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# Hydrogen Deficient Stars and Related Objects

Kurt Hunger,  
Detlef Schönberner and  
N. Kameswara Rao (Editors)

# HYDROGEN DEFICIENT STARS AND RELATED OBJECTS

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## PREFACE

The first helium star was discovered in 1942, the first scientific meeting on the subject, however, took place in 1985. The meeting was hence long overdue for, in the meantime, a substantial amount of material had been accumulated by a rather small, but active scientific community. Hence, it appeared necessary to review the field in order to define the subject, assess its present status and discuss future developments.

Hydrogen deficiency is a widespread phenomenon, occurring in a large variety of stellar and nonstellar objects. It can be readily detected in B stars as these exhibit both hydrogen and helium lines, if the elements are present in appreciable amounts. It becomes less manifest in cool stars, where the temperature is too low to excite helium and where one has to devise indirect methods for proving hydrogen deficiency. Clearly, it was not possible to discuss the whole complex of hydrogen deficiency, i.e. in both stars and diffuse matter, but rather to concentrate on the issue of helium stars.

The scope of the meeting was further determined by the intention to bring together predominantly those scientists who work in the actual field of hydrogen-deficient stars, as it was vital in this first meeting on the subject to set the right accents. To outline this in some detail: the helium stars are divided into two distinct classes, those with hydrogen down by a factor 1000, and those with equal amounts by number of hydrogen and helium. The former we call "extreme helium stars", the others "intermediate helium stars". These two groups represent two totally distinct groups with respect to age, mass and evolution. The extreme helium stars appear to be old, evolved stars with masses of the order of unity, while the intermediate helium stars in most cases appear to belong to rather young or intermediate populations, with masses of the order of 3 solar masses or even main sequence masses. While in the extreme helium stars the helium enrichment of the photospheres appears to be genuine, that in the intermediate helium stars may be the result of diffusion. At least, this subgroup of intermediate helium stars, which has near main sequence star masses, is intimately related to the Ap-stars. However, as we do not want to reiterate the Ap-star physics, a topic that has been dealt with abundantly in the past, we made a cut in the program. We also made a cut at the hot end of the H.-R. diagram for similar reasons: we left out the WR stars, although they are definitively hydrogen-deficient objects. However, their physics differs widely from that of our helium stars, and meetings on WR stars have also been quite frequent in the past. A slight concession was made, however, towards

the white dwarfs as some of these stars are no doubt genetically linked to our helium stars.

The central and most startling problem in the field of helium stars, something which has puzzled us from the very beginning, is how extreme helium stars are formed and how a star of one solar mass may get rid of all its original hydrogen. A few rivalling hypotheses are known but up to now none of them are convincing.

The aim of the meeting was to bring us closer to the answer and discuss paths along which a solution to the above problem can be found, both theoretically and, probably more so, by new methods of observation. To this end, the item "joint discussion" was included in the program, the discussion centering on the point as to whether the Hubble Space Telescope can be used for our key problem. As a result, a number of international collaborative programs have been started during the meeting, comprising further instruments such as IRAS, ESO, CASPEC and, possibly, SEST.

The colloquium was organized by a scientific organizing committee consisting of: J.S. Drilling, M.V. Feast, G.H. Herbig, P.W. Hill, I.M. Kopylov, M. Peimbert, N. Kameswara Rao, D. Schönberner, A.V. Tutukov and K. Hunger (Chairman), and a local organizing committee consisting of: K.R. Anantharamaiah, R.C. Kapoor, P.V. Kulkarni, D.C.V. Mallik, T.M.K. Marar, V.R. Venugopal and N. Kameswara Rao (Chairman). The colloquium was jointly sponsored by the presidents of the IAU commissions 27, 29, 34 and 35. The meetings were held at the famous Lalitha Mahal Palace in Mysore.

The participants are very much indebted to the following supporting organizations: International Astronomical Union; Indian Institute of Astrophysics; Indian National Science Academy; C.Z. Instruments India Pvt. Ltd.; Central Food Technological Research Institute, Mysore; Indian Tourism Development Corporation Jaycees, Mysore; Karnataka Tourism Development Corporation; Tata Consulting Engineers; Vikrant Tyres; Walchandnagar Industries Ltd..

Institut für Theoretische Physik  
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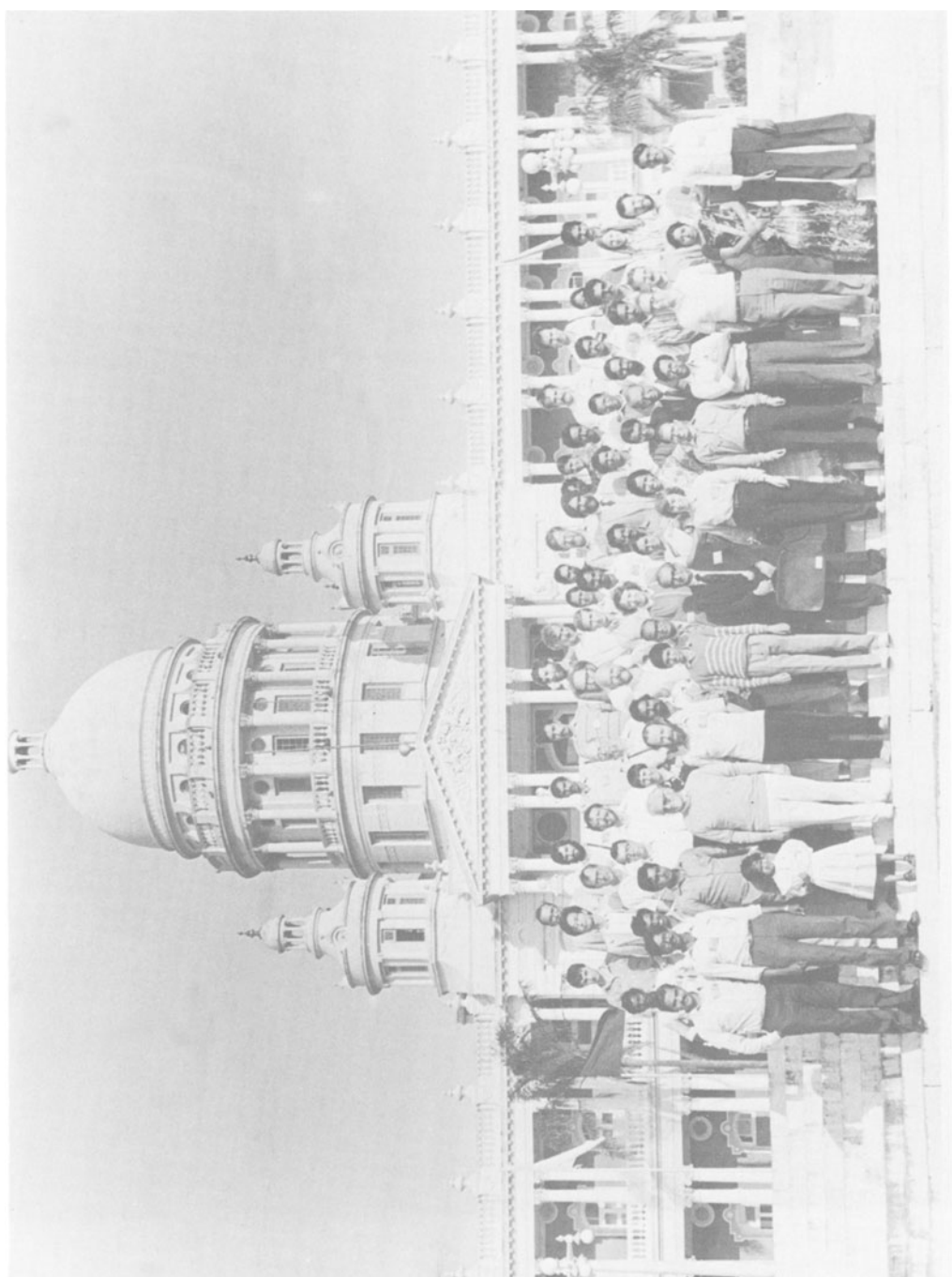
K. Hunger

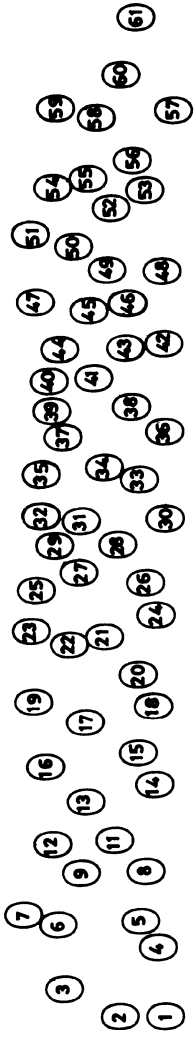
## **EDITORIAL NOTE**

Due to technical problems, the transcripts of the discussion recordings were incomplete and occasionally damaged. The editors tried their best to correct for this. It cannot be excluded, though, that in a few cases our printed version does not fully reflect what the speaker intended to state. The editors apologize for this.

Even more regrettable is that for a major part of the contributions the discussions have been lost entirely. This may lead to the impression that no discussions took place, whereas the opposite was the case: there was not a single contribution without discussion. The editors apologize to the authors concerned.

The editors are happy that John Drilling and Phil Hill agreed to compile a list of objects which is reproduced in the Annex. In view of the many newly discovered helium stars, the reports of which are scattered in literature, such a list appears especially important and will add to the value of this volume.





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|--------------------------|-------------------------|----------------------|-----------------------|
| 1. Babu, G.S.D.          | 27. Schönberner, D.     | 40. Vasundhara, R.   | 53. Pottasch, S.R.    |
| 2. Balakrishnan, A.P.    | 28. Bues, I.            | 41. Ashoka, B.N.     | 54. Mrs. Rao, A.R.    |
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| 9. Liebert, J.W.         | 35. Lambert, D.L.       | 48. Rao, N.K.        | 61. Surendiranath, R. |
| 10. Kalyani Rao          | 36. Walker, H.J.        | 49. Marar, T.M.K.    |                       |
| 11. Lyubimkov, L.S.      | 37. Gurm, H.S.          | 50. Kutty, N.        |                       |
| 12. Mendez, R.H.         | 38. Badalia, J.K.       | 51. Pugach, A.F.     |                       |
| 13. Drilling, J.S.       | 39. Jyotsna, V.         | 52. Rao, P.V.        |                       |

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## HIGHLIGHTS OF THE DISCUSSIONS

It is very easy to make a guess; it is very difficult to prove something. Tutukov

The unwritten rule whenever a talk on magnetic stars is given: never to ask basic questions. Liebert

There are no real spectral features, but some spectroscopists never give up. Walker