III.—Aluminium Alcohols. Part II. *Their Products of Decomposition by Heat.*

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WE lately described some alcohols in which the basic hydrogen is replaced by aluminium (*Chem. Soc. J.*, 1876, p. 158; 1881, p. 1; *Proc. Roy. Soc.*, 1880, p. 546). We have also observed (*Proc. Roy. Soc.*, 1880, p. 548) that these compounds are decomposed by heat, and that in two ways: they may split up into alumina and the alcohol and olefine, or into alumina and the ether. The further investigation of this matter forms the subject of the present paper.

Ethyl Series.

The effect of heat on the aluminic ethylate has already been partially described. Although the compound may be distilled *in vacuo*, it is almost wholly broken up near its boiling point under the ordinary pressure of the atmosphere. A little ether is formed, but the decomposition takes place almost entirely into ethene, alcohol, and alumina, thus:—

In the case of the amylate, a similar decomposition occurs, but the yield of amylc ether is somewhat greater.

Phenyl Series.

If similar reactions take place with the aluminic alcohols of the phenyl series, we should obtain the simple ethers $(\text{C}_n\text{H}_{2n-7})_2\text{O}$, only one of which has been described, together with the hydrocarbons, C_6H_4 and C_7H_6 , and their homologues. We therefore studied more completely the action of heat upon the aluminium derivatives of certain of the phenyl alcohols.

Aluminium Phenylate.

469 grams of this compound were heated in a flask fitted with a wide bent tube about 16 inches long. The substance quickly melted, and, after a little free phenol had passed over, a somewhat viscous yellowish-brown liquid distilled. The residue consisted of charcoal, tarry matter, and alumina. The distillate weighed 268 grams, and after redistillation to remove a small quantity of aluminium phenylate

which was carried over, there remained 252 grams. This was separated by fractionation into three portions:—

- a. 52 grams, from about 80—200°.
- b. 160 grams, from 200—280°.
- c. 34 grams, above 280°.

Fraction a.—The greater part of this portion distilled between 178° and 184°, a small quantity of a very mobile liquid of the odour of benzene passing over at about 80°. By repeated distillation of this higher boiling point product, and rejecting small portions above 180°, a considerable part of it was obtained boiling between 178° and 180°. This liquid was colourless; it was soluble in a solution of potash, crystallised on cooling in long needles; gave hydrogen with the aluminium-iodine reaction, and, on combustion with oxide of copper, yielded 76·57 per cent. of carbon and 6·79 of hydrogen. The principal part of this fraction consisted, therefore, of phenol.

Fraction b.—This portion was shaken repeatedly with three or four times its volume of boiling water to remove any phenyl alcohol not separated by distillation. The residual oily liquid was dried over calcium chloride, and subsequently distilled several times, each time rejecting whatever failed to pass over below 300°. The distillate was now quite colourless, and nearly the whole of it boiled constantly at 249°.

This substance was not miscible with water or aqueous potash, and did not yield hydrogen by the aluminium-iodine reaction. It separated from an alcoholic solution, on cooling to a low temperature, in colourless prisms. Its specific gravity was 1·0904.

Burnt with oxygen and copper oxide—

- I. 0·3658 gram gave 1·1320 gram CO₂ and 0·1955 H₂O;
- II. 0·4241 „ „ 1·3175 gram CO₂ and 0·2279 H₂O;

results which appear from the following comparison to agree with the formula C₁₂H₁₀O, which is that of *phenyl ether*, described by Hoffmeister in 1871 (*Ber.*, 3, 747).

			I.	II.
C ₁₂	.....	144	84·70	84·40
H ₁₀	.....	16	5·88	5·93
O	.....	16	9·42	—
		170	100·00	84·72

Its index of refraction for A was 1·5675 at 25°, and the length of the spectrum, from A to H, was 0·0583. Two determinations gave 90·05 and 90·22 as the refraction equivalent for A, which accords with theory.

Portions of this compound were found to solidify to a mass of colourless prismatic crystals, while other portions apparently identical remained liquid. A few experiments were made in the hope of elucidating this anomaly. A quantity of the freshly distilled compound was well shaken in a stoppered bottle. No solidification occurred. A crystal of the substance was now introduced, and immediately beautiful star-shaped crystals formed on several parts of the introduced crystal, others forming on these, and the whole liquid speedily passed to the crystalline condition. This change was accompanied by a rise in temperature of 8° . Another portion of the substance remained liquid at 2° for hours, but quickly solidified on the vessel containing it being immersed in a freezing mixture.

Fraction c.—This portion consisted of a viscid brown liquid, containing grains of a yellow solid. It was distilled a number of times, rejecting each time a small quantity of a non-volatile tarry substance. The distillate was now less viscid and much lighter in colour. On slowly distilling it, an almost colourless liquid passed over at about 280° , which condensed to a nearly white solid; and this was followed at a higher temperature by a comparatively small quantity of a non-crystallisable, thick orange-coloured liquid.

The solid was purified by repeated solution in, and crystallisation from, alcohol of sp. gr. 0.880. It was white in colour, soluble in absolute alcohol, and more so in ether. It melted at 97° , and sublimed slowly a little below this temperature.

On combustion with oxygen and copper oxide after drying at 100° :

I.	0.1275 gram	gave	0.4018 CO_2	and	0.0654 H_2O
II.	0.1268	„ „	0.3987	„ „	0.0646 H_2O
III.	0.1933	„ „	0.6099	„ „	0.1005 H_2O .

The third portion (III) analysed had undergone sublimation. The results expressed in parts per 100 give—

	I.	II.	III.
C	85.94	85.75	86.03
H	5.70	5.66	5.77

On the determination of its vapour-density by the method of Victor Meyer—

0.0978 gram	gave vapour =	in volume	12.04 c.c. (corr.)
0.0836	„	„	10.19 „

These data give 181.4 and 183.0 respectively for the molecular weight of the substance. Its most probable molecular formula is therefore $\text{C}_{13}\text{H}_{10}\text{O}$.

		Calc. for 100 pts.	Found (mean).
C ₁₃	156	85.71	85.91
H ₁₀	10	5.50	5.71
O	16	8.79	—
	182	100.00	

Three compounds of this formula have been described—fluorene alcohol, and diphenyl ketone, and its isomer. Our body does not accord in physical properties with the description of any one of these compounds. We are inclined, however, from the mode of its formation, to regard it as a phenyl ketone.

It would appear, then, from these results:—

1st. That about half of the phenylate was resolved by heat into phenyl ether and alumina, thus—

which action gives a simple method of preparing this ether.

2nd. That a compound of the formula C₁₃H₁₀O was formed in relatively small quantity.

3rd. That about one-quarter of the aluminium compound was resolved very probably in accordance with the equation—

No evidence was found of the existence of the hydrocarbon C₆H₄, shown in this scheme, but it is not improbable that it existed in admixture in that portion of the distillate above 300°, which was richer in carbon than any of the bodies separated; in fact it contained 87.5 per cent., and its specific refraction and dispersion were very high.

Aluminium Para-cresylate.

760 grams of aluminium para-cresylate were heated as in the case of the phenylate. The distillate was almost solid when cold, yellowish-brown in colour, and weighed 463 grams. This product was boiled with 6 litres of alcohol, sp. gr. 0.805, and filtered from alumina by a calico strainer, supported in a hot water funnel. On cooling, a yellow crystalline substance separated, which, after washing with 9 litres of alcohol, weighed when dry 71 grams. This body was dissolved in alcohol, and crystallised therefrom, until the menstruum was free from yellow colour. After drying at 100°, the body was burnt with oxygen and copper oxide.

I. 0.1622 gram gave 0.5097 gram CO₂ and 0.0956 gram H₂O.

This substance was, however, still yellow, and when melted exhibited a blue fluorescence. It was slowly distilled, when nearly the

whole passed over at 307° . The distillate was of the colour of pale hock, free from the blue fluorescence, and solidified on cooling to a cream-coloured crystalline mass. This was dissolved in boiling alcohol, from which solution the substance separated on cooling in very thin plates, white in colour, and of a pearly lustre.

On combustion—

II. 0.1619 gram gave 0.5081 gram CO_2 and 0.0989 H_2O .

The substance permitted of sublimation, and by the following method was obtained in long white lustrous plates. The compound in the condition of the white plates was melted and poured into a porcelain boat, and placed in the forepart of a glass tube about $1\frac{1}{2}$ inch in diameter, through which a current of hydrogen was passing. The part of the tube in proximity to the loaded boat was heated, and the boat and the flame slowly moved backwards as the compound sublimed.

On combustion—

III. 0.1205 gram gave 0.3774 gram CO_2 and 0.0717 gram H_2O .

These results expressed in parts per 100 give—

	I.	II.	III.
C	85.70	85.59	85.70
H	6.54	6.78	6.52

On the determination of its vapour-density—

0.1186 gram gave vapour = in volume 12.64 c.c. (corr.)

0.1179   "   "   "   12.60   "

These determinations were made in hydrogen, and give 209.4 and 208.8 respectively for the molecular weight of the substance. The most probable molecular formula of the compound is therefore $\text{C}_{15}\text{H}_{14}\text{O}$.

		Calc. for 100 pts.	Found (mean).
C_{15}	180	85.71	85.66
H_{14}	14	6.66	6.61
O	16	7.63	—
	210	100.00	

It melted at 168° , and dissolved but slightly in alcohol, giving 2.5 per cent. at the boiling temperature, and 0.4 per cent. at 20° .

The alcoholic liquids obtained in the operations just described were distilled. About 10 grams of the solid compound separated, and after the alcohol had passed over, the residual liquid began boiling at 190° , gradually rising beyond the limits of the thermometer. The greater part however (120 grams) distilled between 190° and 300° . This

fraction was digested with successive portions of aqueous potash, and the alkaline liquid subsequently neutralised with hydrochloric acid. 36 grams of an oily brown liquid separated, which, after washing with a little water, and drying with calcium chloride, boiled for the most part between 199° and 202° . This distillate was colourless, and had the composition, refraction, and other physical and chemical qualities of para-cresol.

The portion of the fraction not soluble in aqueous potash was of a dark, yellowish-brown colour. It was washed with water, and digested with calcium chloride. It was now distilled about thirty times, each time rejecting small portions above 300° , and below points gradually rising from 220° — 270° . The distillate was colourless at this stage, and on cooling to a low temperature, formed a semi-fluid mass containing colourless prismatic crystals. This product was dissolved in about twice its volume of warm alcohol, from which solution, on cooling to a low temperature, the substance separated in prisms. It was dried at 100° , and burnt with copper oxide.

- I. 0.1070 gram gave 0.3324 CO_2 and 0.0710 H_2O .
 II. 0.0942 " " 0.2928 " " 0.0597 "
 III. 0.1541 " " 0.4793 " " 0.0972 "

These results expressed in parts per 100 give—

	I.	II.	III.
C.....	84.72	85.30	84.82
H.....	7.37	7.04	7.00

On the determination of its vapour-density—

0.1077 gram gave vapour = in volume 12.13 c.c. (corr.).
 0.1040 " " " 11.75 "

These numbers give 198.1 and 197.6 respectively for the molecular weight of the substance. Its most probable molecular formula is therefore $\text{C}_{14}\text{H}_{14}\text{O}$ —

		Calculated.	Found (mean).
C_{14}	168	84.84	84.94
H_{14}	14	7.07	7.13
O	16	8.09	—
		100.00	

which would be that of cresyl ether, and from the general analogy between its properties and mode of preparation and that of phenyl ether, little doubt can exist as to the compound being the second ether of the phenyl series. As it was obtained through the aluminium derivative of para-cresylate, we name the compound *para-cresyl ether*.

This compound melts at 50°C. , is very soluble in ether and in benzol, moderately so in alcohol, and has an odour resembling that of phenyl ether, but fainter.

The action of heat on aluminium cresylate, as was to be expected, presents a general similarity to the action of the same agent on the analogous phenyl compound. The points of difference in the two cases are to be found in the variations in the amount of the corresponding compounds produced. The aluminium phenylate, for example, yields a relatively large quantity of phenyl ether, while the cresyl-aluminium alcohol gives only a relatively small quantity of the corresponding compound. Again, the phenyl compound yields only a small quantity of the $\text{C}_{13}\text{H}_{10}\text{O}$ body, while the cresyl compound yields a relatively large quantity of the homologue $\text{C}_{15}\text{H}_{14}\text{O}$. The hypothetical hydrocarbon C_7H_6 has not been found.

Aluminium Thymolate.

1000 grams of this compound were heated as in the cases of the analogous phenyl and cresyl compounds. A little free thymol at first passed over, then an orange viscid liquid, which partially solidified on cooling. As soon as the thymolate became fluid by heat, it was noticed to be in violent commotion, evidently from the passage through it of gas. The nature of this gas, and the meaning of its evolution, were determined.

45 grams of thymolate were heated until gas evolution practically ceased. The gas for the first 3240 c.c. was a pure olefine, after which it consisted of a mixture of the olefine and probably marsh-gas, the latter compound being evolved in an increasing ratio towards the completion of the action. The total gas collected (corr.) measured 5856 c.c., of which 5032 c.c. combined with bromine.

In another experiment, employing 230 grams of thymolate, 196 grams of an olefine bromide were obtained. The greater part of this compound boiled, on rectification, between 136° and 139° . Its sp. gr. at 4° was 1.913, and when dissolved in alcohol and treated with zinc it gave zinc bromide and a gas burning with very luminous flame. The gas set free on heating the fluid thymolate is therefore propylene.

The distillate from the 1000 grams of thymolate weighed 470 grams. It was divided by distillation into two portions:—*a*, which passed over below 280° , and *b*, above that temperature.

Fraction a.—This portion was liquid, of a brownish-yellow colour, and weighed 207 grams. It was treated with successive quantities of a warm solution of potash, in which it partially dissolved. The alkaline solutions obtained were neutralised with hydrochloric acid, when a

brownish oily liquid separated, which was dried over calcium chloride and distilled. The distillate was redistilled some five or six times, each time rejecting the portion not passing over below 205° . The distillate at this stage was colourless, and nearly the whole of it distilled between $196-202^{\circ}$.

On combustion with copper oxide and oxygen—

0.1820 gram gave 0.5164 gram CO_2 and 0.1208 gram H_2O .

The substance gave hydrogen with the aluminium reaction, and readily dissolved in aqueous potash. Its refractive index for A was 1.5316 at 23°C . These qualities, jointly with its composition exhibited in the following comparison, show the compound to be cresol:—

	Calculated.	Found.
C_7	77.77	77.38
H_8	7.40	7.37
O	14.83	15.25 (by diff.)
	100.00	

Moreover, as this substance did not solidify at a temperature of -17°C ., we concluded that it is meta-cresol. Hitherto this modification had not been seen in the solid condition, but on stirring the product just described with a thermometer, it underwent solidification at -14°C .

Fraction b.—This portion consisted apparently of a yellow crystalline body in admixture with a brownish viscid liquid. It weighed 231 grams. After the addition to it of the high boiling portion of fraction *a*, the product was mixed with about twice its volume of ether, and the mixture heated for a few minutes in hot water. On cooling in a freezing mixture the brown liquid remained in solution, while the solid was apparently unaffected. The solid was now washed on a filter with cooled ether. It quickly became white, and was then found to weigh 15 grams, and to consist of small shining scales. This body was next dissolved in boiling alcohol, sp. gr. 0.805, from which solution, on cooling, it separated in large white plates, having a pure pearly lustre. It was dried and burnt with copper oxide and oxygen with the following results:—

- I. 0.1917 gram gave 0.6017 gram CO_2 and 0.1142 gram H_2O .
 II. 0.2035   „   0.6383   „   0.1218   „

These data expressed in parts per 100 give—

	I.	II.
C.....	85.60	85.54
H	6.61	6.65

On the determination of its vapour-density—

0.1279 gram gave vapour = in volume to 13.66 c.c. (corr.).

0.1219   "   "   "   13.04   "

These numbers give 209 and 208.6 respectively for the molecular weight of the compound. Its molecular formula is therefore $C_{15}H_{14}O$ —

		Calc. for 100 pts.	Found (mean).
C_{15}	180	85.71	85.57
H_{14}	14	6.66	6.63
O	16	7.63	—
	210	100.00	

This compound permits of sublimation by the method used for the compound of the same molecular formula from para-cresol. It sublimes, however, much more readily, and forms larger crystals than that substance.

The ethereal liquids, obtained in the operation described, were distilled. The residuum, after the ether had separated, commenced distilling at about 250° , from which temperature to 300° an almost colourless liquid passed over. The portion above 300° , after distillation, was treated with about twice its volume of ether. On standing, more of the $C_{15}H_{14}O$ compound separated, and by distilling the ethereal solution itself, another quantity of liquid was obtained, boiling between 250° and 300° . These operations were performed on the residue boiling above 300° until no more of the solid compound separated.

All the liquid obtained between 250° and 300° was now treated with a hot solution of potash, then washed with water, dried over calcium chloride, and distilled. The liquid commenced boiling at about 270° . It was distilled some 40 times, each time rejecting small quantities boiling above 300° . The liquid had now a faint yellow tinge, and boiled for the most part between 284° and $288^{\circ}C$. Its index of refraction for α was 1.5576 at $16^{\circ}C$. Burnt with oxygen and copper oxide—

I. 0.1500 gram gave 0.4676 gram CO_2 and 0.0963 gram H_2O .

II. 0.1765   "   0.5488   "   0.1136   "

These results expressed in parts per 100 give—

	I.	II.
C	85.01	84.80
H	7.13	7.15

On the determination of its vapour-density—

0.0929 gram gave vapour = in volume to 10.68 c.c. (corr.).

0.1176   "   "   "   13.56   "

These numbers give 194·16 and 193·58 respectively for the molecular weight of the substance. Its most probable molecular formula is therefore $C_{14}H_{14}O$ —

		Calc. for 100 pts.	Found (mean).
C ₁₄	168	84·84	84·91
H ₁₄	14	7·07	7·14
O	16	8·09	7·95 (by diff.)
	198	100·00	100·00

which is that of cresyl-ether. The physical properties of this substance, however, differ materially from those of the cresyl-ether discovered among the products of the aluminium para-cresylate. For example, it does not solidify even in a freezing mixture, or crystallise from alcohol. We are disposed therefore to regard it as isomeric with the ether of para-cresol, and from the mode of its formation to name it *meta-cresyl-ether*.

It appears then that heat readily resolves aluminium thymolate into aluminium meta-cresylate and propylene, thus—

and further, that the same agent splits up the aluminium compound so produced into alumina, meta-cresol, meta-cresyl-ether, and the pearly compound $C_{15}H_{14}O$, which, judging from the want of agreement between the physical properties of this substance and the one of the same molecular formula from the para-cresylate, would appear to be isomeric with this latter compound. The points of difference referred to are set out in the table below:—

	Melting point.	Solubility in abs. alcohol		Solubility in benzol 21° C.
		Boiling.	20° C.	
C ₁₅ H ₁₄ O from para-cresylate	168°	2·5 p. c.	0·4 p. c.	3·3 p. c.
C ₁₅ H ₁₄ O from meta-cresylate (thymolate)	200	1·0 „	0·17 „	0·93 „

Both of these substances are alike in one special particular, that of giving out a bluish-white light when shaken or rubbed.

Two substances of the formula $C_{15}H_{14}O$ have already been described, viz., para-ditolyl and di-benzyl ketones. Our compounds do not accord in physical properties with either of these bodies. From the composition and mode of formation we are, however, inclined to regard them as ketones, and provisionally as para- and meta-cresyl ketones respectively.

Aluminium β -Naphthylate.

150 grams of β -naphthol were heated with 10 grams of aluminium until the evolution of hydrogen nearly ceased. Some of the metal remained in the free condition, which is doubtless to be attributed to the infusible character of the resulting naphthylate preventing the completion of the action.

On distilling the mixture of naphthol and naphthylate a reddish-brown viscous liquid was obtained, which solidified on cooling. It was divided by distillation into two portions:—*a*, which passed over below 300° , and *b*, above this temperature.

Fraction a weighed 40 grams, and consisted of naphthalene and naphthol in about equal proportions.

Fraction b.—This portion was solid and dark yellowish-brown in colour. It was dissolved in boiling alcohol, and the yellow crystalline substance, which separated as the solution cooled, again and again crystallised from the same liquid. This product was next dried and twice distilled, which it did at a temperature above the limits of the thermometer. On cooling, the distillate formed a crystalline mass pale yellow in colour. It was crystallised from boiling alcohol until the menstruum was free from colour. The substance now separated from alcohol in thin pearly white rhomboidal plates. It melted at 104° C., and on combustion—

I. 0.2713 gram gave 0.8837 CO_2 and 0.1268 gram H_2O .

II. 0.2874   „   0.9359   „   0.1354   „

These results expressed in parts per 100 give—

	I.	II.
C	88.83	88.81
H	5.19	5.23

On the determination of its vapour-density—

0.1219 gram gave vapour = in volume 10.16 c.c.

0.1341   „   „   „   11.02   „

0.1399   „   „   „   11.64   „

These numbers give 267.8, 271.4, and 268.7 respectively for the molecular weight of the substance. Its most probable molecular formula is therefore $\text{C}_{20}\text{H}_{14}\text{O}$ —

		Calculated.	Found (mean).
C_{20}	240	88.84	88.82
H_{14}	14	5.18	5.21
O	16	5.98	5.97 (by diff.)
	270	100.0	

which would be that of a naphthyl ether. As the body was formed by the decomposition of the β -naphthylate we name it provisionally *β -naphthyl ether*.

The alcoholic liquids obtained in the operations just described were distilled. After the alcohol had passed over the residuum commenced boiling at 290° , but quickly rose beyond the limits of the thermometer. A dark-brown viscous liquid distilled. This dissolved readily in alcohol, and the resulting solution very slowly deposited a quantity of the solid body just described. When this body had ceased separating a comparatively small quantity of a very viscous substance was obtained on distillation, containing 89.5 per cent. carbon and 5.3 per cent. hydrogen. It freely dissolved in alcohol, the solution exhibiting a blue fluorescence.

On distilling the several highest boiling point portions collected in the above operations a semi-solid distillate was obtained, which on treatment with boiling alcohol left a dark-yellow crystalline substance. This separated from benzene in square dark golden-yellow shining plates. It dissolved very slightly in alcohol, to which a mere trace imparted a powerful blue fluorescence. The quantity obtained was too small to determine its molecular formula, but a combustion showed it to be a very highly carbonaceous hydrocarbon, probably contaminated with a small quantity of an oxygenated body. For future reference we propose, from its double colour, the temporary name of *chryseudiene*.

The principal product of the decomposition by heat of β -aluminium naphthylate is β -naphthyl ether, thus:—

Aluminium- α -Naphthylate.

In order for aluminium to replace the basic hydrogen in α -naphthol the usual quantity of iodine must be employed. This difference between the α - and β -modification serves to discriminate the two naphthols.

520 grams of α -naphthylate were prepared in the manner ordinarily used for the aluminium-derivatives of the other alcohols. This compound underwent decomposition on heating, but the temperature required was much higher than in the case of the analogous β -compound. A brownish-yellow viscous liquid distilled, which solidified on cooling, and weighed 319 grams. This product was separated by distillation into two portions: *a*, which passed over below 310° , and *b*, above this temperature.

Fraction a weighed 90 grams, and mainly consisted of naphthalene.

Fraction b.—This was melted and poured into about twice its volume of boiling alcohol. A quantity of a yellow substance remained undissolved, and a little more separated on the cooling of the alcoholic liquid. These operations were repeated four times on the yellow body successively obtained. The substance was now distilled, and on cooling the distillate solidified to a yellow crystalline mass. This was crystallised some four times from benzene, in which it dissolved more readily than in alcohol. It now separated in large shining rhombic plates of the colour of uranium glass. Burnt with copper oxide—

I. 0.2694 gram gave 0.9302 gram CO_2 and 0.1342 gram H_2O .

II. 0.2816   „   0.9741   „   0.1408   „

These results expressed in parts per 100 give—

	I.	II.
C	94.17	94.34
H	5.53	5.55

On the determination of its vapour-density—

0.1026 gram gave vapour = in volume to 9.06 c.c.

0.1029   „   „   „   9.06   „

These numbers give 253.0 and 253.4 respectively for the molecular weight of the substance. Its most probable molecular formula is therefore $\text{C}_{20}\text{H}_{14}$.

		Calculated.	Found (mean).
C_{20}	240	94.43	94.26
H_{14}	14	5.57	5.54
	254	100.00	99.80

Three compounds of this formula are known, viz., $\alpha\alpha$ -, $\alpha\beta$ -, $\beta\beta$ -dinaphthyls. The substance described resembles in physical properties the $\beta\beta$ -dinaphthyl of Mr. Watson Smith. It dissolves in hot oil of vitriol, forming a light green, and subsequently a blue colour, and melts at 189° .

The residue left after distilling off the benzene from the liquids obtained in the purification of the hydrocarbon just described was boiled with alcohol, in which the greater part dissolved. On cooling a substance separated, which, after many crystallisations, formed long flat buff-coloured needles. When burnt with copper oxide it gave, as the mean of two determinations, 90.8 per cent. carbon and 5 per cent. of hydrogen. And two determinations of its vapour-density gave for mean 132.6. It would appear from these results that the substance is not a single compound. We are inclined to regard it in fact as

consisting of a $C_{20}H_{14}O$ or $C_{21}H_{14}O$ body in admixture with dinaphthyl.

The alcoholic liquids from fraction *b* were distilled. After the alcohol had passed over a brown viscous substance distilled, containing 90.38 per cent. of carbon and 5.21 per cent. of hydrogen. It dissolved readily in alcohol, the solution exhibiting a blue fluorescence.

The action of heat on the two aluminium naphthylates is seen to be very different. The β -compound splits up at a lower temperature than does the α , and yields as the principal product naphthol-ether, while it is doubtful whether an ether is formed at all in the case of the α -compound.

Though these aluminium alcohols are more or less distillisable at reduced pressures, they are alike decomposed by heat at the ordinary pressure of the atmosphere. The products of the decomposition of the series $C_nH_{2n+1}OH$, $C_nH_{2n-7}OH$, and $C_nH_{2n-15}OH$, appear, however, to be somewhat different. The first series yields the corresponding ethers, alcohols, and olefines; the second, the corresponding ethers and alcohols (with the exception of the thymolate, which suffers reduction to cresylate in the first stage of the action), together with crystalline bodies hitherto undescribed, and probably consisting of ketones. The third series gives in one case the corresponding ether and probably alcohol, together with hydrocarbons of a class differing from the olefines.