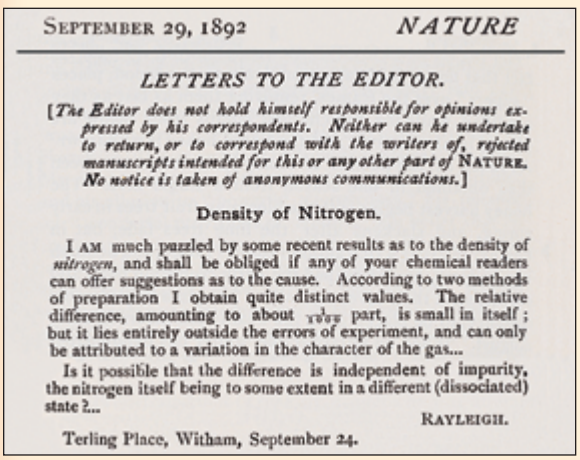
The Noble Decade

By the late nineteenth century, the science of chemistry had begun to be organized. In 1860, the First International Congress of Chemistry established the field's first standards. And Dmitri Mendeleev's periodic table of elements gave chemists across the globe a systematic understanding of matter's building blocks. But many important findings—including the discovery of a family of rare, unreactive gases that were unlike any substances known at the time—were yet to come.

Cross-Disciplinary Correspondence

In 1888, the British physicist Lord Rayleigh encountered a small but significant discrepancy in the results of one of his experiments. In an effort to redetermine the atomic mass of nitrogen, he measured the densities of several samples of nitrogen gas. Each sample had been prepared by a different method. All samples that had been isolated from chemical reactions exhibited similar densities. But they were about one-tenth of a percent less dense than the nitrogen isolated from air, which at the time was believed to be a mixture of nitrogen, oxygen, water vapor, and carbon dioxide.

This excerpt from Lord Rayleigh's letter was originally published in Nature *magazine in 1892.*▼



SEPTEMBER 29, 1892 NATURE

LETTERS TO THE EDITOR.

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Density of Nitrogen.

I AM much puzzled by some recent results as to the density of *nitrogen*, and shall be obliged if any of your chemical readers can offer suggestions as to the cause. According to two methods of preparation I obtain quite distinct values. The relative difference, amounting to about $\frac{1}{100}$ part, is small in itself; but it lies entirely outside the errors of experiment, and can only be attributed to a variation in the character of the gas...

Is it possible that the difference is independent of impurity, the nitrogen itself being to some extent in a different (dissociated) state?...

RAYLEIGH.

Terling Place, Witham, September 24.

Rayleigh was at a loss to explain his discovery. Finally, in 1892, he published a letter in *Nature* magazine to appeal to his colleagues for an explanation. A month later, he received a reply from a Scottish chemist named William Ramsay. Ramsay related that he too had been stumped by the density difference between chemical and atmospheric nitrogen. Rayleigh decided to report his findings to the Royal Society.

A Chemist's Approach

With Rayleigh's permission, Ramsay attempted to remove all known components from a sample of air and to analyze what, if anything, remained. Having removed water vapor, carbon dioxide, and oxygen from the air, Ramsay repeatedly passed the sample over hot magnesium. The nitrogen reacted with the magnesium to form solid magnesium nitride. As a result, all of the then-known components of air were removed. What remained was a minuscule portion of a mysterious gas.

Ramsay tried to cause the gas to react with chemically active substances, such as hydrogen, sodium, and caustic soda, but the gas remained unaltered. He decided to name this new atmospheric component *argon* (Greek for "inert" or "idle").

Periodic Problems

Rayleigh and Ramsay were sure that they had discovered a new element. But this created a problem. Their calculations indicated that argon had an atomic mass of about 40. However, as it appeared in 1894, the periodic table had no space for such an element. The elements with atomic masses closest to that of argon were chlorine and potassium. Unfortunately, the chemical properties of the families of each of these elements were completely dissimilar to those of the strange gas.

Ramsay contemplated argon's lack of reactivity. He knew that Mendeleev had created the periodic table on the basis of valence, or the number of atomic partners an element bonds with in forming a compound. Because Ramsay could not cause argon to form any compounds, he assigned it a valence of zero. And because the valence of the elements in