Examination with high powers showed, however, that the line remained rigorously single when the sodium lines would be widely separated. On throwing sodium light into the spectro-scope simultaneously with that from the new gas, the spectrum of the latter was seen to consist almost entirely of a bright yellow line, a little to the more refrangible side of the sodium lines, and separated from them by a space a little wider than twice that separating the two sodium components from one another. It appeared as bright and as sharp as D_1 and D_2 . Careful measurements gave its wave-length 587.45; the wave-lengths of the sodium lines being D_1 589.51, and D_2 588.91. The differences are therefore—

	Wave-lengths.	Differences.
D_1	589.51	
D_2	588.91	0.60
New line	587.45	1.46

The spectrum of the gas is, therefore, that of the hypothetical element Helium, or D_3 , the wave-length of which is given by Ångström as 587.49, and by Cornu as 587.46.

Besides the Helium line, traces of the more prominent lines of argon were seen.

Comparing the visible spectrum of the new gas with the band and line spectrum of nitrogen, they are almost identical at the red and blue end, but there is a broad space in the green where they differ entirely. The Helium tube shows lines in the following positions:—

	Wave-length.	
(a) D_3 , yellow	587.45	Very strong. Sharp.
(b) Yellowish green ...	568.05	Faint. Sharp.
(c) Yellowish green ...	566.41	Very faint. Sharp.
(d) Green	516.12	Faint. Sharp.
(e) Greenish blue ...	500.81	Faint. Sharp.
(f) Blue	480.63	Faint. Sharp.

I have taken photographs of the spectrum given by the Helium tube. At first glance the ultra-violet part of the spectrum looks like the band spectrum of nitrogen, but closer examination shows considerable differences. Some of the lines and bands in the nitrogen spectrum are absent in that from the Helium tube, whilst there are many fine lines in the latter which are absent in nitrogen. Accurate measurements of these lines are being taken.

ISOLATION OF FREE HYDRAZINE, N_2H_4 .

M. LOBRY DE BRUYN contributes a memoir of special interest to the current issue of the *Recueil des Travaux Chimiques des Pays-Bas*. It is not long since the distinguished Amsterdam chemist succeeded in preparing for the first time free anhydrous hydroxylamine, and now he announces that he has likewise been successful in isolating free hydrazine by a similar method. Eight years ago the important discovery of hydrazine was made by Prof. Curtius, and since that time the amount of knowledge which has been accumulated concerning the base and its compounds by Prof. Curtius and his assistants is so large that a separate volume might well be devoted to it. Nevertheless, the free anhydrous base itself has not hitherto been satisfactorily prepared; indeed it would now appear, in the light of M. de Bruyn's remarkable work, that it has not hitherto been in any way isolated. The hydrate of the base has been obtained in the pure state and fully described by Prof. Curtius, but in his later communications he has expressed the view that the free base is so unstable that most probably it is incapable of separate existence. The hydrate only is produced when the salts are decomposed by a caustic alkali, and even digestion in a sealed tube at 170° with anhydrous baryta, has failed to detach the water molecule from its combination with hydrazine. It appeared, however, to M. de Bruyn that the nature of the salts and other compounds of hydrazine rendered it scarcely probable that the base was less stable than hydroxylamine, and he considered it not unreasonable to hope that it might therefore be isolated in an analogous manner to the latter base, namely, by reacting upon the chloride with sodium methylate in methyl alcohol solution. The experiments made in this direction are only preliminary, but their result is so interesting that an account of them is at once published.

The salt employed was the chloride $N_2H_4 \cdot HCl$, prepared as described by Prof. Curtius. Ten grams of this salt in powder were added to 200 c.c. of pure methyl alcohol, and a solution of the calculated quantity of sodium methylate CH_3ONa in methyl alcohol were subsequently added. Common salt was immediately precipitated without any perceptible rise of temperature. The mixture was consequently boiled for half an hour in a flask fitted with an upright condenser. After cooling the sodium chloride was removed by filtration, and the solution submitted to distillation. At first mainly methyl alcohol passed over, but after a time the distillate began to contain augmenting quantities of hydrazine; the pressure was then reduced, and four further quantities separately collected. The temperature of ebullition rose to 55° , although the pressure was materially reduced. The last 20 c.c. contained the greater portion of the base. This last fraction was then again distilled at the ordinary pressure, until a residue was left which contained 73 per cent. of hydrazine. The hydrate of hydrazine only contains 64 per cent. of the base, hence it was evident that some free hydrazine had been obtained, and that hydrazine is a comparatively stable substance boiling at a temperature higher than that of methyl alcohol.

In a second experiment 42 grams of chloride of hydrazine were treated in a similar manner with methyl alcohol and sodium methylate. This larger quantity evinced some rise of temperature after the admixture, and the heat caused by the reaction of the hydrazine chloride, which at first had not all dissolved, was just sufficient to keep the liquid boiling for several minutes, when once it had been brought to the boiling point by extraneous heating. After the conclusion of the reaction the contents were cooled, avoiding the access of moisture and carbon dioxide, the sodium chloride filtered off as before, and distillation proceeded with, at first in an ordinary distillation apparatus and afterwards with the aid of a Le Bel-Henninger apparatus. A residual 40 c.c. was again fractionated under reduced pressure and six portions collected. The sixth fraction contained no less than 82.6 per cent. of N_2H_4 . A smaller quantity passing over after removing the sixth fraction contained over 84 per cent. The fifth and sixth portions solidified when cooled by a freezing mixture of ice and salt. The crystals melted about 4° . Although the crystals when exposed to the air exhaled dense white fumes, owing to the attraction of moisture, a number of them were quickly pressed between cooled blotting paper, weighed, and volumetrically analysed. The analytical numbers corresponded to 92 per cent. of N_2H_4 , a result which, considering the extremely hygroscopic nature of the crystals, would appear to indicate that they consisted of practically pure N_2H_4 . The dried crystals melted at -1° to -2° .

A drop of the liquid obtained by fusion of the crystals did not explode when heated with a naked flame; a yellow flame was produced, however, accompanied by a hissing noise. The liquid base is heavier than water and considerable heat is evolved upon mixing it with a small quantity of the latter liquid. Dry oxygen slowly oxidises it. When paper is moistened with a drop of hydrazine and exposed to the air, it becomes hot spontaneously and fumes strongly. Crystals of sulphur dissolve promptly in the liquid base with considerable rise of temperature and formation of a reddish-brown liquid whose odour reminds one of ammonium sulphide; upon the addition of water to this liquid, sulphur is precipitated. The halogens react very violently with hydrazine, producing their acids, and liberating nitrogen. Iodine disappears instantly, and a quantitative experiment showed that the reaction proceeded in accordance with the equation $N_2H_4 + 2I_2 = N_2 + 4HI$. Potassium permanganate or bichromate act with great violence upon the liquid base, but the reaction is unaccompanied by either incandescence or explosion. The liquid appears to possess the further property of readily dissolving many salts, such as the potassium salts of the halogen acids, and nitre.

It would thus appear that, instead of being a gas, as at first supposed by Prof. Curtius, free hydrazine is at the ordinary temperature a liquid, which, however, solidifies at a temperature in the neighbourhood of that of the freezing-point of water, to colourless crystals. The base is, moreover, endowed with a very much higher degree of stability than was supposed. M. de Bruyn is now engaged in preparing it upon a very much larger scale, in order more completely to study its properties.

A. E. TUTTON.