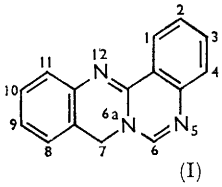
964. *Cyclic Amidines. Part XIV.*[1] *Derivatives of* 7H-5,6*a*,12-*Triazabenz*[a]*anthracene.*

By K. Butler, M. W. Partridge, and J. A. Waite.

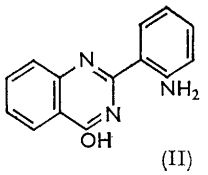
The preparation of derivatives of the triazabenz[*a*]anthracene (I) and their behaviour on hydrolysis are described. Three tetracyclic compounds and their hydrolysis products are different from compounds previously claimed to have such structures. The formation of the indoloquinazoline (XII) in attempts to prepare the triazachrysene (IV) is recorded.

Derivatives of two of the six possible triazatetracyclic compounds resulting from the fusion of two quinazoline rings through bonds 1,2, 2,3, and 3,4 and structurally related to tricycloquinazoline were described in Part VIII.[2] We now describe derivatives of a third possibility, 7*H*-5,6a,12-triazabenz[*a*]anthracene (I). Some of these derivatives differed significantly in properties from compounds recently described as having these structures.

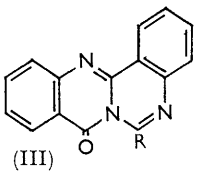
2-*o*-Aminophenyl-4-hydroxyquinazoline (II) with formic acid afforded the triazabenzanthrone (III; R = H) as previously reported,[3] although cyclisation with ethyl ortho-



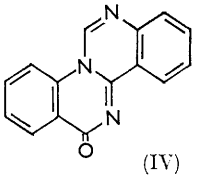
(I)



(II)



(III)

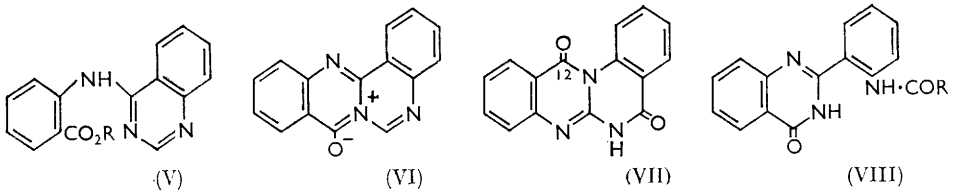


(IV)

formate was more efficient. The possibility of the formation of a triazachrysene (IV) was excluded by the production of the compound (III; R = H) by pyrolysis of 4-*o*-carboxyanilinoquinazoline (V; R = H) or of its methyl ester.[3] Further triazabenzanthracene derivatives (III; R = Me, Et, or Ph) were produced by interaction of the quinazoline (II) and the appropriate acyl anhydride, but they were different from the compounds

[1] Part XIII, Hallows and Partridge, *J.*, 1960, 3675.
[2] Butler and Partridge, *J.*, 1959, 1512.
[3] Stephen and Stephen, *J.*, 1956, 4173, 4178.

previously described as having these structures.[3] The methyl derivative (III; R = Me) was spectroscopically very similar to the parent compound (III; R = H) (Fig. 1); the other derivatives (III; R = Et or Ph) gave similar spectral absorption curves. Moreover, in agreement with the dipolar structure (VI), these curves resembled that of 1,2-benzanthracene.[4] This resemblance to 1,2-benzanthracene was not observed [2] in the triazabenzanthracene (VII), presumably because of the steric interference with uniplanarity of the oxygen at position 12 and the hydrogen at position 1, made evident by inspection of a model.



(V) (VI) (VII) (VIII)

The triazabenzanthracenes (III; R = H, Me, Et or Ph) were very readily hydrolysed in hot aqueous alcohols to the corresponding 2-*o*-acylaminophenylquinazolines (VIII;

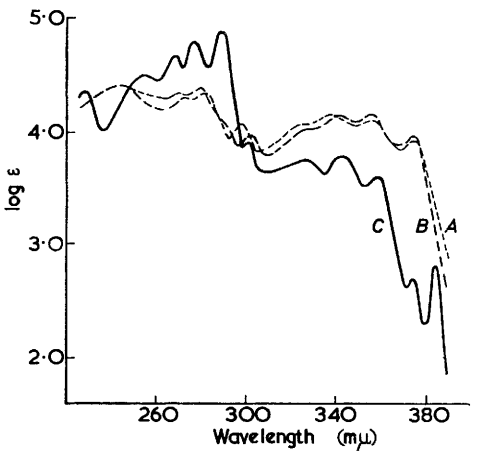


FIG. 1. *Ultraviolet absorption spectra in ethanol of* (*A*) 7-*oxo*-7H-5,6*a*,12-*triazabenz*[a]*anthracene*, (*B*) 6-*methyl*-7-*oxo*-7H-5,6*a*,12-*triazabenz*[a]*anthracene, and* (*C*) 1,2-*benzanthracene.*

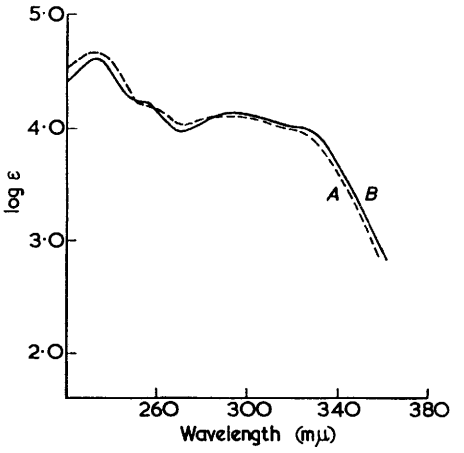


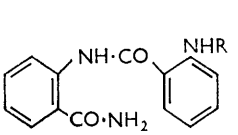
FIG. 2. *Ultraviolet absorption spectra in ethanol of* (*A*) 2-o-*formamidophenyl*-4-*hydroxyquinazoline and* (*B*) 2-o-*acetamidophenyl*-4-*hydroxyquinazoline.*

R = H, Me, Et, or Ph) which, where comparison was possible, differed from the compounds described by Stephen and Stephen [3] but resembled quinazoline spectroscopically [5] (Fig. 2). The acetyl derivative (VIII; R = Me) had the melting point recorded by Mohr and Köhler [6] and by Jacini.[7] That fission occurred at the 6,6*a*-bond was demonstrated by the non-identity of the product (VIII; R = H) with the isomeric acid (V; R = H). Because of the conditions of formation, and the great ease of hydrolysis of the triazabenzanthracenes (III; R = Me and Et), it is possible that these compounds were intermediates in the acylation of the quinazoline (II) to its acyl derivatives (VIII; R = Me and Et). Recyclization of the amides (VIII; R = H, Me, Et, or Ph) gave the triazabenzanthracenes (III; R = H, Me, Et, or Ph).

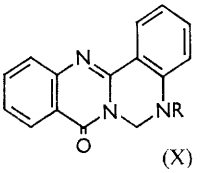
[4] Friedel and Orchin, " Ultraviolet Spectra of Aromatic Compounds," Wiley, New York, 1951, p. 499.
[5] Osborn, Schofield, and Short, *J.*, 1956, 4196.
[6] Mohr and Köhler, *J. prakt. Chem.*, 1909, **80**, 521.
[7] Jacini, *Gazzetta*, 1943, **73**, 306.

In a projected preparation of the acid (V; R = H) by hydrolysis of its methyl ester, the product was the aminophenylquinazoline (II), evidently resulting from the hydrolysis of the intermediately formed triazabenzanthracene (III; R = H) and the corresponding amide (VIII; R = H), since the last two compounds readily gave the same hydrolysis product (II). Analogous cyclizations and degradations have been observed in compounds related to the triazabenzanthracene [2] (VII).

Attempts to synthesise the triazachrysene (IV) were unsuccessful. Thus *o*-*o*′-aminobenzamidobenzamide (IX; R = H) with formic acid gave its formyl derivative (IX; R = CHO), the quinazoline (II), its formyl derivative (VIII; R = H), and the triazabenzanthracene (III; R = H). With paraformaldehyde or formaldehyde dimethyl acetal, the quinazoline (II) yielded the dihydro-derivative (X; R = H), the structure of which was confirmed by dehydrogenation to the triazabenzanthracene (III; R = H).



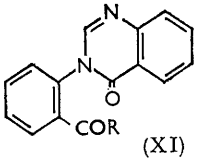
(IX)



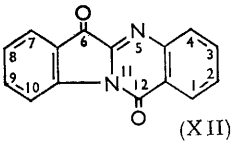
(X)

Acylation and alkylation with reactive alkyl halides furnished 5-substituted derivatives of this triazabenzanthracene (X; R = Ac, OC·CH_2Cl, CO_2Et, Me, Ph·CH_2, or CH_2·CH·CH_2), but with less reactive halides disproportionation occurred preferentially, since the products were the triazabenzanthracene (III; R = H) and a compound, $C_{30}H_{21}N_5O_2$. The 12,12*a*-dihydro-derivative of (III; R = H), which was also readily dehydrogenated to (III; R = H), similarly resulted from the 1,2-dihydro-derivative of the quinazoline (II) and ethyl orthoformate.

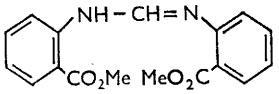
The amide (XI; R = NH_2) was expected to be a useful intermediate for the production of this triazachrysene (IV). It was not formed from methyl *N*-formylanthranilate and *o*-aminobenzamide. The corresponding ester (XI; R = OMe) resulted from the interaction of methyl *o*-*o*′-aminobenzamidobenzoate and formamide or ethyl orthoformate and, together with 6,12-dihydro-6,12-dioxoindolo[2,1-*b*]quinazoline (XII), from methyl anthranilate and ethyl orthoformate, the last process presumably involving intermediate formation of the formamidine (XIII). The amide (XI; R = NH_2) could be formed



(XI)

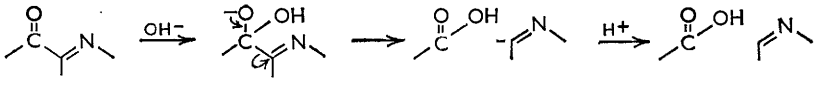


(XII)



(XIII)

neither from the ester (XI; R = OMe) nor from the acid (XI; R = OH), which was itself produced by interaction of ethyl orthoformate and *o*-*o*′-aminobenzamidobenzoic acid. With alkali, the indoloquinazoline (XII) gave the same hydrolysis product as the



(XII) (XI; R=OH)

acid (XI; R = OH), namely, *o*-*o*′-aminobenzamidobenzoic acid; the initial hydrolysis of the indoloquinazoline may involve the steps (XII ⟶ XI; R = OH) as illustrated.

Sodamide did not react analogously to yield the amide (XI; R = NH_2), but gave the acid (XI; R = OH). Thermal cyclization of the ester (XI; R = OMe) furnished the indoloquinazoline (XII) in good yield.

The production of the triazachrysene (IV) *via* an alkylated, hydrogenated derivative could not be effected because of the inaccessibility of useful intermediates. *o-o'*-Nitrobenzamidobenzoic acid with methylamine and phosphorus trichloride afforded its methylamide, which, despite the behaviour of *o-o'*-nitrobenzamidobenzamide,[8] could not be induced to cyclize to a quinazoline.

Experimental

7-Oxo-7H-5,6*a*,12-*triazabenz*[a]*anthracene* (III; R = H).—(i) 2-*o*-Aminophenyl-4-hydroxyquinazoline (0·5 g.) and ethyl orthoformate (15 ml.) were boiled together for 2 hr. The solid which separated when the solution was concentrated furnished the triazabenzanthracene (0·45 g., 86%) which crystallised as needles, m. p. 199·5—200°, undepressed on admixture with a specimen prepared by the method of Stephen and Stephen [3] who reported m.p. 197° (Found: C, 72·6; H, 3·3; N, 17·1. Calc. for $C_{15}H_9N_3O$: C, 72·9; H, 3·7; N, 17·0%).

(ii) The same compound (80%), m. p. and mixed m. p. 199—200°, was precipitated on addition of water to a solution of the foregoing quinazoline (II) in formic acid which had been boiled for 2 hr.

(iii) 4-*o*-Carboxyanilinoquinazoline,[9] when heated at 255° for 5 min., gave the same triazabenzanthracene, m. p. and mixed m. p. 197—198° after recrystallisation from ethanol.

A solution of the product (III; R = H) in warm, dilute hydrochloric acid deposited, when cooled, the hydrochloride, m. p. and mixed [8] m. p. 277—278°, of the starting quinazoline (II).

6-Methyl-7-oxo-7H-5,6*a*,12-*triazabenz*[a]*anthracene* (III; R = Me).—A solution of the quinazoline (II) (1 g.) in acetic anhydride (20 ml.), when boiled under reflux for 90 min. and cooled, deposited the *triazabenzanthracene* (III; R = Me) (0·55 g.), which crystallised from anhydrous ethanol as needles, m. p. 178·5—179·5° (Found: C, 74·0; H, 4·3; N, 16·0. $C_{16}H_{11}N_3O$ requires C, 73·6; H, 4·2; N, 16·1%); Stephen and Stephen [3] record m. p. 276°.

Warm, dilute hydrochloric acid immediately caused hydrolysis to the quinazoline (II), isolated as its hydrochloride,[8] m. p. and mixed m. p. 277—279°, and as the base, m. p. and mixed [8] m. p. 238—240°.

6-Ethyl-7-oxo-7H-5,6*a*,12-*triazabenz*[a]*anthracene* (III; R = Et), prepared analogously (57%) by using propionic anhydride, crystallised from anhydrous ethanol as needles, m. p. 155—156°, $\lambda_{max.}$ 243, 273, 281, 301, 340, 355, and 372 mμ (ε 26,400, 20,700, 23,000, 9900, 15,200, 14,800, and 9400) (Found: C, 74·2; H, 4·8; N, 15·0. $C_{17}H_{13}N_3O$ requires C, 74·2; H, 4·8; N, 15·3%); Stephen and Stephen [3] record m. p. 250°.

7-Oxo-6-phenyl-7H-5,6*a*,12-*triazabenz*[a]*anthracene* (III; R = Ph) was formed when the quinazoline (II) and benzoic anhydride were heated together at 255° for 6 hr. After being washed with aqueous sodium carbonate, it crystallised from dioxan as needles, m. p. 284—285°, $\lambda_{max.}$ 249, 289, 346, 356, and 376 (infl.) mμ (ε 30,100, 24,300, 14,900, 15,000, and 10,000) (Found: N, 12·7, 12·8. $C_{21}H_{13}N_3O$ requires N, 13·0%); Stephen and Stephen [3] record m. p. 292°.

2-o-*Formamidophenyl-4-hydroxyquinazoline*.—This *amide* was formed (0·78 g.) when the triazabenzanthracene (III; R = H) (0·85 g.) was refluxed in aqueous butan-1-ol (15 ml.) for 2 hr. and crystallised from butan-1-ol as needles, m. p. 230—231° (decomp.) depressed to 205—208° by admixture with 4-*o*-carboxyanilinoquinazoline [9] (Found: C, 67·5; H, 4·2; N, 15·6. $C_{15}H_{11}N_3O_2$ requires C, 67·9; H, 4·2; N, 15·8%). When heated at 230—235° for 15 min., this amide quantitatively yielded the triazabenzanthracene (III; R = H), m. p. and mixed m. p. 197—199°.

The amide dissolved readily in warm 2N-hydrochloric acid and 2N-sodium hydroxide. Neutralisation of either solution then precipitated the quinazoline (II) (85%), m. p. and mixed m. p. 238—240°.

2-o-*Acetamidophenyl-4-hydroxyquinazoline* (VIII; R = Me).—(i) A solution of triazabenzanthracene (III; R = Me) in 95% ethanol rapidly deposited this amide, m. p. 276·5—278° (decomp.) (Found: C, 68·8; H, 4·6; N, 15·0. Calc. for $C_{16}H_{13}N_3O_2$: C, 68·8; H, 4·7; N,

[8] Butler and Partridge, *J.*, 1959, 2396.
[9] Anschutz and Schmidt, *Ber.*, 1902, **35**, 3470.

15·1%); Stephen and Stephen [3] record m. p. 177°; Mohr and Köhler [5] record m. p. 278° (decomp.), and Jacini [7] m. p. 276°.

(ii) The same compound, m. p. and mixed m. p. 276—277°, was formed (0·76 g.) when the quinazoline (II) (1 g.) was boiled in acetic anhydride (10 ml.) for 1 hr., and the reaction mixture was poured into water. Acetylation was also effected with acetyl chloride in pyridine.

When refluxed with acetic anhydride for 90 min., this amide afforded the triazabenzanthracene (III; R = Me), m. p. and mixed m. p. 177—178°. A solution in warm dilute hydrochloric acid deposited the quinazoline (II), m. p. and mixed m. p. 238—240°, when neutralised.

4-*Hydroxy*-2-o-*propionamidophenylquinazoline* (VIII; R = Et) was likewise formed by heating the quinazoline (II) with propionic anhydride, and pouring the reaction mixture into water; it separated as needles, m. p. 247—248°, from ethanol; $\lambda_{max.}$ 234 and 294 mμ (ε 42,700 and 13,200) (Found: C, 69·9; H, 5·2; N, 14·3. $C_{17}H_{15}N_3O_2$ requires C, 69·6; H, 5·2; N, 14·3%); Stephen and Stephen [3] give m. p. 156°. When boiled with an excess of propionic anhydride for 90 min., it afforded the triazabenzanthracene (III; R = Et) (81%), m. p. and mixed m. p. 153—154°.

2-o-*Benzamidophenyl*-4-*hydroxyquinazoline* (VIII; R = Ph).—The quinazoline (II) (1·3 g.) and benzoyl chloride (1·5 g.) were boiled in pyridine (15 ml.) for 90 min.; the *amide* (1·13 g.) which separated crystallised from 2-methoxyethanol as needles, m. p. 317—318°, $\lambda_{max.}$ 233 and 273 mμ (ε 31,600 and 20,500) (Found: C, 73·8; H, 4·4; N, 12·1. $C_{21}H_{15}N_3O_2$ requires C, 73·9; H, 4·4; N, 12·3%). Acylation with benzoic anhydride was effected at 255° for 90 min.

When heated with benzoic anhydride at 255° for 6 hr., this amide afforded the triazabenzanthracene (III; R = Ph) (52%), m. p. and mixed m. p. 284—285°, whereas with boiling acetic anhydride it afforded after 12 hr. the methyl analogue (45%), m. p. and mixed m. p. 177—179°.

2-o-*Aminophenyl*-4-*hydroxyquinazoline* (II).—This amine (0·98 g.) was precipitated by acetic acid from a solution of 4-*o*-methoxycarbonylanilinoquinazoline [3] (2·8 g.) in dioxan (35 ml.) and 2N-sodium hydroxide (15 ml.) which had been boiled for 30 min. After crystallisation from 2-methoxyethanol, it had m. p. and mixed [6,8] m. p. 240—241° (Found: C, 71·1; H, 4·7. Calc. for $C_{14}H_{11}N_3O$: C, 70·9; H, 4·7%).

Formylation of o-o′-*Aminobenzamidobenzamide.*—*o-o′*-Aminobenzamidobenzamide [8] (2·5 g.) was boiled for 2 hr. in anhydrous formic acid (8 ml.). Dilution of the mixture with water gave an oil which slowly crystallised and was separated by fractional crystallisation from ethanol into the quinazoline (II) (0·65 g.), m. p. and mixed m. p. 240—241°, and its formyl derivative (0·42 g.), m. p. and mixed m. p. 230—231°. The aqueous formic acid mother-liquor slowly deposited o-o′-*formamidobenzamidobenzamide* (0·13 g.) which crystallised from water as prisms, m. p. 192° (Found: C, 63·8; H, 4·2; N, 14·9. $C_{15}H_{13}N_3O_3$ requires C, 63·6; H, 4·6; N, 14·8%). The triazabenzanthracene (III; R = H) (0·075 g.), m. p. and mixed m. p. 199—200°, was isolated by chromatography of the ethanol mother-liquors on alumina.

5,6-*Dihydro*-7-*oxo*-7H-5,6*a*,12-*triazabenz*[a]*anthracene* (X; R = H).—(i) The quinazoline (II) (0·79 g.) and paraformaldehyde (0·1 g.), when boiled in benzene (30 ml.) for 27 hr., furnished the yellow tetracyclic *compound* (0·75 g.), which crystallised from ethanol or dimethylformamide as needles, m. p. 185—186° (Found: C, 72·2; H, 4·4; N, 17·1. $C_{15}H_{11}N_3O$ requires C, 72·3; H, 4·5; N, 16·9%). Its *hydrochloride* (yellow plates from 2N-hydrochloric acid) decomposed at 255—260° without melting (Found: C, 63·2; H, 3·9; N, 14·7. $C_{15}H_{12}ClN_3O$ requires C, 63·0; H, 4·2; N, 14·7%). Its *acetyl derivative* crystallised from ethanol as yellow needles, m. p. 176—178° (Found C, 69·8; H, 4·6; N, 14·6. $C_{17}H_{13}N_3O_2$ requires C, 70·1; H, 4·5; N, 14·4%).

(ii) The same compound (2 g.) resulted as the alkali-insoluble product when the quinazoline (II) (5 g.) was boiled in benzene (30 ml.) with formaldehyde dimethyl acetal (3 ml.), added gradually during 36 hr.

When this dihydrotriazabenzanthracene (X; R = H) (0·5 g.) in diphenyl ether (10 ml.) was boiled with 10% palladised charcoal (0·05 g.) until evolution of hydrogen ceased (38 ml.; calc., 45 ml.), the solid, non-volatile in steam, gave the triazabenzanthracene (III; R = H) (0·36 g.), m. p. and mixed m. p. 199—200°. Oxidation with potassium ferricyanide (8 mols.) in 0·1N-potassium hydroxide at 60° for 4 hr. afforded the same product (58%), m. p. and mixed m. p. 199—200°.

Acylation of the Dihydrotriazabenzanthracene (X; R = H).—Ethyl chloroformate (0·5 g.)

and the dihydrotriazabenzanthracene (X; R = H) (0·5 g.) were boiled in pyridine (6 ml.) for 30 min. The *urethane*, precipitated as an oil by water, crystallised from ethanol as yellow prisms (0·4 g.), m. p. 168—169° (Found: C, 67·3; H, 4·5; N, 13·2. $C_{18}H_{15}N_3O_3$ requires C, 67·3; H, 4·7; N, 13·1%). Hydrolysis to the triazabenzanthracene (X; R = H) was effected with 2N-hydrochloric acid.

The *chloroacetyl derivative*, analogously prepared, crystallised from ethanol as yellow prisms, m. p. 190—191° (Found: C, 62·9; H, 3·8. $C_{17}H_{12}ClN_3O_2$ requires C, 62·7; H, 3·7%). This compound was inert to a number of aliphatic amines.

Alkylation of the Dihydrotriazabenzanthracene (X; R = H).—This compound (0·5 g.), anhydrous potassium carbonate (0·1 g.), and methyl iodide (0·3 ml.) were boiled in dry dimethylformamide (50 ml.) for 24 hr. After removal of the solvent, the water-insoluble fraction gave the 5-*methyl derivative* (0·38 g.) which crystallised from ethanol as needles, m. p. 167° (Found: C, 72·7; H, 4·8; N, 15·7. $C_{16}H_{13}N_3O$ requires C, 73·0; H, 5·0; N, 16·0%). In acetone the yield was 22%.

Analogously prepared were the 5-*allyl derivative*, m. p. 123—124° (Found: C, 74·4; H, 5·4; N, 14·4. $C_{18}H_{15}N_3O$ requires C, 74·7; H, 5·2; N, 14·5%), and the 5-*benzyl derivative*, m. p. 130—131° (Found: C, 77·9; H, 5·4; N, 12·4. $C_{22}H_{17}N_3O$ requires C, 77·9; H, 5·1; N, 12·4%).

With other alkyl bromides, the products were the triazabenzanthracene (III; R = H), m. p. and mixed m. p. 199—200°, and a *substance* which crystallised from a large volume of benzene as needles, m. p. 290—293° (Found: C, 74·6, 74·8; H, 4·4, 4·5; N, 14·8, 14·9. $C_{30}H_{21}N_5O_2$ requires C, 74·5; H, 4·4; N, 14·5%).

2-o-*Aminophenyl*-1,2-*dihydro*-4-*hydroxyquinazoline*.—This *quinazoline* (0·37 g.) was prepared by catalytic reduction of the corresponding nitro-compound [10] (0·5 g.) in ethanol (30 ml.) with Adams catalyst (0·30 g.) at atmospheric pressure. After filtration of the suspension, and evaporation of the solvent, the basic product was collected in 2N-hydrochloric acid, liberated into ether, recovered (0·37 g.), and crystallised from benzene; it had m. p. 173—174° (Found: C, 70·4; H, 5·7; N, 17·6. $C_{14}H_{13}N_3O$ requires C, 70·3; H, 5·5; N, 17·6%). Its *picrate* (needles from benzene) had m. p. 174—175° (decomp.) (Found: C, 51·4; H, 3·4; N, 18·0. $C_{20}H_{16}N_6O_8$ requires C, 51·3; H, 3·4; N, 17·9%), and its *diacetyl derivative* (needles from benzene–light petroleum) had m. p. 210—211° (Found: C, 66·9; H, 5·5. $C_{18}H_{17}N_3O_3$ requires C, 66·9; N, 5·3%).

12,12*a*-*Dihydro*-7-*oxo*-7H-5,6*a*,12-*triazabenz*[a]*anthracene*.—The foregoing quinazoline (0·5 g.) was refluxed in ethyl orthoformate (5 ml.) for 2 hr. Precipitation of the *product* (0·32 g.), which crystallised from 2-ethoxyethanol and had m. p. 316—317°, was completed by the addition of ether to the concentrated reaction mixture (Found: N, 16·6. $C_{15}H_{11}N_3O$ requires N, 16·8%).

This tetracyclic compound (0·1 g.) was boiled in *p*-cymene with 10% palladised charcoal until evolution of hydrogen ceased, solvent was removed in steam, and the residue afforded the triazabenzanthracene (III; R = H) (0·075 g.), m. p. and mixed m. p. 199—200°, after crystallisation from ethanol. Oxidation with potassium ferricyanide in 0·1N-potassium hydroxide at 60° for 4 hr. gave the same product (56%).

Interaction of Methyl N-*Formylanthranilate and Anthranilamide*.—Equimolecular quantities of these reagents, heated at 150° for 2 hr., afforded as the only recognisable products a benzene-soluble fraction consisting of methyl anthranilate, b. p. 134—136°/15 mm., and 4-hydroxyquinazoline, m. p. and mixed m. p. 216° (Found: C, 66·0; H, 4·1. Calc. for $C_8H_6N_2O$: C, 65·8; H, 4·1%); Bogert and Hand [11] record m. p. 215·5—216·5°.

3,4-*Dihydro*-3-o-*methoxycarbonylphenyl*-4-*oxoquinazoline* (XI; R = OMe).—(i) Methyl *o*-*o*′-nitrobenzamidobenzoate, prepared by the method of Schroeter,[12] who records no m. p., had m. p. 153° (Found: C, 60·1; H, 4·0. Calc. for $C_{15}H_{12}N_2O_5$: C, 60·0; H, 4·0%). Formamide (2 ml.) reacted with the corresponding amine [12] (1 g.) at 140° during 4 hr. to yield, as a water-insoluble fraction, the *quinazoline* (XI; R = OMe) (0·7 g.), which crystallised from ethanol as prisms, m. p. 175—176° (Found: C, 68·4; H, 4·0; N, 10·0. $C_{16}H_{12}N_2O_3$ requires C, 68·6; H, 4·3; N, 10·0%). An analogous cyclization in refluxing ethyl orthorformate for 1 hr. gave 85% of the same compound. Hydrolysis with acid or alkali furnished *o*-*o*′-aminobenzamidobenzoic acid, m. p. 202—203° (Found: C, 65·5; H, 4·5; N, 10·8. Calc. for $C_{14}H_{12}N_2O_3$: C, 65·6; H, 4·7; N, 10·9%); Schroeter [12] records m. p. 203—204°.

[10] Kilroe-Smith and Stephen, *Tetrahedron*, 1957, **1**, 38.
[11] Bogert and Hand, *J. Amer. Chem. Soc.*, 1902, **24**, 1031.
[12] Schroeter, *Ber.*, 1907, **40**, 1610.

(ii) Methyl anthranilate (60 g.) and ethyl orthoformate (30 g.) were refluxed together for 4 hr. Volatile material was removed under reduced pressure, and the residue, by fractional crystallisation from ethanol, gave this quinazoline (45 g.), m. p. and mixed m. p. 175—176°, and the indoloquinazoline (XII), m. p. 258° [Found: C, 72·6; H, 3·2; N, 11·4%; *M* (Rast), 278. Calc. for $C_{15}H_8N_2O_2$: C, 72·6; H, 3·3; N, 11·3%; *M*, 248]; Heller and Benade [13] record m. p. 262°.

6,12-Dihydro-6,12-dioxoindolo[2,1-*b*]quinazoline (XII) (5·3 g.) was also formed when the foregoing quinazoline (XI; R = OMe) (10 g.) was boiled in nitrobenzene (50 ml.) for 16 hr. Removal of the solvent *in vacuo*, and the addition of light petroleum furnished brown needles which, after vacuum-sublimation and crystallisation from ethanol, had m. p. and mixed m. p. 256—258°. Its *picrate* had m. p. 143° (effervescence) (Found, on desolvated material: C, 53·1; H, 2·3; N, 14·6. $C_{21}H_{11}N_5O_9$ requires C, 52·8; H, 2·3; N, 14·7%); the *2,4-dinitrophenylhydrazone* crystallised from dimethylformamide as red needles which decomposed at about 200—230° (Found: C, 58·9; H, 2·9. $C_{21}H_{12}N_6O_5$ requires C, 58·8; H, 2·8%), and its *hydrazone* decomposed at about 230—240° (Found: C, 68·8; H, 4·0; N, 21·3. $C_{15}H_{10}N_4O$ requires C, 68·7; H, 3·8; N, 21·4%).

This indoloquinazoline (0·1 g.) afforded *o-o'*-aminobenzamidobenzoic acid (0·055 g.), m. p. and mixed m. p. 202—203°, when boiled for 30 min. with 2·5N-sodium hydroxide (5 ml.).

3-o-*Carboxyphenyl*-3,4-*dihydro*-4-*oxoquinazoline* (XI; R = OH).—(i) *o-o'*-Aminobenzamidobenzoic acid (0·1 g.) and ethyl orthoformate (3 ml.), when boiled together for 8 hr., afforded the quinazoline (0·12 g.), m. p. 279° (decomp.), undepressed on admixture with the compound made by the method of Anschutz and Schmidt.[9] By hydrolysis with 2N-sodium hydroxide or 2N-hydrochloric acid, *o-o'*-aminobenzamidobenzoic acid, m. p. and mixed m. p. 202—203° (63—71%), was obtained.

(ii) The 3-*o*-methoxycarbonylphenylquinazoline (XI; R = OMe) (4 g.) was heated with sodamide (2 g.) in dimethylaniline (15 ml.) at 150° for 6 hr. Ethanol (2 ml.) and water (50 ml.) were added. The aqueous layer yielded the same acid (XI; R = OH) (3 g.), m. p. and mixed m. p. 279° (decomp.), on neutralisation with acetic acid.

(iii) The indoloquinazoline treated analogously with sodamide also furnished this carboxylic acid (XI; R = OH) (84%).

o-o'-*Nitrobenzamidobenzomethylamide*.—Methylamine was passed into a boiling solution of *o-o'*-nitrobenzamidobenzoic acid [14] (1 g.) and phosphorus trichloride (1 ml.) in toluene (20 ml.), and boiling was continued for 2 hr. Excess of aqueous sodium carbonate was added, the mixture was steam-distilled, and the *methylamide* (0·23 g.), m. p. 180—181°, was crystallised from ethanol (Found: C, 60·1; H, 4·2; N, 13·8. $C_{15}H_{13}N_3O_4$ requires C, 60·2; H, 4·4; N, 14·0%). The same compound was prepared in 82% yield by interaction of *o*-nitrobenzoyl chloride and *o*-aminobenzomethylamide in benzene–pyridine.

We thank the Nottinghamshire Council of the British Empire Cancer Campaign for the award of a postgraduate studentship (to J. A. W.).

THE UNIVERSITY, NOTTINGHAM. [*Received, April 27th*, 1960.]

[13] Heller and Benade, *Ber.*, 1922, **55**, 1006.
[14] Schroeter and Eisleb, *Annalen*, 1909, **367**, 101.