Identification of a Missing Element.

IN two recent communications to the Paris Academy of Sciences (*Comptes rendus*, May 22), by M. A. Dauvillier and Prof. G. Urbain respectively, very definite conclusions have been reached as to the identity of celtium with the missing element of number 72 on the Moseley classification. This discovery is of special interest to British workers, since Moseley's last work dealt with this particular problem. Prof. Urbain adds a statement on the unpublished work of Moseley on the X-ray spectra of his preparations of the rare earths. In his paper M. Dauvillier announces the discovery of certain lines in the L X-ray spectrum of celtium which show that its atomic number is 72. An improved De Broglie photographic spectrometer was used, and the oxides of lutecium and ytterbium in a preparation of Urbain's were attached to the anti-cathode. The tube was run at a potential of 40 k.v., and nearly complete L-spectra of lutecium and ytterbium were obtained. In addition three lines of thulium were found and two feeble lines which were identified as the α_1 and β_2 radiations of celtium. These lines ($\alpha_1 = 1{\cdot}5618$ Å ; $\beta_2 = 1{\cdot}3194$ Å) fall in the correct places for the element of atomic number 72, between the corresponding lines of lutecium and ytterbium. The β_1 and γ_1 lines of celtium which might have been expected are coincident with the β'_2 and γ_3 lines of lutecium. Reasons are given why these lines of celtium cannot be due to any impurities, such as other rare earths.

The following is a translation of Prof. Urbain's paper in the *Comptes rendus*:

THE ATOMIC NUMBERS OF YTTERBIUM, LUTECIUM, AND CELTIUM.

"The results of M. Dauvillier's examination of my preparations containing celtium have a theoretical importance obvious to all who have followed recent scientific developments with regard to the chemical elements and their atomic structure.

"It is now unquestionable that the element of atomic number 72 is actually celtium. The atomic weight of celtium must therefore lie between 175 (lutecium) and 181·5 (tantalum). Characterised by two sets of spectral lines (arc and X-ray) and by the order of magnitude of its atomic weight, celtium has conclusively won its place among the chemical elements.

"Thus the problem of the constituent elements of Marignac's 'ytterbium' has been solved. The method of X-ray analysis is the most significant, and probably the crucial, test of a chemical element, and this method has confirmed the work I have done over a period of more than ten years on 'ytterbium,' using more difficult and probably less conclusive methods. Though I only succeeded in obtaining a partial separation, this was sufficient to permit the high-frequency spectra method to assign its atomic number to each of the constituents I discovered, namely, (neo-) ytterbium 70, lutecium 71, celtium 72.

"Now that these results are clear, I wish to outline a part of the history of these elements that has not yet become known to the scientific public. When I originally announced the discovery of celtium, Moseley's law of the atomic numbers was still unknown. After this law had been found it seemed evident that it should be possible to define the three elements of the ytterbium group by their X-ray spectra. Moseley himself put forward the hypothesis that celtium and the element with atomic number 72 were one and the same. On the other hand, Moseley, relying on the evidence of Auer von Welsbach, in his first lists of the elements had included two thuliums, while my experiments only permitted the existence of one.

"In order to settle this question, in June 1914 Ramsay and I visited Prof. Townsend's laboratory at Oxford, where Moseley was working. Our intention was to examine the different products of my separation of ytterbium by this young investigator's method, then unique.

"We found one thulium of atomic number 69, one ytterbium of atomic number 70, and one lutecium of atomic number 71. The spectra which Moseley obtained included only a few lines, and we could not find any corresponding to the element of atomic number 72. The first of these results was announced several years ago, but as the result of the researches of others. No claim of priority was possible, since Moseley himself was responsible for the publication of these results, and for this purpose had kept the necessary documents. But the war broke out before he had time to write his paper. He was among the first to enlist, and by great misfortune was killed at the Dardanelles.

"Sir Ernest Rutherford, who prepared the obituary notice of his pupil, wrote to me about these last researches of Moseley's, at which I had assisted. In the absence of precise data I thought I must forgo the publication of results that would rest on my memory alone.

"M. Dauvillier's discoveries complete the early results obtained at Oxford. They show that the negative result given by Moseley's method in the case of celtium was due only to the insensitiveness of the method, since the preparation examined by M. Dauvillier is the same as that used in Moseley's own X-ray tube."

Now that the missing element of number 72 has been identified, there remain only three vacant places of ordinal numbers—43, 61, 75—between hydrogen and bismuth in the Moseley classification of the elements. With the rapidly increasing perfection of technique of X-ray spectra and the use of powerful installations, it is to be anticipated that the missing elements should soon be identified if they exist in the earth. The law of the X-ray spectra, as found by Moseley, is an infallible guide in fixing the number of an element, even if present in only small proportion in the material under examination. E. RUTHERFORD.

Recent Excavations at Stonehenge.[1]

By Col. WILLIAM HAWLEY, F.S.A.

THE arrangement of the stones at Stonehenge includes on the outside a circle of sarsen stones, which were originally thirty in number and were capped with lintels, forming a continuous ring round the top. Inside this circle is another of smaller stones, originally forty-three in number, but without lintels and of a different rock from those of the outer circle.

Within the second circle of small stones were five

[1] Address to members of the Portsmouth Literary and Philosophical Society on the occasion of a visit to Stonehenge on May 6, 1922.