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## THE COSMICAL ABUNDANCE OF THE ELEMENTS<sup>1</sup>

By Dr. HENRY NORRIS RUSSELL

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EIGHTY-EIGHT chemical elements are known—(not counting two whose isolation is still a matter of controversy, nor unstable isotopes of short life, produced artificially). For all these, methods of isolation and of qualitative and quantitative analysis have been developed in chemical and physical laboratories, so that it is only a matter of hard work for the analyst, presented with a sample of matter of any sort, to determine its composition with accuracy. The simplest definition of composition alone concerns us here—the relative abundance of the elements in our specimen. We may measure this by weight or by the numbers of atoms of different kinds. The chemist is

likely to do the first, the astrophysicist the second. As one of the latter, it is not my place to-day to do more than mention the many methods by which the chemist separates the various elements, and avoids loss of them in the process. Suffice it to say that the separation is sometimes easy, sometimes very difficult (as for the rare earths). The best available tests are much more sensitive for some elements than for others, and it is peculiarly hard to detect the latter when they are present in but small proportion, say less than one ten-thousandth of the whole mass.

The physicist can at times come in to ease the situation. Radio-active tests are available for but a small number of the elements, but can detect these in excessively small amounts.

<sup>1</sup> An address delivered at the symposium, September 26, 1941, in connection with the Fiftieth Anniversary Celebration of the University of Chicago.

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