XCI.—*The Absorption Spectra of Cyanogen Compounds.*

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THE following investigation was undertaken with the view of ascertaining whether, by an examination of the absorption spectra of the cyanogen compounds, it might be possible to throw some light upon the vexed question of the constitution of these substances.

Some of the substances of a simple constitution belonging to this group had previously been examined. W. A. Miller and also L. Soret proved the transparency of hydrocyanic acid and the cyanides (*Phil. Trans.*, 1862, 861; this Journ., 1864, 2, 59; *Arch. Sci. Phys. Nat.* 1878, 61), and Hartley independently found that hydrocyanic acid is a remarkably diactinic substance which exhibits no trace of selective absorption (*Trans.*, 1882, 41, 45). Cyanuric acid, owing to difficulties in its examination arising out of its sparing solubility and the necessity for examining warm solutions, at first appeared to give evidence of selective absorption. It was subsequently proved, however, that there was no absorption band even in layers of liquid 200 mm. thick, but that the rays between wave-lengths 3330 and 2572, to where the spectrum was sharply cut off, were only feebly transmitted (*Proc.*, 1899, 15, 46). In the present research, some derivatives of cyanic acid have been included, but we have directed our attention chiefly to cyanuric acid, melamine, and their respective alkyl derivatives.

The derivatives of cyanic acid which were examined are highly diactinic, and show only general absorption.

Cyanuric acid is commonly represented as a closed chain compound in which the chain is formed of alternate atoms of carbon and nitrogen, united by alternate double and single bonds (formula I), and a similar structure is assigned to the methyl ester (methyl cyanurate, m. p. 135°), which is obtained from cyanuric chloride by the action of sodium methoxide. The methyl derivative (methyl *isocyanurate*; methyl tricarbimide; m. p. 175°), on the other hand, which is prepared by the distillation of potassium cyanate with potassium methyl sulphate, is represented as a derivative of *isocyanuric acid* (formula II), which contains three ketonic groups, and has the carbon and nitrogen atoms united by single bonds only. In this derivative, the alkyl groups are directly united to the nitrogen atoms.

Cyanuric acid.

iso-Cyanuric acid or
tricarbimide.

Pyridine and dimethylpyrazine, in which there are carbon and nitrogen atoms, united by alternate double and single bonds,* exhibit strong and persistent absorption bands, the selective absorption being more marked in dimethylpyrazine (*Trans.*, 1900, 77, 846), which contains two nitrogen atoms, than in pyridine, which contains only one.

* That is, which possess the true benzenoid structure represented by alternate double and single bonds, or by the cyclic formula.

It was therefore to be expected that substances possessing the constitution assigned to normal cyanuric acid and its esters would likewise exhibit marked selective absorption, and that even to a greater degree than dimethylpyrazine.

On the other hand, it was to be anticipated that the alkyl derivatives of isocyanuric acid (formula II) would behave like piperidine and other substances composed of a closed chain of singly linked carbon and nitrogen atoms, or of a closed chain of singly linked carbon atoms, which exhibit general absorption only. All the cyanuric compounds, however, which we have examined show only general absorption, and give no indication of the presence of absorption bands. This result is what we anticipated in the case of derivatives of isocyanuric acid, but so far as cyanuric acid and its esters are concerned, it is remarkable, especially when considered in connection with the fact that no strict experimental evidence has yet been advanced in support of the commonly received structural formula for cyanuric acid and its derivatives. The more complete study, therefore, of this acid and its derivatives renders doubtful the correctness of the formula which was deduced in the first instance from the examination of its optical properties.

Methyl cyanurate (m. p. 135°) yields cyanuric acid and methyl alcohol on hydrolysis with alkalis. It is therefore regarded as the ester of normal cyanuric acid (formula I), a conclusion which is supported by its method of formation from sodium methoxide and cyanuric chloride. Trimethylcarbimide (m. p. 175°), on the other hand, yields methylamine on treatment with alkalis, and is therefore regarded as a derivative of isocyanuric acid (formula II). It is generally admitted, however, that chemical evidence of this kind is, in such cases, frequently misleading (Goldschmidt and Meissler, *Ber.*, 1890, 23, 253; Michael, *J. pr. Chem.*, 1888, [ii], 37, 513; Hartley and Dobbie, *Trans.*, 1899, 75, 640). In this instance, the spectrographic examination confirms the results arrived at on purely chemical grounds. The spectra of methyl cyanurate, m. p. 135° , bear a close resemblance to those of cyanuric acid, the absorption being somewhat greater owing to the replacement of three hydrogen atoms by three methyl groups. On the other hand, the spectra of trimethylcarbimide, m. p. 175° , notwithstanding a similar replacement of hydrogen by methyl groups, show considerably less absorption than those of cyanuric acid. In none of the cyanogen compounds is there any trace of an absorption band.

Melamine and its esters show only general absorption, the amount of absorption being somewhat greater than in the case of cyanuric acid. Melamine is regarded as the triamide of normal cyanuric acid (formula I).

Melamine
or cyanurtriamide.

*iso*Melamine
or *isocyanurtriimide*.

The triethyl derivative (m. p. 74°), which is obtained by the action of ethylamine on cyanuric chloride, is, from its method of formation, considered to be a derivative of melamine; the ethyl derivative (m. p. 92°), on the other hand, which is prepared by the desulphurisation of thiourea, is regarded as a derivative of *isomelamine*. Here again the results of the spectrographic investigation are in accord with the conclusions arrived at on chemical grounds. The spectra of melamine and the triethyl derivative, m. p. 74°, are almost identical, whilst the general absorption exhibited by the spectra of the isomeric compound is considerably less.

The general result of the examination of these substances is in complete agreement with the views now generally held as to their relations to one another. As already observed, however, the absence of selective absorption is not in harmony with the constitution of cyanuric acid, as represented by a formula which is closely analogous to that of pyridine and still more closely to that of dimethylpyrazine. It may therefore be fairly considered as doubtful whether the constitution of cyanuric acid is rightly understood.

EXPERIMENTAL.

Potassium Cyanate.—Two specimens of potassium cyanate were examined; one obtained from Schuchardt of Görlitz, the other prepared by oxidising potassium ferrocyanide with manganese dioxide according to the method given by Wurtz (*Ann. Chem. Phys.*, 1854, [iii], 42, 44). This substance is highly diactinic, 50 mm. of a solution containing 1 milligram-molecule in 4 c.c. water, transmitting all rays to $1/\lambda$ 4128 (λ 2422).

Potassium cyanate has also been examined by Soret (*Arch. Sci. Phys. Nat.*, 1893, [iii], 10, 429), who found that it gave a strong absorption band, of which we could find no indication.

In the preparation of ethylcarbimide from potassium cyanate and potassium ethyl sulphate, it is essential to the success of the experiment that the potassium cyanate should be freshly prepared. From this it might be supposed that the potassium cyanate undergoes some change on keeping. If this is the case, the change is not one which can be detected by means of the spectrograph, as we found the absorp-

tion spectra of specimens photographed immediately after preparation and again after standing for six months to be identical.

Ethyl isocyanate; *Ethylcarbimide*, *b. p.* 60°. *Methyl isocyanate*; *Methylcarbimide*, *b. p.* 44°.

These derivatives were prepared by the interaction of potassium cyanate with potassium ethyl sulphate and potassium methyl sulphate respectively (*Ann. Chem. Phys.*, 1854, [iii], 42, 43; *Chem. Centr.*, 1898, i, 445). As no suitable solvent could be found for these esters, they were photographed in thin layers.

Cyanuric Chloride.—This substance was prepared by passing dry chlorine and anhydrous hydrocyanic acid into dry chloroform, care being taken always to keep the chlorine in excess. The chloroform was evaporated in a current of dry air and the crystalline residue of cyanuric chloride purified by repeated crystallisation from carefully dried ether; it melted at 146°.

Cyanuric Acid.—Samples of cyanuric acid obtained from various sources as well as several specimens prepared by us from urea were examined and were found to give identical spectra. Owing to the insolubility of cyanuric acid, considerable difficulty was experienced in making the spectroscopic examination. On this account, layers of greater thickness than usual of the cold saturated aqueous solution were employed, but no indication of selective absorption was observed. A layer 60 mm. in thickness of a solution containing 1 milligram-molecule in 60 c.c. of water transmits all rays to $1/\lambda$ 3886 (λ 2573).

Methyl Cyanurate (*m. p.* 136°).—This substance was prepared by the interaction of sodium methoxide and cyanuric chloride. As will be seen from the curves, its spectra show close agreement with those of cyanuric acid. A layer 25 mm. in thickness of a solution containing 1 milligram-molecule in 20 c.c. of alcohol transmits all rays to $1/\lambda$ 3922 (λ 2549):

Ethyl isocyanurate; *Ethyltricarbimide*, *m. p.* 95°. *Methyl isocyanurate*; *Methyltricarbimide*, *m. p.* 175°.

Two specimens of ethyl isocyanurate were examined; one purchased from Schuchardt, the other obtained in the preparation of ethylcarbimide by the polymerisation of the latter substance. The photographs of the absorption spectra of the two specimens were identical. The specimen of methyl isocyanurate examined was obtained in the same way during the preparation of methylcarbimide. The photographs of the trimethyl and triethyl derivatives show almost complete agreement. They are more highly diactinic than the corresponding derivatives of normal cyanuric acid.

Melamine.—The specimen examined was prepared by heating pure cyanuric chloride with excess of strong ammonia in a sealed tube at 100° for 5 hours. The melamine was extracted from the residue with water and purified by repeated recrystallisation. This substance is less diactinic than cyanuric acid, owing to the replacement of the three OH by three NH_2 groups. A layer 50 mm. in thickness of a solution containing 1 milligram-molecule in 40 c.c. of water transmitted all rays to $1/\lambda$ 3638 (λ 2748).

Triethylmelamine (m. p. 74°).—The specimen examined was prepared by heating pure cyanuric chloride with excess of an alcoholic solution of ethylamine in a sealed tube at 100° for 6 hours. It was purified by crystallisation from dilute alcohol. As will be seen from the curve, its absorption is in close agreement with that of melamine. A solution of 1 milligram-molecule in 20 c.c. of alcohol transmits all rays to $1/\lambda$ 3525 (λ 2836).

Triethylisomelamine.—The preparation of this substance in a state of purity was found to be most tedious and difficult. The method followed was that described by Hofmann (*Ber.*, 1869, 2, 452). The yield of mustard oil was very small; this was also Hofmann's experience. On the other hand, no difficulty was experienced in converting the ethyl mustard oil into monoethylthiourea, although, so far as could be ascertained, the method which we followed did not differ from that given by Hofmann. It was found also that little heat was evolved by the action of ammonia on the ethyl mustard oil, and that the solution, on evaporation, crystallised without difficulty. The melting point of the crystals differed by only 1° from that given by Hofmann. The desulphurisation of the ethylthiourea was effected by repeatedly boiling with freshly precipitated and carefully dried mercuric oxide until the oxide was no longer darkened. On filtering the solution and evaporating, a thick syrup was obtained which crystallised only after long standing and upon subsequent repeated treatment with solvents, notwithstanding that every precaution was taken, as recommended by Hofmann, to thoroughly purify and dry both the mercuric oxide and the alcohol. Details are given of the preparation of this substance, as it seems to have been but little investigated since the publication of Hofmann's paper.

The spectra of triethylisomelamine show less absorption than melamine and triethylmelamine, in this respect they bear the same relation to those substances that ethyl isocyanurate bears to cyanuric acid and ethyl cyanurate.

Notes on the Curves.—For an account of the method employed in drawing the curves on p. 854, see *Trans.*, 1899, 75, 649, and the papers mentioned therein.

The thickness of the layer of liquid in millimetres is given in the
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Scale of oscillation frequencies.

FIG. A.

- I. Methyl isocyanurate, m. p. 175°.
 II. Cynuric acid.
 III. Methyl cyanurate, m. p. 135°.
 IV. Curve deduced for the hypothetical isocyanuric acid.

FIG. B.

- I. Triethyl isomelamine, m. p. 92°.
 II. Melamine.
 III. Triethylmelamine, m. p. 74°.
 IV. Curve deduced for the hypothetical isomelamine.

column headed 'mm.' on the left-hand side of each of the figures A and B.

In the case of cyanuric acid, 1 milligram-molecule was dissolved in 60 c.c. of water, and layers of 3—60 mm. in thickness were photographed. For the sake of easy comparison with the curves of the esters, 60 mm. of this solution are taken as equivalent to 20 mm. of a solution containing 1 milligram-molecule in 20 c.c., and the curve plotted accordingly.

The curves for the stronger solutions of melamine and triethylmelamine are not given, as we were unable to obtain photographs of the corresponding solutions of triethylisomelamine for comparison.

The difference between the curves II and III (Fig. A) is due to the greater molecular weight of the ester, which contains three methyl groups in place of three hydrogen atoms, and therefore has greater absorption than the acid. The difference between curves I and III expresses the difference in the amount of absorption which is caused by the difference in constitution of the two esters. Assuming the relation between the unknown *isocyanuric* acid and its alkyl derivative to be the same as that between the normal acid and its ester, the curve of *isocyanuric* acid would be represented approximately by the dotted line IV. The difference in the amount of absorption due to the difference in constitution between the normal and the *iso*-acid would then be expressed by the difference between the curves II and IV.

The melamine curves (Fig. B) are to be interpreted in the same manner.

Potassium cyanate. $\text{N}:\text{C}\cdot\text{OK}$ or $\text{O}:\text{C}:\text{NK}$.

1 milligram-mol. in 4 c.c. water.

Thickness of layer of liquid in millimetres.	Description of spectrum.	$1/\lambda$.	λ .
50 } 40 } 30 }	Spectrum continuous to Complete absorption beyond.	4128	2422
20 } 10 }	Spectrum continuous to Complete absorption beyond.	4325	2312
8 } 6 } 4 }	Spectrum continuous to Complete absorption beyond.	4417	2263
2	Same as 4 mm., with lines showing faintly at and	4484 4561	2230 2192

Methyl isoCyanate ; Methylcarbimide. $\text{CO:NH}\cdot\text{CH}_3$. B. p. 44° .

Thickness of layer of liquid in millimetres.	Description of spectrum.	$1/\lambda$.	λ .
2	Spectrum continuous to	3638	2748
	But weak from to	3462	2888
		3638	2748
1	Complete absorption beyond.		
	Spectrum continuous to	3638	2748
	Complete absorption beyond.		

Ethyl isoCyanate ; Ethylcarbimide. $\text{CO:NH}\cdot\text{C}_2\text{H}_5$. B. p. 60° .

Thickness of layer of liquid in millimetres.	Description of spectrum.	$1/\lambda$.	λ .
1	Spectrum continuous to	3638	2748
	Complete absorption beyond.		

Cyanuric Chloride. $\text{C}_3\text{N}_3\text{Cl}_3$. M. p. 146° .

1 milligram-mol. in 4 c.c. alcohol.

Thickness of layer of liquid in millimetres.	Description of spectrum.	$1/\lambda$.	λ .
25	Spectrum continuous to	3315	3016
	Faint line at	3345	2989
	Complete absorption beyond.		
20 } 15 } 10 }	Spectrum continuous to	3345	2989
	Complete absorption beyond.		
5 } 4 } 3 }	Spectrum continuous to	3482	2871
	Complete absorption beyond.		
2 }	Spectrum continuous to	3516	2844

Cyanuric Chloride—(continued).

1 milligram-mol. in 20 c.c. alcohol.

Thickness of layer of liquid in millimetres.	Description of spectrum.	$1/\lambda$.	λ .
25	Spectrum continuous to	3340	2994
	Complete absorption beyond.		
20	Spectrum continuous to	3438	2908
	Complete absorption beyond.		
15	Spectrum continuous to	3516	2844
	Complete absorption beyond.		
10 } 5 } 4 } 3 } 2 }	Spectrum continuous to	3559	2809
	Complete absorption beyond.		
	Spectrum continuous to	3628	2756
	Complete absorption beyond.		

Cyanuric Acid. $C_3N_3O_3H_3$.

Schuchardt's specimen recrystallised from water.

1 milligram-mol. in 60 c.c.

Thickness of layer of liquid in millimetres.	Description of spectrum.	$1/\lambda$.	λ .
60	Spectrum continuous to	3886	2573
	Weak prolongation to	4132	2420
	Complete absorption beyond.		
45	Spectrum continuous to	4132	2420
	Complete absorption beyond.		
30	Spectrum continuous to	4176	2394
	Faint prolongation to	4230	2364
	Complete absorption beyond.		
15 } 12 } 9 }	Spectrum continuous to	4321	2314
	Complete absorption beyond.		
6	Spectrum continuous to	4368	2289
	Complete absorption beyond.		
3	Spectrum continuous to	4417	2263
	Complete absorption beyond.		

Methyl Cyanurate. $C_3N_3(O\cdot CH_3)_3$. M. p. $134\cdot5^\circ$.

1 milligram-mol. in 8 c.c. alcohol.

Thickness of layer of liquid in millimetres.	Description of spectrum.	$1/\lambda$.	λ .
50	Spectrum continuous to	3807	2626
	Faint line at	3870	2583
	Complete absorption beyond.		
40 } 30 } 20 }	Spectrum continuous to	3870	2583
	Complete absorption beyond.		
	Spectrum continuous to	3911	2556
	Complete absorption beyond.		
10 } 8 } 6 }	Spectrum continuous to	4020	2487
	Complete absorption beyond.		
4 } 2 }	Spectrum continuous to	4112	2431
	Complete absorption beyond.		

Methyl Cyanurate—(continued).

1 milligram-mol. in 20 c.c.

Thickness of layer of liquid in millimetres.	Description of spectrum.	$1/\lambda$.	λ .
25 } 20 }	Spectrum continuous to	3922	2549
	Complete absorption beyond.		
15 }	Spectrum continuous to	4032	2480
	Complete absorption beyond.		
10	Same as 15 mm., but faint prolongation to	4112	2431
5 } 4 }	Spectrum continuous to	4125	2424
	Complete absorption beyond.		
3 } 2 }	Spectrum continuous to	4176	2394
	Complete absorption beyond.		
1	Spectrum continuous to	4245	2355
	Complete absorption beyond.		

Methyl isoCyanurate ; Methyltricarbimide. $C_3O_3(N\cdot CH_3)_3$. M. p. 175° .

1 milligram-mol. in 8 c.c. alcohol.

Thickness of layer of liquid in millimetres.	Description of spectrum.	$1/\lambda$.	λ .
50	Spectrum continuous, but weak to	3313	3018
	Very faint indication of lines at.....	3480	2873
	and	3509	2849
40	Complete absorption beyond.		
	Spectrum continuous to	3555	2812
30	Complete absorption beyond.		
	Spectrum continuous to	3625	2758
20	Complete absorption beyond.		
	Same as 30 mm., very faint prolonga-		
	tion to.....	3873	2581
	And lines at	4102	2437
10	and	4116	2429
	Complete absorption beyond.		
	Spectrum continuous to	4306	2322
8	Complete absorption beyond.		
6			
4	Spectrum continuous to	4402	2271
2	Complete absorption beyond.		

Methyl isoCyanurate ; Methyltricarbimide—(continued).

1 milligram-mol. in 20 c.c. alcohol.

Thickness of layer of liquid in millimetres.	Description of spectrum.	$1/\lambda$.	λ .
25	Spectrum continuous to	4321	2314
20	Complete absorption beyond.		
	Spectrum continuous to	4368	2289
15	Complete absorption beyond.		
10	Spectrum continuous to	4413	2266
5	Complete absorption beyond.		
4	Spectrum continuous to	4448	2248
3	Complete absorption beyond.		
	Substantially as above.		
2	Complete absorption beyond.		
	Spectrum continuous to	4560	2192
1	Complete absorption beyond.		
	Spectrum continuous to	4555	2195
	Complete absorption beyond.		

Ethyl isoCyanurate ; Ethyltricarbimide. $C_3O_3(N \cdot C_2H_5)_3$. M. p. 95°

1 milligram-mol. in 20 c.c. alcohol.

Thickness of layer of liquid in millimetres.	Description of spectrum.	$1/\lambda$.	λ
25	Spectrum continuous to	4105	2436
	Feeble transmission to.....	4335	2306
	Complete absorption beyond.		
20	Spectrum continuous to	4215	2372
	Feeble transmission to.....	4368	2289
	Complete absorption beyond.		
15	Spectrum continuous to	4335	2306
	Lines transmitted at	4347	2300
	and	4368	2289
	Complete absorption beyond.		
10	Spectrum continuous to	4347	2300
	Lines at	4368	2289
	and	4325	2312
	Complete absorption beyond.		
5 } 4 } 3 }	Spectrum continuous to	4325	2312
	Complete absorption beyond.		
2 } 1 }	Spectrum continuous to	4507	2218
	Line at.....	4572	2187
	Complete absorption beyond.		

Melamine ; Cyanurtriamide. $C_3N_3(NH_2)_3$.

1 milligram-mol. in 40 c.c. water.

Thickness of layer of liquid in millimetres.	Description of spectrum.	$1/\lambda$.	λ .
50 } 40 } 30 }	Spectrum continuous to	3638	2748
	Complete absorption beyond.		
20	Spectrum continuous to	3648	2741
	Complete absorption beyond.		
10 } 8 }	Spectrum continuous to	3667	2727
	Complete absorption beyond.		
6	Spectrum continuous to	3707	2697
	Complete absorption beyond.		
4	Spectrum continuous to	3740	2673
	Complete absorption beyond.		
2	Spectrum continuous to	3886	2573
	Complete absorption beyond.		

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Melamine ; Cyanurtriamide—(continued).

1 milligram-mol. in 100 c.c. water.

Thickness of layer of liquid in millimetres.	Description of spectrum.	$1/\lambda$.	λ .
5 } 4 } 3 }	Spectrum continuous to Complete absorption beyond. Spectrum continuous to Complete absorption beyond.	3877 3918	2579 2552
2 }	Spectrum continuous to Complete absorption beyond.	4038	2476
1 }	Spectrum continuous to Complete absorption beyond.	4080	2450

1 milligram-mol. in 500 c.c. water.

Thickness of layer of liquid in millimetres.	Description of spectrum.	$1/\lambda$.	λ .
5 }	Spectrum continuous to Feeble transmission to Complete absorption beyond.	4080 4315	2450 2314
4 }	Spectrum continuous to Feeble transmission to Complete absorption beyond.	4125 4362	2424 2292
3 } 2 } 1 }	Spectrum continuous to Feeble transmission to Complete absorption beyond.	4200 4407	2380 2269

Triethylmelamine. $C_3N_3(NH \cdot CH_3)_3$ M. p. 74° .

1 milligram-mol. in 20 c.c. alcohol.

Thickness of layer of liquid in millimetres.	Description of spectrum.	$1/\lambda$.	λ .
25 }	Spectrum continuous to Strong line transmitted at Complete absorption beyond.	3525 3635	2836 2751
20 } 15 } 10 }	Spectrum continuous, but weak, to ... Complete absorption beyond.	3635	2751
5 } 4 } 3 }	Spectrum continuous to Complete absorption beyond. Spectrum continuous to Complete absorption beyond.	3777 3812	2647 2623
2 }	Spectrum continuous to Strong line transmitted at Complete absorption beyond.	3830 3886	2610 2573
1 }	Spectrum continuous to Complete absorption beyond.	3886	2573

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Triethylmelamine—(continued).
1 milligram-mol. in 100 c.c.

Thickness of layer of liquid in millimetres.	Description of spectrum.	$1/\lambda$.	λ .
5 } 4 }	Spectrum continuous to Strong line transmitted at	3830 3886	2610 2573
3	Complete absorption beyond. Spectrum continuous to	3886	2573
2	Complete absorption beyond. Spectrum continuous to	3901	2563
1	Complete absorption beyond. Spectrum continuous to	3914	2554

1 milligram-mol. in 500 c.c. alcohol.

Thickness of layer of liquid in millimetres.	Description of spectrum.	$1/\lambda$.	λ .
5	Spectrum continuous to Complete absorption beyond.	3914	2554
4	Spectrum continuous to Complete absorption beyond.	3935	2541
3	Spectrum continuous to Complete absorption beyond.	3967	2520
2	Spectrum continuous to Complete absorption beyond.	3985	2509
1	Spectrum continuous to Complete absorption beyond.	4043	2473

Triethylisomelamine. $\text{C}_3\text{N}_3\text{H}_3(\text{N}\cdot\text{C}_2\text{H}_5)_3 + 4\text{H}_2\text{O}$. M. p. 92° .
1 milligram-mol. in 100 c.c. alcohol.

Thickness of layer of liquid in millimetres.	Description of spectrum.	$1/\lambda$.	λ .
20	Spectrum continuous to Line feebly transmitted at	3620 3681	2762 2716
15	Complete absorption beyond. Spectrum continuous to	3805	2628
10	Complete absorption beyond. Spectrum continuous to	3852	2596
5	Complete absorption beyond. Spectrum continuous to	3911	2556
4	Complete absorption beyond. Spectrum continuous to	3988	2507
3	Complete absorption beyond. Spectrum continuous to	4023	2485
2	Complete absorption beyond. Spectrum continuous to	4116	2429

Triethylisomelamine—(continued).
1 milligram-mol. in 500 c.c. alcohol.

Thickness of layer of liquid in millimetres.	Description of spectrum.	$1/\lambda$.	λ .
5	Spectrum continuous to Complete absorption beyond.	4116	2429
4	Spectrum continuous to Complete absorption beyond.	4165	2400
3	Spectrum continuous to Faint line at	4165 4234	2400 2361
2	Complete absorption beyond. Spectrum continuous to Complete absorption beyond.	4234	2361