

But we are not yet done with transmutation and the Philosopher's Stone. The idea of an underlying unity,—a primal matter has never been lost sight of. The relative weights of the atoms as deduced from the proportions in which the elements combine, are many of them whole multiples of that of hydrogen, the smallest. This led to Prout's suggestion that the atoms of the elements were originally formed by the union of congeries of hydrogen atoms. But the exact investigations of Stars show that the whole-multiple relation is absent from the atomic weights of many of the elements. On the other hand Lockyer has pointed out that the hottest of the fixed stars (temperatures being judged by the character of their light) show chiefly the hydrogen spectrum, the spectra of other elements showing more clearly in stars of lower temperatures. But the predominant presence of helium, an element of atomic weight $=4$, in stars considered to be the hottest of all, seems to render Lockyer's position untenable. At present, however, we must conclude that the balance of evidence is in favour of the unity of matter and therefore of the transmutability of the elements. Dalton insisted "you cannot split an atom." Modern investigators believe that they have split atoms into a million fragments.

This leads us to the last division of our subject. In 1895 Roentgen, in the preliminary to his memorable X-ray investigation noticed that the light from a phosphorescent substance had a photographic effect even when the sensitive plate was covered with black paper, etc. A year later Becquerel obtained photographic effects from uranium compounds *even when these gave off no light; and the effect was continuous*. That is, the uranium compounds did not, like phosphorescent substances, require to be exposed to light in order to excite their activity. They had a *source of radiant energy within themselves*, not exhausted when the uranium compounds are kept in the dark for years. On July 18th, 1898, M. and Mme. Curie announced in Paris that they had isolated from the mineral source of the *uranium* compounds a new element, which they named *polonium*, and which had the photographic effect, or rather the accompanying power of rendering air a conductor of electricity. In January, 1899, they announced the discovery of another new element from the same source, and this they named *radium*. A third was later added by Debierne, and called *actinium*. These with *thorium* constitute the group of *radio active* elements. In announcing their discovery of radium the Curies stated:—

"On photographic plates we obtain good impressions with radium and polonium in half a minute; it requires several hours to obtain the same results with uranium and thorium. The radiations from radium and polonium cause a screen of barium platino-cyanide to emit a fluorescent light just as the Rontgen rays do. We thus have a continuous source of light without any source of energy other than the substance itself."

It soon developed that these wonderful substances, particularly radium, the most powerful of them, were storehouses of astonishing quantities of available energy. A thermometer placed near a solution of radium bromide