with both of them.

While these experiments may mean that dystrophin is associated with the triads, it is not clear what form that association might take. For those with a morphologist's eye, a picture may be worth a thousand gels, and localization at the level of the electron microscope is eagerly awaited. Unfortunately, the very low abundance of dystrophin is likely to make this difficult unless it is highly concentrated at discrete sites.

The triads mediate a rapid increase in the intracellular level of free calcium. Because several lytic enzymes within cells are activated by calcium, it has been suggested[8,9] that necrosis of muscle fibres results from an uncontrolled rise of calcium concentration within the cell. Although Hoffman *et al.* speculate[2] that the absence of dystrophin may somehow disrupt calcium homoeostatis and cause the activation of proteases and phospholipases, much work needs to be done before the details of this process are elucidated. If the absence of dystrophin is the primary cause of muscle-fibre degeneration in DMD, learning why this is so, however challenging, should tell us much about how the internal environment of muscle fibres is regulated. Understanding why the lack of dystrophin has such different effects on boys and mice may ultimately suggest ways of treating the many boys still dying from DMD. ☐

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History of science

H. Moseley and the Nobel prize

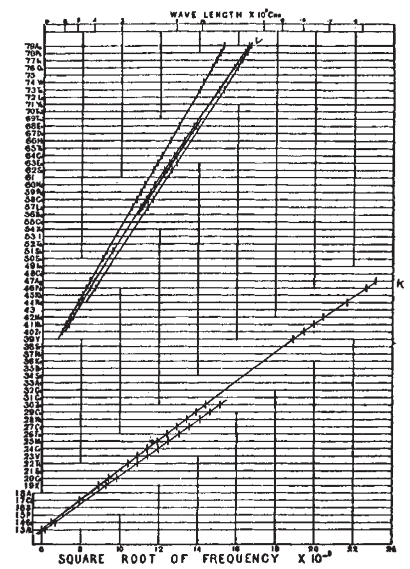
J.L. Heilbron

HENRY MOSELEY, born 100 years ago on 23 November 1887, established in 1913 the doctrine of atomic number by measurements on the characteristic X-ray spectra of the elements. Like many of his age and class (he came from a well-off academic family), he rushed to enlist at the outbreak of the First World War. Despite appeals from teachers and colleagues that he would be more useful at home, Moseley forced himself into the army engineers. His death in combat in Gallipoli, on 10 August 1915, was noticed on both sides; "*ein schwerer Verlust für die Naturwissenschaften*", "a matter of great regret", "*une mort glorieuse*" (see my book, *H.G.J. Moseley, The Life and Letters of an English Physicist*, Univ. California Press, 1974). This journal carried an obituary by his professor, Ernest Rutherford, who took the opportunity to berate the War Office for so "striking [an] example of the misuse of scientific talent".

In 1912, M. von Laue and collaborators showed that crystals can diffract X-rays, and W.L. and W.H. Bragg demonstrated interference between X-rays reflected from a crystal. The following year, in Rutherford's laboratory in Manchester, Moseley perfected the Braggs' technique with C.G. Darwin and adapted it to measurements of the high-frequency line spectra emitted by atoms exposed to the broadband X-rays from a discharge tube. These spectra, like optical spectra, are characteristic for each atomic element, but in contrast can be expressed mathematically fairly simply. Thus, the frequency of the most intense lines (the K lines) is roughly proportional to $(Z-1)^2$, where Z is the atomic number of the element. Moseley confirmed this for 10 metals from calcium to zinc. He later showed the similar relation for L X-rays for much of the periodic table while at Oxford (see graph). Where no known element fit the formula, he inferred that chemists had missed an opportunity. His method not only demonstrated the fundamental importance of the idea of atomic number, but also reliably revealed where elements remained to be discovered.

Had Moseley lived, he would probably soon have received the Nobel prize for physics or chemistry. He was nominated for both in 1915 by Svante Arrhenius, the most influential member of the committee on the Nobel physics prize of the Royal Swedish Academy of Sciences. The physics prize for 1914 had been reserved; in 1915 the Academy decided to give no propaganda advantage to either warring camp by awarding that year's prize to the Braggs and the reserved one from 1914 to von Laue. No such solution was available in 1916, when nominees for the physics prize included several future winners from belligerent nations (Einstein, Perrin, Planck and Stark). The Academy again reserved the prizes in 1917 despite the renewed candidacy of Einstein, Planck and Stark in physics and Nernst in chemistry. The reservation became permanent in chemistry, but not so in physics. In 1918 the physics prize for 1917 was awarded to C.G. Barkla "for his discovery of the characteristic Röntgen radiation of the elements".

Henry Moseley — a wasted talent.



A Moseley diagram showing the relationship between X-ray frequency and atomic number (from Phil. Mag. *27, 703; 1914).*

Barkla was the *locum tenens* for Moseley. Barkla received only one nomination, from Rutherford, who argued that the discovery of characteristic X-rays was second in importance only to the discovery of their diffraction, which the Academy had already rewarded. Futhermore, as Rutherford observed, Barkla had inferred from his measurements important information about the number of electrons in an atom. The judges in Stockholm were thus invited to conclude that Barkla had made some progress toward the idea of atomic number using the same sort of X-rays Moseley was to use. In deciding to adopt Rutherford's suggestion, Arrhenius's committee considered that the value of Barkla's work, then a decade or more old, had been newly demonstrated by recent work — that is, by Moseley's work — in X-ray spectroscopy. It is difficult to resist the inference that, had it not been for the war, Moseley would have received, perhaps jointly with Barkla, the Nobel prize in physics for 1917. ☐

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