 93°, yield: 80%; 0·8 g. (Found: C, 64·66; H, 6·81; N, 6·39; O, 21·84. Calc. for $C_{12}H_{15}NO_3$, M.W. 221·25: C, 65·14; H, 6·83; N, 6·33; O, 21·70%); IR: 5·88 μ and 6·08 μ.

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