

HIGHLIGHTS AND CLOSING REMARKS

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I have never been clear on what the best and most useful way to summarize a scientific conference is. Obviously, most of those in attendance have heard most of the presentations, and have examined the posters. Perhaps what is expected of me is to make value judgements, to pronounce upon the merits of what we have heard and seen. This I cannot do, not because of a reluctance to offend those not mentioned, but simply because I am very reluctant to make such pronouncements even in areas in which I might claim some expertise. It has been my observation that mighty scientific oaks sometimes grow from the most modest acorns, acorns that at the beginning even the keenest acorn-inspector could not have imagined held much promise. So I would like simply to mention several contributions that caught my eye and gave me pleasure for one reason or another.

Of course we have heard some papers these past days which we all recognized were important, were sure to leave their mark on astronomy. I shall comment upon some of these in a moment. Some of what we heard resonated with me for very personal reasons: I love stellar spectra, and my heart warmed to hear Philip Keenan lead us so skillfully through the morass of cool metal-rich and carbon-rich stars, and to have Bob Garrison share his expertise on the oddities of B-type spectral classification. When Davis Philip talked about blue horizontal-branch stars, and Ms. Luridiana described her group's calculations of red giant evolution, I think we all could sense that this was very good work, which raised in at least one of us the thought: "I should know more about this".

I found David Turner's discussion of interstellar extinction, as obtained by careful treatment of *UBV* data, very instructive and also very cautionary. One would have thought that such issues as the regional and magnitude variation of the parameters of the reddening line had been disposed of in the 1950's by the Yerkes group: Morgan, Hiltner, Johnson, Harris,... But obviously that is not the case.

Bob Wing provided a fine account of what can be learned from infrared photometry, both from the ground and from *IRAS*: interstellar extinction, molecular bands, dust shells, silicate and carbide grains. He mixed science with a most interesting account—which could have been supplied only by a thoughtful participant in those exciting discoveries—of how some things came about, and how in some cases enlightenment finally emerged from error. I was struck how the area described by Wing, of dust manufactured in cool stars and presumably washed out into the interstellar medium, overlapped with its consequence: the interstellar extinction discussed by Turner.

One must hold precision stellar photometry, and its dedicated practitioners, in great respect. Dave Crawford's talk confirmed that impression. I had not seen the distinction between the "system" and its "calibration" so clearly drawn before. In this era when we are all at the mercy of black boxes, I appreciated the repeated stress he laid upon *understanding* what it is we are doing, or is being done for us.

I thought that Dave's stress upon precision photometry provided an appropriate background for the later talk by Poul Nissen, which displayed a meticulous attention to detail, a clear grasp of the physical issues and their treatment, and a command of the appropriate instrumentation. All this, completely in the great tradition of Bengt Strömgren, was directed to some of the central issues of galactic chemical evolution.

Let me insert a remark of my own here. Some of you have read the book *Cosmic Discovery*, by Martin Armitage, in which it is emphasized that many of the important discoveries in astronomy were made possible by technical innovation, through some instrumental advantage possessed by the discoverer. I would like to say that the kind of work reported here by Nissen, although not in the class of Newton and the apple or the discovery of the microwave background, shows that important results can come not necessarily from a technical breakthrough, but simply from the application of clear thinking, patience, and hard work.

But on the other hand, when we turn to the area of star formation and early stellar evolution, we have seen several excellent examples of how new technical opportunities can indeed provide unique information, and here I refer to the impact of X-ray surveys, VLA interferometry in the centimeter region, and infrared arrays.

Joachim Krautter showed us a tantalizing sample of *ROSAT* data, in particular what it can tell us about pre-main sequence stars that are young enough to be X-ray emitters yet old enough for much of their surface

or circumstellar activity to have subsided. This technique brings out a population that would be most difficult to isolate otherwise. Whether it represents the only channel by which low-mass stars can approach the main sequence is not clear. That and other questions, such as whether these X-ray active weak-line T Tauri stars are the evolutionary successors of the classical TTS or another species altogether, remain unsettled. But certainly the *ROSAT* results represent the opening of an important new window on this subject, and we impatiently await publication of the details.

Luis Rodríguez spoke of mm and cm observations of thermal emission from circumstellar material around very young stars, and of outflows. Here is certainly an area where sub-mm and mm technology, and VL interferometry, are providing information that would otherwise be utterly beyond our grasp. Interferometers under construction or yet to be built will certainly enlarge our understanding of the arrangement and the kinematics of circumstellar material around young stars. This is without doubt an area where Mexican astronomers can play a leading role in an important new subject.

We heard from Steve and Karen Strom, and from Suzan Edwards, a fine account of the work on young stars that is being pressed so vigorously, on so many fronts, by that research group. One admires the advantage that the Stroms and their co-workers have taken of instrumental opportunities, all the way from *HST* and ground-based telescopes — with a full mastery of detectors, spectrographs, imagers at all optical wavelengths — to a new venture into the mm domain. From Steve Strom we heard an interesting synthesis of this multi-faceted field, to which he has contributed so much. Karen Strom told us of her work with IR arrays on dense, heavily obscured young clusters, and of future spectroscopic prospects in the domain longward of $1\ \mu\text{m}$, but before the point where stellar absorption spectra are submerged by the thermal continuum of circumstellar dust.

Suzan Edwards discussed the problem of how to reconcile what we know about the rotation of pre-main sequence and ZAMS stars on the one hand, with the influence of an accretion disk in earlier times. The star seems constrained to rotate slowly while the disk is present, but is free to spin up once the disk is dissipated. Given some dispersion in disk lifetimes, the wide range in rotational velocities observed in young clusters may be accounted for in this way. An interesting idea, clearly deserving of closer examination.

As a footnote, I would remind you that the “boundary layer emission” in T Tauri stars that has been mentioned by several speakers during this meeting is the same phenomenon that was discovered at Tonantzintlán in the 1950's by Guillermo Haro, in the form of his “bright ultraviolet” TTS.

To those speakers that I have not mentioned, I apologize: my impressions, as I warned you at the outset, are constrained by my simple inability to appreciate many of the things we have heard here. One issue, however, that we can agree upon: we are all the better for these days in Mexico. We have all learned something new, made new friends, and I am sure that our science will profit from this occasion, in ways we cannot now anticipate.

I would like to thank Eugenio Mendoza for his presence, for his scientific contributions, and for his friendship. On behalf of us all, I would like to thank Armando Arellano Ferro for his hospitality and for the efficiency of his arrangements, and to acknowledge all his helpers who have made our meeting so pleasant. As lastly, I would like to extend our thanks to the authorities of the Institute of Astronomy, of UNAM, and of the National Council of Science and Technology for their support and for the many courtesies extended to us.

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