CONCLUDING REMARKS

WILLIAM P. BIDELMAN
Warner and Swasey Observatory, Case Western Reserve University, Cleveland, Ohio, U.S.A.

It is now time to ring down the curtain on the drama entitled 'IAU Symposium No. 70'. In this presentation in which the actors have doubled as the audience, some of us have acted as principals, some have played supporting roles, some have been bit players, some have walked on, and others have been stage hands. Lest you think I am being unduly histrionic, I would remind you of that immortal line from Hamlet, namely, the one that describes the predicament of a rapidly rotating early type star, which goes "to Be or not to Be: that is the question".* Our play may be characterized as partly historical, partly tragical, as we have seen some of our revered old ideas called seriously into question, and partly comical, though not always intentionally so. There has been some resemblance to 'The Tempest', and, finally, some of us who are not so deeply immersed in the subject as other might claim that there has been 'Much Ado About Nothing'. For certain, however, it could not possibly be called a farce.

Almost everybody's concluding remarks at such a meeting as this include the statement that "there is no point in attempting to summarize the discussion". I agree; it would be quite impossible for me to elucidate the theoretical papers or to add anything significant to the observational ones. What I would like to do is to introduce a bit of systematization into the subject, and to make a very few comments concerning some of the things that we have talked about.

It is obvious that among the stars that would have been considered by Merrill and McLaughlin as B-emission stars we have a great diversity of objects. I would divide them into at least five classes:

B-Emission Objects

(1) Supergiants
(2) Rapidly rotating single stars
(3) Interacting binaries
(4) Early type nebular variables
(5) Quasi (or young) planetary nebulae

All of these types of objects are loosely occasionally termed 'Be' stars, but in view of their diversity it is essential that we attempt to make the theories fit the observational data in each case. In other words, if an object is a binary no theory based on the hypothesis that it is a single star can prove satisfactory in the long run, and vice versa.

Now a few comments: (1) The supergiants comprise perhaps 15% of all of the stars in the Be catalogues. We have had almost no discussion of these objects except for the *Copernicus* data demonstrating their appreciable mass loss and Dr Hummer's

* The editor assumes no responsibility for any comments made in this or other papers. (A.S.)

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theoretical paper on line formation in spherically symmetric expanding atmospheres which should apply in these cases.

(2) Despite today's eloquence, I am inclined to believe that the majority of the Be stars that we know today are really single rather than double stars. At least I think the presumption is in this direction. However, from the discussions it appears that there is a crucial question involved in the single-star hypothesis: why is the Be and/or shell phenomenon so markedly irregular? Why should Pleione suddenly decide to eject a shell and then stop? Why not continuous ejection of matter? The ultraviolet observations, again, have made a real contribution in pointing out that these stars have appreciable mass loss. Polarization and infrared and radio observations are capable of telling us a lot about the envelopes, though they may not contribute much to answering the important question just posed. In connection with the general problem of stellar shells, there is no doubt that we either need some agreement on the definition of a shell star, or at least we should always make clear exactly what type of shell we are talking about. Is there shell absorption in the hydrogen lines, and if so, which? Or is there also strong metallic-line absorption? I hope that we may be able to provide a useful list of shell stars of various types, though the often discontinuous nature of the shell phenomenon necessitates continued spectroscopic observations.

(3) I am amazed that we have not heard a single paper on β Lyrae. I find it hard to believe that we could have had a Be-star symposium without at least four or five such papers. My only conclusion is that we must have given up on this enigmatic binary, but I cannot help but feel strongly that we should spend more time on objects that we already know something about rather than frittering it all away on 10th to 15th magnitude stars about which we know practically nothing! Surely, understanding β Lyrae should still be one of astrophysics' highest priority goals. In connection with the general problem of binaries it is perhaps worth emphasizing that the detection of secondary components that are decidedly cooler than their primaries may be a comparatively simple task with the aid of infrared or millimeter-wave observations, but the situation is not at all as favorable if the secondaries are of comparable spectral type to their primaries. We should never forget that binaries with early type primaries can have secondaries that are, as far as we know, main sequence, giant or sub-giant stars, horizontal-branch stars, white dwarfs, neutron stars, or even, of course, black holes. We must be prepared for the worst.

(4) I only mention the nebular variables in order that they are not forgotten. There are some in Merrill's catalogues, and, curiously enough, the spectra of many are not so very different from those of ordinary Be or shell stars. For example, a spectrum of BF Orionis that I once obtained resembles that of a conventional A-type shell star to a surprising extent. We have heard almost nothing about these interesting objects at this meeting, although it is likely that a number of the curious pathological objects picked up in the far infrared and radio range belong to this class.

(5) Again, little has been said of the fascinating objects of the 5th class aside from their probable radio detection. They are certainly important objects for study. At the moment there is much confusion between these and other varieties of emission stars such as the symbiotics, and much clarification remains to be done.

So far I have said nothing profound; and also, I have as yet failed to say anything nice about the various papers. The review papers all appeared to me to have been

excellent, and I am looking forward to seeing them in print where I can begin to absorb them. The contributed papers were, as usual, a somewhat mixed bag; but none seemed to be sheer nonsense, as occasionally happens, and we should all be thankful for that.

Finally, I will suggest that we are all working on a giant jigsaw puzzle, or perhaps better, on a number of them. We all know what happens when we do this: sometimes progress is painfully slow until one person fits a piece in and then the way is open for others to make their contributions. Once in a while it turns out that a few of the pieces have fallen on the floor and been overlooked; someone happens to find them, and they make all the difference. Sooner or later the puzzle is done; we admire it for a while and then tear it up and turn enthusiastically to another apparently hopelessly scrambled picture.