

### Biological Activity of Vitamin A Acid

In a previous communication in *Nature*<sup>1</sup>, we reported that the amount of vitamin A acid equivalent to one international unit of vitamin A (0.3  $\gamma$  pure crystalline vitamin A or 0.6  $\gamma$  pure  $\beta$ -carotene) is dependent on the method of administration. In the growth-test with A-deficient rats, using a  $\beta$ -carotene standard in oily solution (orally) for comparison, the equivalents were as follows: (1) free vitamin A acid, dissolved in peanut oil and given orally, 1 I.U. equal to 4.0  $\gamma$ ; (2) sodium salt of crystalline vitamin A acid, dissolved in buffer solution (pH 10.0) and injected subcutaneously, 1 I.U. equal to 0.6  $\gamma$ .

We have now found that the sodium salt, dissolved in buffer (pH 10.0) and given orally, is still more potent, 1 I.U. being equal to 0.3  $\gamma$ . Hence the sodium salt of vitamin A acid given orally in aqueous solution seems to be as potent as vitamin A itself given orally in oil.

The experiments were carried out with groups of 8-13 rats for each concentration of  $\beta$ -carotene and vitamin A acid.

We are now studying the question whether vitamin A acid is converted to vitamin A in the animal body, or acts as such.

Full details about the above experiments, which were carried out in collaboration with Dr. A. Menega and Mr. R. W. Spanhoff, of the Pharmacological Department here, will be published elsewhere.

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<sup>1</sup> *Nature*, 157, 190 (1946).

### Electrolytic Reduction in Liquid Ammonia

BENZENOID compounds have been reduced to dihydro-derivatives by means of sodium and alcohol in liquid ammonia<sup>1</sup>. The process has now been carried out electrolytically on *m*-tolyl methyl ether at a smooth copper cathode with a current density of 0.04 amp./sq. cm. in a saturated solution of sodium ethoxide in liquid ammonia containing 5 per cent of ethyl alcohol, the temperature being maintained at about -40° by means of a solid carbon dioxide-alcohol bath. The dihydro-*m*-tolyl methyl ether, probably the 2:5-, was identified (see ref. 1) by conversion to the 2:4-dinitrophenyl-hydrazone of 3-methyl- $\Delta^2$ -cyclohexenone, m.p. 174°, undepressed by an authentic specimen. The current efficiency of the reduction was low, but can probably be improved, and the process may be of general utility for similar reactions.

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<sup>1</sup> Birch, *J. Chem. Soc.*, 430 (1944).

### Hydrocarbon Azeotropes of Benzene

In a recent publication<sup>1</sup>, many of the binary, hydrocarbon azeotropes of benzene have been described, and it has been shown how the properties of such azeotropes may be correlated with the properties of the non-benzene component. On the basis of this correlation, the occurrence and properties of certain unknown benzene azeotropes have been predicted.

It is therefore of interest that work recently carried out in these laboratories on vapour-liquid equilibrium at atmospheric pressure enables an experimental check to be made upon the accuracy of one of these predictions, and provides further experimental evidence in one instance of conflicting published data. We have found that a minimum boiling azeotrope is formed in the system benzene - 2.2-dimethylpentane, of properties similar to those predicted, as shown in the accompanying table.

In the system benzene - 2.4-dimethylpentane there is some discrepancy between the results of Marschner and Cropper<sup>1</sup> and those of Richards and Hargreaves<sup>2</sup>, and in the accompanying table it is shown that our results are in close agreement with those of the former authors.

Marschner and Cropper<sup>1</sup> propose azeotropic distillation with benzene as a means of separating close-boiling paraffin-cycloparaffin (naphthene) mixtures. This technique, however, has already<sup>3</sup> been discovered and successfully applied in these laboratories to the separation of cyclohexane from 2.2- and 2.4-dimethylpentanes, which is the most difficult step in the recovery of pure cyclohexane from Iranian petroleum distillates.

Our vapour-liquid equilibrium data were obtained using fractionating columns equivalent to 100-theoretical plates and Othmer-type equilibrium stills<sup>4</sup>, all temperatures being recorded electrically to within 0.05° C.

Components of azeotrope	Properties of azeotrope		Reference
	b.p. at 760 mm. (° C.)	Mol. per cent benzene	
Benzene-2.2-dimethylpentane	75.7 75.85	48 52.5	Predicted values <sup>1</sup> This work
Benzene-2.4-dimethylpentane	76.7 76.6 75.3* 76.45	56.2 56.7 54.5 56.4	ref. 1 ref. 1 ref. 3 This work

\* Estimated from the literature value of 75.2° C. at 757 mm.

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Middlesex. May 24.

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<sup>1</sup> Marschner and Cropper, *Ind. Eng. Chem.*, 38, 262 (1946).

<sup>2</sup> Richards and Hargreaves, *Ind. Eng. Chem.*, 36, 805 (1944).

<sup>3</sup> Birch, Habeshaw and Collis, Brit. Prov. Patent Application 24302/44, filed Dec. 5, 1944.

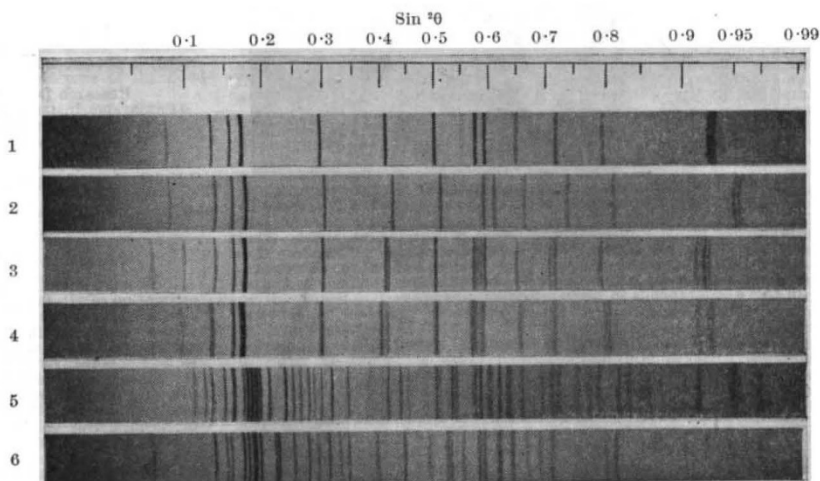
<sup>4</sup> Othmer, *Ind. Eng. Chem.*, 35, 614 (1943).

### Iron-Nitrogen, Iron-Carbon and Iron-Carbon-Nitrogen Interstitial Alloys: their Occurrence in Tempered Martensite

In a recent communication<sup>1</sup>, Heidenreich, Sturkey and Woods report that when martensitic steel is tempered at 200° C. a fine dispersion of hexagonal Fe<sub>3</sub>N is produced with no trace of cementite. Above 300° C. the reaction product is cementite; further, Fe<sub>3</sub>N formed at 200° C. is transformed to cementite by heating at 350° C. The presence of an unknown carbide is reported by Arbusow and Kurdjumov<sup>2</sup> when martensite is tempered at 130-300° C.; above 300° C. this carbide decomposes into cementite.

Investigations of the iron-nitrogen, iron-carbon and iron-carbon-nitrogen systems, carried out during the last two years for the British Iron and Steel Research Association, have provided a simple explanation for the above observations. The results, which will be given in detail elsewhere, may be summarized as follows.

**Iron-nitrogen system.** The existence of the  $\zeta$ -iron nitride phase<sup>3</sup> (N, 11.1-11.3 wt. per cent) is confirmed. It is prepared by passing anhydrous ammonia over  $\epsilon$ -iron nitrides (N, 7.3-11.0 per cent) or over pure iron at temperatures below 450° C. under such conditions that the partial pressure of hydrogen is negligible. The  $\epsilon$ -phase has a "normal" 12b6 structure and the  $\zeta$ -phase a distorted 12b6 structure<sup>4</sup>, but the arrangement of nitrogen atoms, deduced from observations of numerous faint superlattice reflexions on X-ray powder photographs, is different in each of these phases. In the  $\epsilon$ -phase, when the composition corresponds to Fe<sub>3</sub>N, one third of the octahedral interstices in the iron atom lattice are occupied by nitrogen atoms in such a way that each nitrogen atom has the nearest six interstices surrounding it in its own layer plane unoccupied, and interstices directly above it in the next two planes also unoccupied. As the nitrogen concentration increases, the additional nitrogen atoms occupy empty interstices in



1.  $\epsilon$ -Iron nitride. N, 32.1 atomic per cent
2.  $\epsilon$ -Iron carbonitride. C, 15.7; N, 13.0 atomic per cent
3.  $\zeta$ -Iron nitride. N, 33.7 atomic per cent
4.  $\zeta$ -Iron carbonitride. C, 23.8; N, 10.8 atomic per cent
5. Iron percarbide. C, 32.1 atomic per cent
6. Cementite (Fe<sub>3</sub>C), small amount of graphitic carbon