I. INTRODUCTION

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INTRODUCTORY COMMENTS

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The chairman has kindly encouraged, not to say entreated, me to write a few remarks concerning the subject of your symposium, which I was unfortunately unable to attend. This I am happy to do: the hydrogen-deficient stars are dear to my heart and even though I haven't contributed anything to the subject for several years, it is certainly nice to be remembered. From an outsider, then, a few thoughts.

To quote from Miss Payne, in her classical study of 1925: The uniformity of composition of stellar atmospheres appears to be an established fact." Certainly for the time that statement was beyond reproach. Yet even then the seeds of hydrogen deficiency had already been sown. Mrs. Fleming, in noting the presence of bright Hβ in υ Sagittarii, in 1891, further states that its spectrum "is remarkable, since the hydrogen lines are very faint and of the same intensity as the additional dark lines." Further, Ludendorff, in a paper written on Aug. 16, 1906, discovered the complete absence of the Hγ line in R Coronae Borealis (a similar situation with respect to Hβ and Hδ being confirmed by Frost). And by a remarkable coincidence, a Harvard objective-prism plate taken the very same day was described by Miss Cannon as showing very little absorption at the G band. Both HD 30353 and RY Sagittarii are stated in the Henry Draper Catalogue to show a spectral resemblance to R CrB. And finally, the non-typical weakness of the G band of the carbon star HD 182040 was pointed out by Rufus as early as 1923.

There was considerable reluctance to accept the possibility of a deficiency of hydrogen in stellar atmospheres: in 1923 Joy and Humason noted that the hydrogen lines were "greatly weakened by partial emission" in the spectrum of R CrB. Plaskett's 1927 study of υ Sgr suggested that the simultaneous appearance of helium and metallic lines in its spectrum might be "due to a supernormal abundance of helium or to the star being an exaggerated form of pseudo-cepheid or giant." The latter point of view was adopted by Miss Payne in her 1930 monograph. It was only with Berman's study of R CrB in 1935 and Struve and Sherman's and Greenstein's work on υ Sgr in 1940 that astronomers were forced to the conclusion that, somehow, a very substantial amount of hydrogen had been lost in a few exceptional stars.

K. Hunger et al. (eds.), Hydrogen Deficient Stars and Related Objects, 3–5.

Since that time a considerable number of luminous hydrogen-deficient stars--a recent list being contained in the writer's paper in IAU Symposium No. 83 (from which the star CoD $-37^{\circ}9248$ should be deleted)--have been studied. A few are single-line spectroscopic binaries, but the majority, including the numerous stars of the R CrB type, do not appear to be so.

In recent years the hydrogen-deficient character of a considerable number of subluminous O and B stars has been recognized, as has also the existence of the H-poor white dwarfs. Further, the hydrogen-deficient nature of at least the carbon Wolf-Rayet stars seems to have been finally established. This then completes the roster of the generally-recognized hydrogen-deficient objects. I shall mention some other candidates a bit later.

On the theoretical side the first consideration of hydrogen deficiency that I know of is due to Russell, who in 1933 wrote: "Suppose that some stars contain a considerably less overwhelming excess of hydrogen than the average. If the difference extends to the interior, as well as the surface, these stars will be brighter than the mass-luminosity relation indicates; they will be, or tend to be, supergiants...owing to the low density, the (Balmer) lines will be sharper and may appear fainter than in normal stars. The lines of other elements will be stronger than usual...especially the enhanced lines of the metals...Lines of high excitation, ordinarily absent, may appear." Unfortunately, he went too far, as we all tend to do, by adding that "these predictions of theory amount almost to a description of the spectrum of Alpha Cygni, and the suggestion that this and perhaps other c-stars are deficient in hydrogen appears plausible. To attribute the deficiency to partial exhaustion of hydrogen by processes of atomic synthesis in these very luminous stars is tempting."

Scanning the early literature on the hydrogen-deficient stars does not provide any enlightenment as to the cause of the phenomenon. For the binaries among them the suggestion---by Louis Henyey in the mid-50's to the best of my recollection---that they might result from a tidal-stripping process a la β Lyrae seems quite plausible now, but the large number of presumably single stars in the group would appear to indicate that the stars can lose their hydrogen-rich regions on their own. You will no doubt hear more of both explnations during the next few days.

Finally, a few suggestions for further work. First, I believe that a study of additional stars for which the evidence of hydrogen-deficiency is not quite so obvious would be well worthwhile. Are the so-called helium-rich stars actually also to some extent hydrogen-poor? What about the not-so-typical Ap star HR 6870 whose spectrum shows high-excitation lines of Ti III and Cl II? How about 3 Puppis, an early A-type spectroscopic binary with the same period as υ Sgr whose spectrum shows strong emission lines of [O I] and Ca II and which has enormous infrared excess? What about any stars that have suffered significant mass loss? Second, I have always been greatly disappointed by the lack of complete data on the light variations of υ Sgr and HD 30353. There must be some significance to this observable, perhaps very important, perhaps not.

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Thus I conclude my opening remarks. I hope that they have not been too content-deficient! I am sure that by the end of this conference you will all have more than enough new observations to make and theories to concoct. May the force---or even better all four (or more) be with you!

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