Introduction

https://doi.org/10.1017/S0074180900002175 Published online by Cambridge University Press

Hülya Çalışkan and Sylvia Önder paying homage to Ulugh Beg (1394-1449) outside the Physics Department of Istanbul University (from symposium "scouting expedition" of August 1994).

https://doi.org/10.1017/S0074180900002175 Published online by Cambridge University Press

INTRODUCTORY REMARKS: WATCH THE DETAILS

How to Deal with Unexpected Scientific Results

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I have always been fascinated by red stars, partly because they were so easy to find in a telescope field, and partly also because they seemed to warm things up a bit on a cold winter night. Thus I early became acquainted with the celebrated carbon star 280 Schjellerup, better known as WZ Cassiopeiae, which was recognized about 100 years ago as an unusual member of a group of red stars then known as the stars of Secchi's fourth type. The Upsala astronomer Dunér (1899) stated that "so far as my experience goes the great strength in the spectrum of this star of band 4 (= sodium 'D'), combined with the remarkable faintness of band 6 (= the λ5635 sequence of C_2), is met with in the same degree in no other spectrum." Remarkably good photographic spectrograms, reproduced by Hale, Ellerman & Parkhurst (1903), confirmed Dunér's visual observation that the carbon bands in WZ Cas were "relatively very feeble." The Yerkes investigators also published a wavelength table for this star extending from λ4430 to λ5786 which to my knowledge is the only one yet published, though Dr. Keenan is planning to remedy this to some extent. We now know, of course, that WZ Cas is the brightest object in which the atmospheric abundance ratio of carbon to oxygen is very close to one, though this situation is no doubt rather temporary. The star has many other interesting properties, including strong Li I, H_2, CO, etc.

My purpose here, however, is not to discuss this stellar oddball in any detail, but rather to make the point that sometimes observers note things that don't seem to make much sense, but which later are realized to have been very significant indeed. A good example is the statement in Hale et al. (1903), referring to the λ4606 blue CN sequence, that "for some reason the maximum intensity of these flutings seems to have been attained in so slightly developed a fourth-type star as 280 Schjellerup." Some 12 years

R.F. Wing (ed.), The Carbon Star Phenomenon, 3-5.

later the aptly named Michigan red star investigator W. C. Rufus (1915), in his study of the spectra of the R and N stars, noted that "the cyanogen bands appear to be somewhat stronger in the spectra of class N stars (than in class R), especially λ4553.6 and λ4606." And finally, in 1928, C. D. Shane emphasized that "the behavior of the λ4606 CN group in the carbon stars is not typical of the entire (blue) cyanogen spectrum." Since the same lower electronic state is involved this was rather surprising.

The mystery was solved, as far as I was concerned, with the discovery at the Dearborn Observatory of the very weak-banded star BD +15°726 = GP Orionis (Bidelman 1950[1]). This object exhibited an extremely strong feature near λ4606 that could not possibly be due to cyanogen, but was in fact due to the resonance line of neutral strontium. In my innocence I assumed at the time that the great strength of the low-lying lines in GP Ori, WZ Cas, and other similar objects was solely a consequence of low temperature, which is certainly only part of the story. My student Courtney Gordon (1968) was far ahead of me in recognizing the importance of atomic abundance variations among carbon stars.

However, I must here record the embarrassing fact that the Russian astronomer G. A. Shajn had already pointed out (in English!) in 1942 that the λ4606 cyanogen sequence heads were likely to be severely blended with the resonance lines of Sr I and Ba II. I was a graduate student at the time, concerned with more important matters.

I hope you get my point: that if something seems a bit strange it is worth doing some serious thinking to try to make sense of it. At the very least do tell others about it; though perhaps hard to believe, they may be smarter than you! This policy may not make you popular with the establishment but the risk is well worth taking.

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[1] A somewhat more informative photograph of the spectrum appears in Vol. I of *Stellar Astronomy*, ed. H.-Y. Chiu, R. L. Warasila and J. L. Remo (New York: Gordon & Breach), p. 203, 1969.

Discussion

Wing: I thank Dr. Bidelman for sending these remarks to open our conference and am sorry that he couldn't be here to present them himself.

We are here to discuss the many kinds of stars that have managed — whether by themselves or with help from a companion — to change their surface chemical compositions. This large field of study began with the recognition of various groups of spectroscopically peculiar stars. Dr. Bidelman's sharp eye for noticing subtle spectral peculiarities, and his role in recognizing and defining the properties of the Barium stars (Bidelman & Keenan 1951, *ApJ*, 114, 473), are well known. Less well known is his contribution to the idea that stars of types M, S, and C form a continuous sequence in which the C/O ratio is the significant variable. The idea itself is fairly old, going back at least to the work of Y. Fujita (1939, *Japanese J. Astron. Geophys.*, 17, 17) who showed that many of the properties of S stars could be accounted for by simply increasing the C/O ratio of an M star. Bidelman's contribution, a decade later, was to find real stars to fill out the M–S–C sequence and to identify examples of the intermediate MS and SC classes. The clincher was his observation that the highly unusual spectrum of GP Ori has exactly the characteristics expected for a star in which O and C are precisely balanced. This 9th-magnitude star was thus shown to link the SC stars that show ZrO bands to the SC stars that show C_2, thereby tying together the whole M–MS–S–SC–C sequence.

Papers that have great impact on individuals are not always the well-known classics. Bidelman's fullest discussion of the pivotal position of GP Ori in the M–S–C sequence was given at one of the early Liège Colloquia (1954, *Mém. 8° Soc. Roy. Sci. Liège*, 4th ser., Vol. 14 [Liège Contr. No. 357], p. 402). I have seldom seen citations to that paper, but its effect on me was profound. When I stumbled across it as a graduate student in 1964, on a cloudy night at Lick Observatory, I suddenly had the exhilarating feeling that many things were starting to make sense. That paper influenced the direction of my dissertation, and consequently of my entire career, up to and including the organization of this conference.