—even better without, perhaps. The next alternative is between isolated vascular bundles, and vascular bundles in a cylinder, connected with other characters, entailing previous teaching and study, which should largely consist of acquiring a knowledge of natural orders. Nevertheless this book may prove useful, especially to the collector desirous of determining the natural orders of his plants in the field or at home. So far as we have tested it, it is carefully compiled and edited, and we can conscientiously recommend it to those who know the characters of many natural orders in advance.

W. B. H.

LETTERS TO THE EDITOR.

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Attempt to Liquefy Helium.

I HAVE received a letter from Prof. Olszewski, of Krakau, in which he informs me that having exposed a sample of helium which I sent him to the same treatment as was successful in liquefying hydrogen—namely, compressing with a pressure of 140 atmospheres, cooling to the temperature of air boiling at low pressure, and then expanding suddenly—he has been unable to detect any sign of liquefaction.

The density of helium being, roughly speaking, twice that of hydrogen, it is very striking that its liquefying point should lie below that of hydrogen. It may be remembered that argon, which has a higher density than oxygen, liquefies at a lower temperature than oxygen; and it was pointed out by Prof. Olszewski that this behaviour was not improbably connected with its apparently simple molecular constitution. The similar fact now recorded for helium may therefore be regarded as evidence of its simple molecular constitution. I use the word "its" instead of "their," although further research may corroborate Prof. Runge's contention that what is termed helium may in reality be a mixture of two, if not more than two elements. If this contention is true, both, or all, must have extraordinarily low boiling-points.

WILLIAM RAMSAY.

September 23.

Helium and the Spectrum of Nova Aurigæ.

IN the paper on the constituents of the gas in cleveite that we read before the British Association, we said that in the first spectrum of Nova Aurigæ the principal lines 5016 and 4922 of the lighter constituent were far more intense than those of the other constituent. But we were puzzled at the line 6678 not having been observed, as it is also a strong line in the spectrum of the lighter constituent. On inquiry, Dr. and Mrs. Huggins were kind enough to give us better information. Dr. Huggins writes: "I think there is no doubt that we did see the red line at 6678 in Nova Aurigæ. We were unable to measure in that part of the spectrum, but on three nights we saw a bright line a little below C. This was a pure estimation under difficult circumstances. In the map we put the line, as a mere guess, at a little over 6700. On the first night we put the line in a rough diagram, made at the time, a little nearer C, almost exactly at 6678. On a subsequent night, we made the estimation a little below 6700, but the line was not then so bright."

London, September 27. C. RUNGE AND F. PASCHEN.

Latent Vitality in Seeds.

THERE is no doubt, as M. Casimir de Candolle has recently shown in his paper on latent life in seeds, that all the functions of seeds can remain completely quiescent for a long period; probably in some cases this period may be indefinitely long. In 1878 I published a paper¹ on the resistance of seeds,

¹ Italo Giglioli. "Resistenza di alcuni semi all'azione prolungata di agenti chimici, gassosi e liquidi," *Gazzetta Chimica italiana*, ix., 1879, p. 199; and *Giorn. delle staz. sper. ital.* viii., 1879, p. 199.

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especially of *Medicago sativa*, or lucerne, to the action of gaseous and liquid chemical reagents. An abstract of my experiments was published in NATURE, vol. xxv., 1882, p. 328.

Recently I have examined portions of the seeds used in the experiments of 1877 and 1878, to see if after the lapse of so many years, during which the seeds have remained constantly surrounded by special gases, or immersed in different solutions, they had retained their vitality. The results have been remarkable, for in some cases a large proportion of the seeds have maintained their vitality after a lapse of 15, 16, and nearly 17 years of special external chemical conditions. I summarise the results of some of my experiments.

(a) Experiments in Gases.

In all these experiments the gases were *dry*, for in these conditions moisture is rapidly fatal to the seeds. The seeds were introduced into small bulbed tubes, into which the dry gas was made to pass for some time, after which the tubes were rapidly sealed at a spirit-lamp flame. The tubes were then kept in the dark.

In the following summary I give the dates of the sealing and opening of the tubes:—

Hydrogen.—Lucerne seeds, from September 15, 1877, to August 5, 1894, a period of 16 years, 10 months, and 20 days. Out of 51 seeds sown, none germinated. Seeds of wheat, vetch, *Cynara cardunculus* and coriander, kept in hydrogen, gave the same negative results. There is some suspicion that the hydrogen had not been originally well dried.

Oxygen.—Lucerne, from May 19, 1878, to August 4, 1894, 16 years, 2 months, and 15 days. Out of 293 seeds sown, 2 germinated, or 0.68 per cent. The seeds were not thoroughly dry.

Nitrogen.—Lucerne, from April 12, 1878, to August 21, 1894, 16 years, 3 months, and 22 days. Out of 320 seeds, 181 germinated, or 56.56 per cent.

Chlorine and Hydrochloric Acid Gas.—Lucerne, from April 28, 1878, to August 3, 1894, 16 years, 3 months, and 5 days. Out of 342 seeds, 23 germinated, or 6.72 per cent. Originally these seeds had been put into pure chlorine; but the gas had acted on the seeds, carbonising a portion of them, so that at the end of the experiment the seeds were in an atmosphere composed chiefly of hydrochloric acid gas, mixed with carbon dioxide.

In a second experiment with lucerne seed, kept in chlorine, and then hydrochloric acid, during the same period, out of 167 sown, 10 germinated, or 5.98 per cent. In this experiment the tube was carefully opened *in vacuo*, to protect the seeds from the moisture condensed by the hydrochloric acid gas at the moment when it is brought into contact with common air.

Sulphuretted Hydrogen.—From October 14, 1877, to August 5, 1894, 16 years, 9 months, and 22 days. After the opening of the tube, filled with the strongly smelling gas, the seeds were left in contact with the air for 24 hours, before sowing them in the moist sand of the germinator. Out of 101 lucerne seeds, one germinated, or 0.99 per cent. Out of 50 seeds of wheat, none germinated.

Arseniuretted Hydrogen.—From April 4, 1878, to August 4, 1894, 16 years and 4 months. On opening the tube the garlic smell of AsH₃ was strongly evident. Out of 255 lucerne seeds sown, 181 germinated, or 70.98 per cent. In a second experiment with seeds kept in arseniuretted hydrogen, out of 247 lucerne seeds 170 germinated, or 68.82 per cent.

Carbon Monoxide.—From April 3, 1878, to August 4, 1894, or 16 years and 4 months. Out of 266 lucerne seeds, 224 germinated, or 84.2 per cent.

Carbon Dioxide.—From September 8, 1877, to August 5, 1894, or 16 years, 11 months, and 27 days. The same tube contained seeds of lucerne, wheat, vetch, *Cynara*, and coriander. None germinated. Perhaps the large number of seeds contained in a relatively small tube rendered the carbon dioxide damp, and therefore noxious.

Nitric Oxide.—From May 2, 1878, to August 4, 1894, or 16 years, 3 months, and 2 days. On opening the tube, abundant red fumes were produced by contact with air. Before sowing, the seeds were left dry for 24 hours. Some of the seeds were brownish, the rest retained their natural colour. Out of 309 lucerne seeds, 3 germinated, or 0.97 per cent. In a second experiment, the tube containing the lucerne seeds was opened *in vacuo*: out of 320 seeds, 2 germinated, or 0.62 per cent.