

investigators, and the resulting figures depend upon theories that cannot be discussed here. The order given by Clarke is based on the assumption of a nickel-iron core.

The numbers expressing the stellar abundance are percentages, calculated on the assumption that the stellar and terrestrial elements form the same fraction of the total material present. This reduces the two columns of numbers to a form in which they are directly comparable, but no great importance is attached to the absolute percentages in the third column.

The method that has here been used is subject to inaccuracy and uncertainty, especially in the estimates of the exact spectral class at which a line is first or last seen. The most that can be expected is that the results will be trustworthy in order of magnitude. It may be seen that the only element for which the stellar and terrestrial values are not of the same order is zinc. Further, it appears that when the estimates for the percentage composition of the *whole* earth are used in the comparison with the stellar values, the agreement is improved in the case of silicon, magnesium, aluminum, manganese, chromium, and potassium; it is about the same for calcium and titanium, is less close for sodium, and markedly poorer for iron.* In the stellar atmosphere and the meteorite the agreement is good for all the atoms that are common to the two, but several important elements are not recorded in the meteorite.

The outstanding discrepancies between the astrophysical and terrestrial abundances are displayed for hydrogen and helium. The enormous abundance derived for these elements in the stellar atmosphere is almost certainly not real. Probably the result

* Professor Russell believes that iron is much more abundant, at least in the sun, than calculated above. He writes: "More than half of all the strong winged solar lines are iron lines, and the strength and evident saturation of even the faint satellites in the iron multiplets is remarkable. . . . There are a great many multiplets of nearly equal strength arising from the low triplet F level in iron. . . . Nothing like this happens for the D lines, or for H and K, although it may hold true for the Mg triplets. I should consequently favor multiplying the percentage for iron by a factor of at least 3 and probably 5 — which would put it where it obviously belongs."

may be considered, for hydrogen, as another aspect of its abnormal behavior, already alluded to;²⁰ and helium, which has some features of astrophysical behavior in common with hydrogen, possibly deviates for similar reasons. The lines of both atoms appear to be far more persistent, at high and at low temperatures, than those of any other element.

The uniformity of composition of stellar atmospheres appears to be an established fact. The quantitative composition of the atmosphere of a star is derived, in the present chapter, from estimates of the "marginal appearance" of certain spectral lines, and the inferred composition displays a striking parallel with the composition of the earth.

The observations on abundance refer merely to the stellar atmosphere, and it is not possible to arrive in this way at conclusions as to internal composition. But marked differences of internal composition from star to star might be expected to affect the atmospheres to a noticeable extent, and it is therefore somewhat unlikely that such differences do occur.

²⁰ Chapter V, p. 56.