

*Zoneless polar edge :*

$$(33)_{am.gr}^2 410 = 2.$$

*Zonal non-polar edges :*

$$(33)_{zo} 410 = 8, \quad Z = \{4, 2, 0, 0^3\};$$

$$(33)_{zo} 410 = 1, \quad Z = \{2, 2, 0, 0\};$$

$$(33)_{zo} 410 = 5, \quad Z = \{4, 4, 0^2, 0^2\};$$

$$(33)_{zo} 410 = 2, \quad Z = \{4, \dots, 0^4\};$$

$$(33)_{zo} 410 = 2, \quad Z = \{6, 2, 0, 0^5\}.$$

*Objanal zonal edge :*

$$(33)_{zo.ob} 410 = 1, \quad Z = \{2.2, 2.2, 0^{2.1}, 0^{2.1}\},$$

which is also above entered as zonal.

*Epizonal edges :*

$$(33)_{ep} 410 = 3, \quad Z = \{4, 2, 0, 0^3\};$$

$$(33)_{ep} 410 = 1, \quad Z = \{2, 2, 0, 0\};$$

$$(33)_{ep} 410 = 3, \quad Z = \{4, 4, 0^2, 0^2\};$$

$$(33)_{ep} 410 = 1, \quad Z = \{2, 4, 0^2\}.$$

*Asymmetric edge :*

$$(33)_{as} 410 = 83.$$

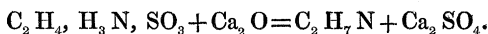
I may be permitted to remark here that these results were in my possession early in 1858, when the prize question of the French Academy was published for the competition of 1861 : "*Perfectionner en quelque point important la théorie géométrique des polyèdres.*" My work on this theory was first completely composed in the French language, in its present form, with the intention of presenting it to the Academy in 1861. Any person, who cares to know the reasons why I altered its destination, may read them at page 352 of the 'Memoirs of the Literary and Philosophical Society of Manchester,' 3rd series, vol. i. 1862, beginning at the second line *ab infra*.

## II. "Contributions towards the History of the Monamines.—

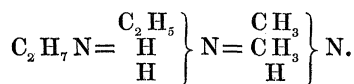
No. VI. Note on the Action of Iodide of Methyl on Ammonia." By A. W. HOFMANN, LL.D., F.R.S. Received December 2, 1862.

When studying, many years ago, the action of iodide of methyl upon ammonia, I pointed out the existence of dimethylamine among the products of the reaction. The amount of iodide of dimethylam-

monium is very small when compared with the quantities of the iodides of methyl, trimethyl, and more especially of tetramethylammonium, not to speak of iodide of ammonium itself, so that I was compelled to be satisfied with approximative platinum determinations in order to establish the formation of dimethylamine under these circumstances. Having lately had to prepare a specimen of the dimethylated ammonia, and remembering the small quantity which is formed by means of iodide of methyl, I resolved to avail myself of an observation made in the mean time, according to which dimethylamine is formed by the action of soda-lime upon the sulphite of aldehyde ammonia,



According to M. Gossmann\*, this reaction furnishes ethylamine, and indeed in such quantities as to render this process a convenient mode of preparing the substance. Re-examined subsequently by M. Petersen†, the ethylamine of M. Gossmann proved to be dimethylamine, which is isomeric with the former,



Nor does M. Petersen appear to share the enthusiasm of his predecessor for the facility and elegance of this reaction. Indeed, a glance at the analysis published by this chemist is sufficient to show how small a quantity of the base produced by this process must have been obtained.

In repeating this experiment, I have indeed obtained a minute quantity of an inflammable ammonia; but, though varying the process, and working on a tolerably large scale, I was unable to procure a sufficient amount for a single analysis.

Under these circumstances I was compelled to return to the reaction by which I had originally obtained dimethylamine, viz. by the action of iodide of methyl upon ammonia.

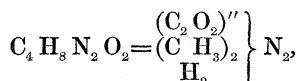
By availing myself of the method of separating the ethyl-bases, which some time ago I submitted to the Royal Society‡, I succeeded

\* Ann. Chem. Pharm. vol. xc. p. 122.

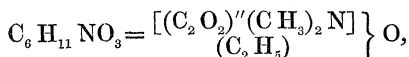
† Ibid. vol. cii. p. 317.

‡ Proceedings of the Royal Society, vol. xi. p. 66.

without difficulty in separating the dimethylamine from the mixture of ammonias which this reaction produces. An alcoholic solution of ammonia, gently heated with iodide of methyl in a flask provided with a condenser, rapidly solidifies into a crystalline mixture of the iodides of ammonium, methyl-, dimethyl-, trimethyl-, and tetramethylammonium. The more soluble iodides separated from the difficultly soluble iodide of tetramethylammonium are evaporated and distilled with potash, and the bases evolved carefully dried by passing over hydrate of potassium, and conveyed through a powerfully refrigerated serpentine in which dimethylamine and trimethylamine, together with a portion of methylamine, are condensed, the ammonia and the remainder of the methylamine being carried off as gas and condensed in water. The mixture of the three methylated bases is then brought in contact with oxalate of ethyl, when the methylamine immediately solidifies into a crystalline mass of dimethyloxamide,



the dimethylamine being converted into dimethyloxamate of ethyl,



a liquid boiling between  $250^\circ$  and  $260^\circ$ , while the trimethylamine remaining unchanged may be expelled from the mixture by gently heating in the water-bath. Dimethyloxamate of ethyl being easily soluble in water, is separated from the dimethyloxamide by treatment of the mixture with cold water. Distilled with hydrate of potash, dimethyloxamate of ethyl yields a mixture of alcohol and dimethylamine, oxalate of potassium remaining behind. Evaporated with hydrochloric acid, the distillate furnishes a crystallized residue of chloride of dimethylammonium, from which, on addition of an alkali, the pure dimethylamine is liberated.

Dimethylamine is a powerfully alkaline liquid of a strongly ammoniacal odour, easily soluble in water, and possessing the general characters of this class of compounds. Its boiling-point, strange to say, very nearly coincides with that of trimethylamine,—the boiling-point of the former being between  $8^\circ$  and  $9^\circ$ , that of the latter  $9^\circ$ . To eliminate the influence of changes of pressure, the boiling-points of the two substances were determined at the same time.

I have fixed the composition of dimethylamine by the analysis of the platinum-salt and gold-salt. The former is one of the finest salts which I have ever examined, crystallizing in long splendid needles, shooting through the liquid from one side of the vessel to the other. It contains



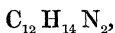
The gold-salt, which likewise crystallizes very well, has an analogous composition, viz.



If the products obtained by distilling the sulphite of aldehyde-ammonia with lime had contained the minutest trace of dimethylamine, the formation of the beautiful characteristic platinum-salt would have revealed it. In none of the experiments did I observe the formation of this compound.

III. "Contributions towards the History of the Monamines.—  
No. VII. Transformation of Aniline into Benzoic Acid."  
By A. W. HOFMANN, LL.D., F.R.S. Received December  
3, 1862.

In a Note recently addressed to the Royal Society, I have described a new organic base which is formed of a secondary product in the manufacture of aniline upon a large scale. This substance, paraniline,



is isomeric with aniline, and owes its origin evidently to the action of heat, under circumstances not yet precisely determined, upon that body. I have not yet succeeded in producing this compound from aniline, but the experiments made with the view of accomplishing this transformation have led me to an observation which I beg leave to mention briefly to the Royal Society. The vapour of aniline, when passed through a red-hot glass tube, undergoes decomposition; the tube becomes coated with a film of carbon, a brown liquid collects in the receiver, and a colourless gas burning with a luminous flame is evolved; if this be allowed to pass through water, the latter becomes charged with a considerable amount of cyanide of ammonium.