Derivatives of Acetoacetic Acid. Part V. The Reaction of Diketen with Thioureas, Amidines, Guanidines, and S-Substituted Thioureas.†*

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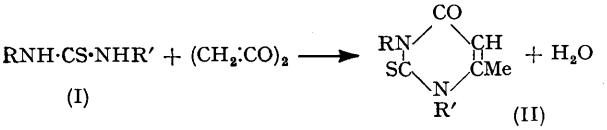
The reaction of diketen with thioureas, in general, gave substituted thiouracils, although *NN'*-diphenylthiourea afforded only phenyl *iso*thiocyanate and acetoacetanilide. Acetamidine and benzamidine with diketen gave the same pyrimidones as are obtained by using acetoacetic ester. Guanidine and methylguanidine gave the known aminopyrimidones but *NN'*-diphenylguanidine gave a 1 : 3-oxazine. The condensation of *S*-alkylthioureas proceeded *via* a 1 : 3-oxazine which, with alkali, rearranges with loss of water to give a 2-alkylthiopyrimidone.

While the formation of pyrimidine derivatives from the reaction of an acetoacetic ester with urea and its derivatives, *e.g.*, ureas, thioureas, guanidines, and *iso*thioureas, and with amidines, has long been known, little attention has been devoted to the reaction of diketen, which affords a valuable precursor of acetoacetic esters, with these compounds. Boese (U.S.P. 2,138,756/1938) has shown that urea and alkyl-ureas with diketen in dioxan give substituted uracils. The yield of 6-methyluracil obtained was poor and most of the diketen was converted into dehydroacetic acid, acetone, etc., the latter arising from the hydrolysis of diketen by the water eliminated.

The condensation of diketen with amines of basic strength not less than that of aniline occurs in aqueous medium but diketen did not react with thiourea in water, rapid hydrolysis of the diketen or, under milder conditions, recovery of the starting materials taking place. No perceptible reaction took place in benzene, in which thiourea is only slightly soluble, but vigorous reaction occurred in boiling acetic acid with the formation of 6-methyl-2-thiouracil (II; R = R' = H) in 55% yield.



Similarly, methylthiourea and diketen in boiling acetic acid give a 30% yield of crystalline product, shown, by hydrolysis with concentrated hydrochloric acid at 160—170° to 1 : 6-dimethyluracil, to be essentially 1 : 6-dimethyl-2-thiouracil.

Phenylthiourea with diketen in boiling acetic acid gave 6-methyl-3-phenyl-2-thiouracil (II; R = Ph, R' = H), the configuration being proved by comparison with an authentic specimen obtained from the reaction of phenyl *iso*thiocyanate with methyl β-aminocrotonate (Behrend, Meyer, and Buchholz, *Annalen*, 1901, **314**, 224). The solubility of

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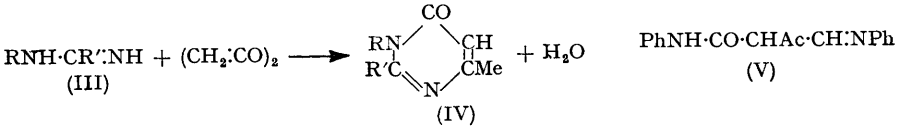
phenylthiourea permitted the reaction with diketen to be carried out in several other solvents.

NN'-Diethylthiourea was also successfully condensed with diketen to give 1 : 3-diethyl-6-methyl-2-thiouracil (II; R = R' = Et). However, *NN'*-diphenylthiourea gave phenyl *iso*thiocyanate, acetoacetanilide, and a small amount of *NN'*-diphenylurea, arising from the cleavage of the thiourea molecule. Similarly, *NN'*-di-*o*-tolylthiourea gave acetoacet-*o*-toluidide. Similar cleavage of *NN'*-diphenylthiourea by acetic anhydride has been observed by Hugershoff (*Ber.*, 1899, **32**, 3655; cf. Werner, *J.*, 1891, 396).

$$PhNH{\cdot}CS{\cdot}NHPh + (CH_2{:}CO)_2 \longrightarrow PhNCS + PhNH{\cdot}CO{\cdot}CH_2Ac$$

The reaction of *N*-methyl-*N'*-phenylthiourea in boiling acetic acid gave a thiouracil for which two possible configurations (II; R = Ph, R' = Me or R = Me, R' = Ph) may be postulated. Acid hydrolysis of the thiouracil gave the corresponding uracil, which was prepared unambiguously by the methylation of 6-methyl-3-phenyluracil, indicating structure (II; R = Ph, R' = Me) for the thiouracil.

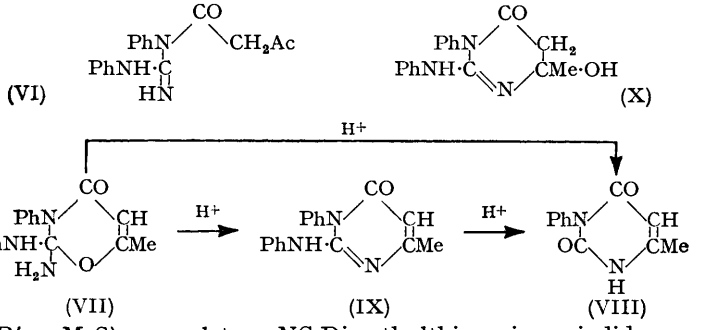
Pinner has shown the reaction of acetoacetic ester with amidines to afford a general route to substituted 4-hydroxypyrimidines (cf. Pinner, *Ber.*, 1884, **17**, 2520). The reaction of acetamidine, liberated from its hydrochloride with sodium hydroxide, in aqueous solution with diketen at 0° afforded only an unidentifiable gum. However, the use of alcoholic sodium ethoxide to liberate the free base gave 3 : 4-dihydro-2 : 6-dimethyl-4-oxopyrimidine. Since the reaction of diketen under these conditions was much more rapid than its reaction with alcohol, it is concluded that the diketen reacted with the amidine without intermediate formation of an acetoacetic ester, and that failure to obtain the pyrimidone by reaction in the presence of water must be attributed to the rapid hydrolysis of acetamidine. Benzamidine, whether as the free base or as liberated *in situ* from its hydrochloride, readily reacted with diketen in water at 10—13° to give 3 : 4-dihydro-6-methyl-4-oxo-2-phenylpyrimidine (IV; R = H, R' = Ph) in high yield. *NN'*-Diphenylformamidine did not give a pyrimidine derivative but yielded α-(phenyliminomethyl)acetoacetanilide (V), previously obtained by Dains (*Ber.*, 1902, **35**, 2509) from the reaction of this amidine with ethyl acetoacetate.



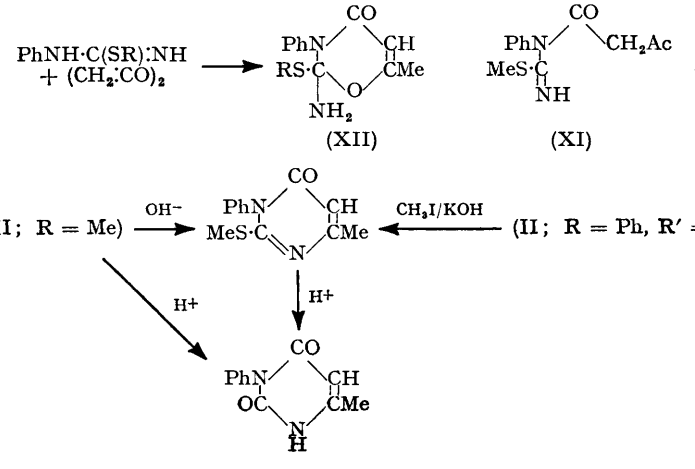
Guanidine, liberated *in situ* in aqueous solution, readily reacted with diketen at room temperature to give 2-amino-3 : 4-dihydro-6-methyl-4-oxopyrimidine (IV; R = H, R' = NH_2); methylguanidine reacted similarly to give (IV; R = Me, R' = NH_2). *NN'*-Diphenylguanidine (III; R = Ph, R' = NHPh) is readily obtainable as a stable free base; its rapid reaction with diketen in acetone solution at room temperature gave an almost quantitative yield of a non-ketonic solid which gave analytical data corresponding to $C_{17}H_{17}O_2N_3$. Its insolubility in alkali eliminated (VI), and largely by analogy with the reaction of diketen with *S*-alkylthioureas (see Part VI, following paper), the product is regarded as a 2 : 3-dihydro-4-oxo-1 : 3-oxazine (VII). The evidence afforded by light-absorption measurements is in agreement with this formulation and sufficed to eliminate (X), which would not be expected to exhibit high-intensity absorption in the 2100—3500-Å region (contrast Gage, *J.*, 1949, 221). Prolonged refluxing with dilute hydrochloric acid gave 6-methyl-3-phenyluracil (VIII), while hydrolysis with weaker acid and for a shorter time afforded a product, formulated as 2-anilino-3 : 4-dihydro-6-methyl-4-oxo-3-phenylpyrimidine (IX), since further hydrolysis with hydrochloric acid gave 6-methyl-3-phenyluracil and aniline. Curd, Raison, and Rose (*J.*, 1946, 362) have shown that 3 : 4-dihydro-6-methyl-2-methylthio-4-oxopyrimidine (IV; R = H, R' = MeS) when heated with aromatic amines affords the corresponding 2-arylamino-compounds (IV; R = H, R' = ArNH), with the elimination of methanethiol. However, attempts to use this method to synthesise (IX) from aniline and 3 : 4-dihydro-6-methyl-2-methylthio-

4-oxo-3-phenylpyrimidine (IV; R = Ph, R′ = MeS) were unsuccessful and it is likely that the reaction is limited to compounds unsubstituted in the 3-position which can enolise.

A rapid reaction took place in the cold between diketen and a solution of *S*-methylthiuronium iodide and one equivalent of aqueous sodium hydroxide. However, only after two days was crystallisation of 3 : 4-dihydro-6-methyl-2-methylthio-4-oxopyrimidine



(IV; R = H, R′ = MeS) complete. *NS*-Dimethylthiuronium iodide was similarly treated with aqueous sodium hydroxide and diketen, but even after being left overnight no precipitation had occurred. However, on addition of more aqueous sodium hydroxide, crystallisation of 3 : 4-dihydro-3 : 6-dimethyl-2-methylthio-4-oxopyrimidine (IV; R = Me, R′ = MeS) (cf. Wheeler and McFarland, *Amer. Chem. J.*, 1909, **42**, 105) ensued within a few minutes. These experiments had indicated that diketen reacted rapidly with the two *S*-alkylthioureas to give intermediates which were converted slowly, or more rapidly in the presence of alkali, into pyrimidones. This hypothesis received powerful support when the reaction of *S*-methyl-*N*-phenylthiourea (III; R = Ph, R′ = MeS) with diketen was studied. In this case the stability of the free base allowed the condensation to be carried out in ether, and, after a rapid exothermic reaction, a solid crystallised. Analysis of the product indicated the empirical formula of the expected pyrimidone plus water, but when the product was treated with aqueous alkali, there was rapid precipitation of 3 : 4-dihydro-6-methyl-2-methylthio-4-oxo-3-phenylpyrimidine (IV; R = Ph, R′ = MeS). The configuration of this pyrimidone was established both by methylation of 6-methyl-3-phenyl-2-thiouracil (II; R = Ph, R′ = H) and by acid hydrolysis to 6-methyl-3-phenyluracil. The intermediate was soluble in acids but since it was insoluble in alkali and



non-ketonic, (XI) must be eliminated. The product is probably a 1 : 3-oxazine derivative (XII; R = Me), this formulation being supported by light-absorption evidence ($\lambda_{max.}$ 2220 Å).

S-Benzyl-*N*-methylthiourea readily reacted with diketen to give a 1 : 3-oxazine derivative (XII; R = CH_2Ph); the formulation again being confirmed by light-absorption measurements, which showed an intense band at $\lambda_{max.}$ 2230 Å. Although alkali failed to convert the product into a 2-benzylthio-3 : 4-dihydro-4-oxopyrimidine, acid hydrolysis gave 6-methyl-3-phenyluracil and toluene-ω-thiol.

While 1 : 3-benzoxazines, derived from urea and salicylic acid derivatives, have frequently been described, compounds containing the simple 1 : 3-oxazine ring system appear to be almost unknown. Further examples, also derived from diketen, are to be discussed in a subsequent paper.

Experimental

M. p.s were determined on a Kofler block and are corrected. Light-absorption measurements were made in ethanol.

Condensations with Thioureas.—(a) *Thiourea.* No reaction took place between diketen and thiourea in an aqueous suspension at room temperature. To a solution of thiourea (19 g.) in acetic acid (50 c.c.) at 110° diketen (22·5 g.) was rapidly added with agitation: a vigorous reaction took place with the deposition of solid. After being refluxed for 15 min., the product was cooled and a pale yellow solid (20 g., 55·5%), m. p. 280—290° (decomp.), was collected; it did not depress the m. p. of authentic 6-methyl-2-thiouracil (II; R = R′ = H). Methylation with an excess of alcoholic potassium hydroxide and methyl iodide gave 3 : 4-dihydro-3 : 6-dimethyl-2-methylthio-4-oxopyrimidine, m. p. and mixed m. p. 94° (Wheeler and McFarland, *loc. cit.*, give m. p. 94°). Distillation of the filtrate from the above diketen condensation gave acetone (3 g.) followed by a fraction, b. p. 60—100°, which had a powerful sulphurous odour: the presence of thioketones was suspected.

(b) *Methylthiourea.* Diketen (8·6 g.) was added during 15 min. to a refluxing, agitated solution of methylthiourea (9·0 g.) in acetic acid (25 c.c.), and refluxing continued for a further 20 min. Water was added; the product (4·6 g.), m. p. 235—245° could not be purified to a sharp melting point by repeated crystallisation. A portion (1 g.) was heated with concentrated hydrochloric acid (10 c.c.) in a sealed tube at 160—170° for 20 hr. Concentration gave a precipitate which on recrystallisation from water formed prisms, m. p. 224—225°, undepressed with authentic 1 : 6-dimethyluracil (Behrend and Thurm, *Annalen*, 1902, **323**, 160, give m. p. 219—220°).

(c) *Phenylthiourea.* Diketen (23 g.) was added during 0·5 hr. to a refluxing, agitated solution of phenylthiourea (38 g.) in acetic acid (100 c.c.), and heating continued for a further 0·5 hr. Part of the solvent was then distilled off, and water added. The precipitate was recrystallised from aqueous acetic acid, giving 6-methyl-3-phenyl-2-thiouracil (28 g., 47·5%), m. p. and mixed m. p. 266°. The authentic sample was prepared by heating phenyl *iso*thiocyanate (13·5 g.) and methyl β-aminocrotonate (11·5 g.) at 150° for 3 hr. Crystallisation of the product gave the thiouracil (II; R = Ph, R′ = H) as plates, m. p. 266°, from aqueous acetic acid (Behrend, Meyer, and Buchholz, *loc. cit.*, give m. p. 255—256°). The condensation of diketen with phenylthiourea in ethyl acetate, benzene, chloroform, and dioxan gave very similar results.

(d) NN′-*Diethylthiourea.* To a solution of *NN′*-diethylthiourea (13·2 g.) in boiling acetic acid (20 c.c.) diketen (8·6 g.) was added during 0·5 hr., and heating then continued for a further 0·5 hr. Removal of solvent under reduced pressure and crystallisation of the residue from aqueous methanol gave 1 : 3-*diethyl*-6-*methyl*-2-*thiouracil* (II; R = R′ = Et) (13·5 g., 63%) as needles, m. p. 97—98° (Found: C, 54·7; H, 6·8; N, 14·1. $C_9H_{14}ON_2S$ requires C, 54·5; H, 7·1; N, 14·15%). Similar preparations in other solvent gave the following yields: benzene (11·5 g.), chloroform (10·0 g.), ethyl acetate (11·0 g.), and dioxan (11·5 g.).

(e) NN′-*Diphenylthiourea.* Diketen (7·5 g.) was added to *NN′*-diphenylthiourea (19·5 g.) in boiling acetic acid (20 c.c.) as described for the diethyl compound. After removal of the solvent under reduced pressure, the product was dissolved in ether and extracted with aqueous sodium hydroxide. Acidification of the aqueous extract and crystallisation of the deposited solid from water, gave acetoacetanilide (9·6 g.), m. p. and mixed m. p. 85°. Evaporation of the ether extract and distillation of the residue gave phenyl *iso*thiocyanate (4·2 g.), b. p. 90—93°/10 mm., n_D^{20} 1·6438 (lit., b. p. 95°/12 mm., $n_D^{23\cdot4}$ 1·6492), and *NN′*-diphenylurea (0·15 g.), m. p. and mixed m. p. 235°.

A similar experiment with *NN′*-di-*o*-tolylthiourea (12·8 g.), diketen (4·5 g.), and acetic acid (40 c.c.) gave acetoacet-*o*-toluidide, m. p. and mixed m. p. 104°.

(f) N-*Methyl*-N′-*phenylthiourea*. *N*-Methyl-*N*′-phenylthiourea was prepared in quantitative yield from phenyl *iso*thiocyanate and aqueous methylamine (40%) at 60—100°. Diketen (13·3 g.) was added during 10 min. to a refluxing agitated solution of the thiourea (25 g.) in acetic acid (50 c.c.), and heating continued for a further 15 min. Removal of 30 c.c. of solvent, addition of water, and crystallisation of the deposited solid (23·5 g.) from *n*-butanol gave 1 : 6-*dimethyl*-3-*phenyl*-2-*thiouracil* (II; R = Ph, R′ = Me) as prisms, m. p. 197—199° (Found: C, 62·4; H, 5·25. $C_{12}H_{12}ON_2S$ requires C, 62·05; H, 5·2%).

The thiouracil (3 g.) was heated with concentrated hydrochloric acid (10 c.c.) in a sealed tube at 160° overnight. The product, smelling strongly of hydrogen sulphide, was evaporated giving a solid (1·0 g.) which crystallised from ethyl acetate as needles, m. p. 211°. The same compound was prepared by refluxing 4-methyl-1-phenylthiouracil (II; R = Ph, R′ = H; 0·5 g.) with an excess of alcoholic potassium hydroxide (0·5N; 10 c.c.) and methyl iodide (2 g.) for 1·5 hr. 1 : 6-*Dimethyl*-3-*phenyluracil* formed needles, m. p. 211°, from ethyl acetate (Found: C, 66·95; H, 5·75. $C_{12}H_{12}O_2N_2$ requires C, 66·65; H, 5·6%). A mixed m. p. determination with the material prepared as above showed no depression.

Condensations with Amidines.—(a) *Acetamidine*. A solution of acetamidine hydrochloride (18·9 g.) in ethanol (100 c.c.) was added to one of sodium ethoxide (from 4·6 g. of sodium and 60 c.c. of ethanol), and diketen (17·5 g.) was added dropwise with agitation to the cooled mixture (0—5°) during 0·5 hr. After 5 days, the solution was filtered and evaporated, giving 3 : 4-dihydro-3 : 6-dimethyl-4-oxopyrimidine (IV; R = H, R′ = Me) (8·6 g., 34·5%), m. p. 193° (Pinner, *loc. cit.*, gives m. p. 192°).

(b) *Benzamidine*. Diketen (8·9 g.) was added to a solution of benzamidine hydrochloride dihydrate (19·25 g.) in aqueous sodium hydroxide (10%; 40 c.c.) at 10—13°. After 0·5 hr. at room temperature, the pale yellow, crystalline deposit of 3 : 4-dihydro-6-methyl-4-oxo-2-phenylpyrimidine (IV; R = H, R′ = Ph) (12 g., 64·5%), m. p. 214°, was collected. A similar experiment, in which diketen reacted with an aqueous solution of the previously isolated free base, gave a 70% yield of the pyrimidone, m. p. 215° (Pinner, *loc. cit.*, gives m. p. 216°).

(c) NN′-*Diphenylformamidine*. Diketen (4·4 g.) was added during 20 min. to an agitated solution of *NN*′-diphenylformamidine (9·8 g.) in benzene (50 c.c.) at 50—60°. After the solution had refluxed for 20 min. solvent was distilled off and the residue crystallised from aqueous methanol, giving β-phenyliminomethylacetoacetanilide (V) (9·8 g.) as needles, m. p. 156° (Dains, *loc. cit.*, gives m. p. 156°).

Condensations with Guanidines.—(a) *Guanidine*. Aqueous sodium hydroxide (8 g. in 25 c.c.) was added to an agitated suspension of guanidine carbonate (18 g.) in water (25 c.c.). Diketen (17·5 g.) was added to the pale yellow solution during 30 min. at 15—20°, and the product was stirred at room temperature for 1 hr., giving 2-amino-3 : 4-dihydro-6-methyl-4-oxopyrimidine (IV; R = H, R′ = NH_2) (3·5 g., 14%), m. p. 285° (decomp.). In a similar experiment with guanidine hydrochloride (19 g.), a 28% yield of the aminopyrimidone, m. p. 285—290° (decomp.), was obtained [Gabriel and Colman, *Ber.*, 1899, **32**, 2924, give m. p. 297—299° (decomp.), on rapid heating].

(b) *Methylguanidine*. Diketen (8·8 g.) was added during 0·5 hr. to a solution of methylguanidine hydrochloride (11 g.) and sodium hydroxide (4 g.) in water (60 c.c.) at 0—10°. The solution was set aside overnight, then concentrated under reduced pressure, and cooled. Sodium chloride was first precipitated, followed by 2-amino-3 : 4-dihydro-3 : 6-dimethyl-4-oxopyrimidine (IV; R = Me, R′ = NH_2) (1·1 g., 8%), m. p. and mixed m. p. 310° (Majima, *Ber.*, 1908, **41**, 176, gives m. p. 312°).

(c) NN′-*Diphenylguanidine*. Diketen (8·6 g.) was added to a solution of *NN*′-diphenylguanidine (21·1 g.) in acetone (50 c.c.) during 20 min., initially at 20°. After a further 15 min.' stirring, the solution was evaporated under reduced pressure to give a white solid (29 g., 98%), m. p. 99—102° (decomp.). Crystallisation from acetone–light petroleum (b. p. 60—80°) gave 2-*amino*-2-*anilino*-2 : 3-*dihydro*-6-*methyl*-4-*oxo*-3-*phenyl*-1 : 3-*oxazine* (VII) as prisms, m. p. 114° (decomp.) (Found: C, 69·05; H, 5·6; N, 14·4. $C_{17}H_{17}O_2N_3$ requires C, 69·2; H, 5·8; N, 14·3%). Light absorption: end absorption, 2100 Å; ε, 14,000: inflection, 3000 Å; ε, 2800. The compound was soluble in dilute hydrochloric acid but insoluble in aqueous sodium hydroxide with which it afforded an oil on being boiled. No reaction occurred with 2 : 4-dinitrophenylhydrazine sulphate.

The oxazine (5 g.) was refluxed with concentrated hydrochloric acid (5 c.c.) and water (12 c.c.) for 2 hr. Cooling and neutralisation of the solution precipitated a solid (2·0 g.), which, on crystallisation, afforded 2-*anilino*-3 : 4-*dihydro*-6-*methyl*-4-*oxo*-3-*phenylpyrimidine* (IV; R = Ph, R′ = PhNH) as needles, m. p. 113—114° (Found: C, 73·85; H, 5·55; N, 14·9. $C_{17}H_{15}ON_3$

requires C, 73·55; H, 5·45; N, 15·15%). Hydrolysis with a higher concentration of acid (7 c.c. of concentrated acid plus 8 c.c. of water) and refluxing for 4 hr. gave 6-methyl-3-phenyluracil (crude yield: 3·1 g.), m. p. and mixed m. p. 256° (from water) [Behrend, Meyer, and Buchholz, *loc. cit.*, give m. p. 244—245° (decomp.)].

Condensations with S-*Substituted Thioureas.*—(a) S-*Methylthiourea.* Diketen (22 g.) was added dropwise to an agitated, cooled (<5°) solution of *S*-methylthiuronium iodide (55 g.) in aqueous sodium hydroxide (10%; 100 c.c.). After 2 days, 3 : 4-dihydro-6-methyl-2-methylthio-4-oxopyrimidine (IV; R = H, R′ = MeS) (24·6 g., 70%), m. p. 221°, was collected (Wheeler and Merriam, *Amer. Chem. J.*, 1903, **29**, 492, give m. p. 219°).

(b) NS-*Dimethylthiourea.* Diketen (4·3 g.) was added as in (a) to a solution of *NS*-dimethylthiuronium iodide (11·6 g.) in aqueous sodium hydroxide (1N; 50 c.c.) during 0·5 hr. Next day more aqueous sodium hydroxide (10%; 15 c.c.), was added and the precipitate (2·6 g., 31%) of 3 : 4-dihydro-3 : 6-dimethyl-2-methylthio-4-oxopyrimidine, (IV; R = Me, R′ = MeS), m. p. 90°, was recrystallised from water, giving needles, m. p. and mixed 94° (Wheeler and McFarland, *loc. cit.*, give m. p. 94°).

(c) S-*Methyl*-N-*phenylthiourea.* *S*-Methyl-*N*-phenylthiourea (16·7 g.) in ether (150 c.c.) was treated with diketen (8·6 g.), added to the agitated solution during 0·5 hr. A white powder (16·1 g.), m. p. 109° (decomp.) slowly crystallised, and concentration of the liquid gave a further crop (2·9 g., total yield 75·5%), m. p. 101—108° (decomp.). 2-*Amino*-2 : 3-*dihydro*-6-*methyl*-2-*methylthio*-4-*oxo*-3-*phenyl*-1 : 3-*oxazine* (XII; R = Me) formed small crystalline granules, m. p. 118° (decomp.), from ethyl acetate (Found: C, 57·55; H, 5·35; N, 11·2. $C_{12}H_{14}O_2N_2S$ requires C, 57·6; H, 5·65; N, 11·2%). Light absorption: max., 2220 Å; ε, 14,700 : inflection, 2700 Å; ε = 2500 [β-methoxycrotonic acid has max., 2340 Å (ε, 14,000), cf. Braude, *Ann. Reports*, 1945, **42**, 119]. Ethanol, acetone, and ethyl acetate were also successfully used as reaction solvents.

This product (0·5 g.) was warmed with methanol (5 c.c.), water (5 c.c.), and aqueous potassium hydroxide (0·5N; 0·5 c.c.); the solid precipitate (0·45 g.), m. p. 146°, was crystallised from aqueous methanol, giving 3 : 4-*dihydro*-6-*methyl*-2-*methylthio*-4-*oxo*-3-*phenylpyrimidine* (IV; R = Ph, R′ = MeS) as rhombic crystals, m. p. 147° (Found: C, 62·05; H, 5·05; N, 12·0. $C_{12}H_{12}ON_2S$ requires C, 62·05; H, 5·2; N, 12·05%). Potassium hydroxide was replaced by barium hydroxide, pyridine, and triethylamine, though not by sodium carbonate, with similar results. A specimen was also prepared by heating 6-methyl-3-phenyl-2-thiouracil (1·0 g.), methyl iodide (1·0 g.) and alcoholic potassium hydroxide (0·5N; 10 c.c.) under reflux for 1 hr. Addition of water and cooling gave a crystalline precipitate (0·7 g.), m. p. 147°, undepressed with the above material.

The oxazine (XII; R = Me) (2·0 g.) was refluxed with concentrated hydrochloric acid (20 c.c.) for 2 hr. methanethiol was evolved and, on cooling, a white precipitate, m. p. 251°, was deposited. Crystallisation from water gave 6-methyl-3-phenyluracil, m. p. and mixed 258—259° [Behrend, Meyer, and Buchholz, *loc. cit.*, give m. p. 244—245° (decomp.)]. On heating of the oxazine (XII; R = Me) (5·0 g.) in an oil-bath at 130—140° for 1 hr., methanethiol was evolved, and repeated crystallisation from water of the gummy solid that remained gave 6-methyl-3-phenyluracil (0·6 g.), m. p. and mixed m. p. 255—257°.

(d) S-*Benzyl*-N-*phenylthiourea.* Diketen (4·2 g.) was added during 15 min. to a solution of *S*-benzyl-*N*-phenylthiourea (12·1 g.; m. p. 80°) in ether (70 c.c.). Evaporation, after decantation from a little separated solid, gave a white crystalline residue (14·7 g.), m. p. 110—112°. Crystallisation from ethyl acetate–light petroleum (b. p. 60—80°) gave 2-*amino*-2-*benzylthio*-3 : 4-*dihydro*-6-*methyl*-4-*oxo*-3-*phenyl*-1 : 3-*oxazine* (XII; R = CH_2Ph) as needles, m. p. 114° (decomp.) (Found: C, 66·0; H, 5·4; N, 8·6. $C_{18}H_{18}O_2N_2S$ requires C, 66·25; H, 5·55; N, 8·6%). Light absorption: max. 2230 Å; ε, 22,600.

The oxazine (3·5 g.) was refluxed with concentrated hydrochloric acid (20 c.c.) for 1 hr., and the toluene-ω-thiol formed was steam-distilled. On cooling the residue, 6-methyl-3-phenyluracil (1·6 g.), m. p. and mixed m. p. 255—256° was deposited.

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