RevMexAA (Serie de Conferencias), **3**, 281–282 (1995)

DO WE ASTRONOMERS EVER SOLVE PROBLEMS?

Luis F. Rodríguez
Instituto de Astronomía, UNAM, Apdo. Postal 70-264, 04510 México D.F., México

RESUMEN

Este breve comentario se refiere al tema de la resolución de problemas en la astronomía, con énfasis en el campo de formación estelar. Cuando la pregunta está bien formulada y el problema es lo suficientemente claro y simple, parece que podemos producir una respuesta razonable en una década o inclusive menos. Sin embargo, la mayoría de las preguntas básicas son contestadas solo parcialmente y el proceso parece producir más nuevas preguntas que respuestas. Esto es afortunado para nosotros porque, ¿qué puede ser peor para un científico que tener todas las respuestas a sus problemas de investigación?

ABSTRACT

This brief commentary addresses the issue of problem solving in astronomy, with emphasis in the field of star formation. When the question is properly posed and the problem is clear and simple enough, we seem to be able to produce a reasonable answer in a matter of a decade or less. However, most of the basic questions are answered only partially and the process seems to produce more new questions than solutions. This is fortunate for us because, what could be worst for a scientist than having all the answers to his research problems?

Key words: **STARS: MASS LOSS — STARS: PRE-MAIN SEQUENCE**

Do we astronomers ever solve problems? Well, yes and no, depending on the nature of the problem. Let me start by giving an example of a question that was still open a decade ago and that appears to have found a reasonable answer in the meantime (remember, however, that in science anything can be wrong and that even these consensus cases could become open again). The question was: are highly-collimated outflows restricted to *low-mass* young stars?

In the last several years, studies such as those of Poetzel, Mundt, & Ray (1989) and Martí, Rodríguez, & Reipurth (1993) have answered the question in the negative. The phenomenon of highly collimated jets appears not only in young, solar analogues, but also in massive and luminous stars. Other outflow phenomena such as Herbig-Haro objects and molecular outflows appear to be also present in young stars across the mass spectrum. In Figure 1, I show a radio continuum map of the thermal jet that powers the HH 80-81 complex (Martí, Rodríguez, & Reipurth 1993, 1995). The exciting source is a young, massive star with a luminosity of about 20 000 $L_{\odot}$.

Why was this a valid and yet unsolved question a decade ago? Massive stars are much less common than low mass stars. Furthermore, their life as pre-main sequence objects is much shorter than that of low-mass stars. All this conspires to make the number of young stars in the Galaxy with collimated outflow phenomena to go inversely as the stellar mass to the sixth power! (i.e., $N \propto M^{-6}$; see Martí et al. 1993). On the other hand, these massive sources are more luminous and the search for them is not as difficult as the above dependence would appear to imply. Indeed, it was a matter of persistence and patience to find some examples, that were inexistent ten years ago.

On the other hand, questions that troubled pioneers in the field are still with us, such as: Are young stars forming planets? Or, how does the new star get rid of excess magnetic field and angular momentum?

Perhaps in reasonable amounts of time we can mostly answer simple, well-defined questions such as: Are highly-collimated outflows restricted to *low-mass* young stars? And not ambitious and grandiose questions that may require centuries and not decades for a proper solution, such as: Are young stars forming planets?

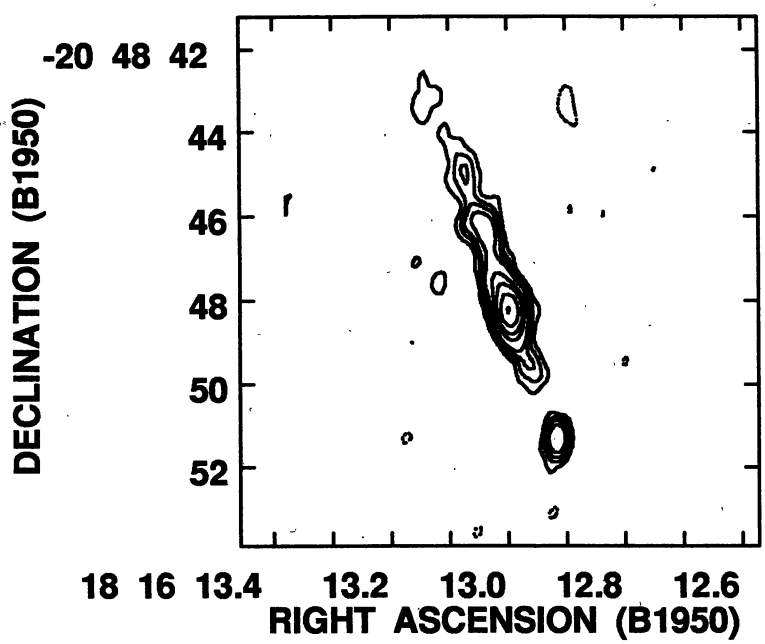

Fig. 1. High angular resolution map of the central radio continuum thermal jet that excites the HH 80-81 system. The HH objects are located several arcmin away from the core and are not included in this image. Contours are −3, 3, 5, 7, 10, 20, 30, 50, and 80 times the rms noise (20 μJy per beam) of the map. Data from Martí et al. (1993) obtained with the Very Large Array in the A configuration at 6-cm.

Perhaps we need both types of questions: those that we can solve in our lifetime and those that we pass to the coming generations.

Perhaps it is a bad idea to have only one type of question, as it is a bad idea to have only one type of music, of food, of viewpoint.

I do know of a center of research in my university that is called the Center for the Fixation of Nitrogen (nitrogen fixation is a problem of great importance for fertilizers and agriculture). Great, the members of that center probably have clear, well-defined goals. But, what happens if they finally solve their problem and fixate nitrogen? Do you change the name of the center? Do you close it? Do you move to the next element in the periodic table?

You see, a lack of clear, well-defined goals can sometimes be a good thing.

REFERENCES

Martí, J., Rodríguez, L. F., & Reipurth, B. 1993, ApJ, 416, 208
———. 1995, ApJ, 449, 184
Poetzel, R., Mundt, R., & Ray, T. P. 1989, A&A, 224, L13