



Advice to the Young Astronomer

by Ed Nather

- a. Go into some other profession
 1. Consider being a Rock Star. It pays very well, and does not demand much in the way of talent, other than a willingness to dress really strangely, act like a manic 5 year old trying to get Mommy's undivided attention, and make a lot of noise. Perks include unprecedented access to sex and drugs, and the quiet satisfaction that you are making a lasting contribution to society.
 2. How about politics? It also pays well and requires nothing in the way of education or talent. If you are inherently honest, however, that could create problems, since then you would not fit in very well with those already in the business.
 3. You might try astrology. Most people confuse this with astronomy anyway, since it involves the stars, and anything you might already have learned about them would not be wasted. Some talent is needed: you must be able to present nonsense in a sincere, convincing way. If you insist on being an academic, you could espouse Creation Science, but it would be harder to keep a straight face.
- b. If nothing will satisfy you except doing astronomy, then plan your graduate career and subsequent job-hunting with some care, since there aren't many research jobs to be had, and the available ones don't pay very well. Are you sure you want to do this?
- c. About half of the advertised jobs in astronomy mention that experience with instrumentation of some kind is desirable, if not essential. Just knowing how to surf the internet is not enough, since any 6-year-old can do that; you need to know something about optics, electronics, and real-time programming to be able to build anything useful and get it to work. Note that a shallow acquaintance with these skills, so you can talk to a technician or programmer to get what you want, does not work. Learn to do it yourself, first. Make something, then try to use it to take data. You'll understand far more after klutzing around a bit than you ever will in a formal design course. Learn from others who know how to do these things, read books about them, but above all do them yourself. Having a professional design the instrument for you will get you a skilled, polished, economical design that solves the wrong problem.
- d. After the relief and euphoria that follows a successful thesis defense has worn off, you'll need to find a job. It may be too late already. Why did you wait until you were finished? Get your advisor to help by asking his friends about job openings, if you are still on speaking terms with him. You are far more likely to get a job if there is someone who knows about you, and wants you to have it, than if you come in cold. Every applicant looks good on paper so it's hard to choose. A friend on the search committee is worth 10 refereed research papers on your resume'. Unjust? Sure. Welcome to planet Earth.
- e. It has been my experience that groups of people who form entities - companies, university departments, whatever - will hire you to do a job and then do everything they can to keep you from doing it. They have rules. You will have to learn your way around these things to get anything done. Do not be deceived by organization charts: nobody follows them. Find out who really is in charge, and make friends with them. Be totally shameless: pay for the beer, and listen attentively when they whine. Bureaucracies are the same all over the world: they want you to follow the rules, and they don't care if you never get anything done. If you must break their rules (and you must) then give them something on paper so they won't get blamed. It is always easier to get forgiveness than permission.
- f. The bureaucratic hierarchy in a university begins with the Department Chairman or Observatory Director and goes up from there. If you want to be a research scientist never accept one of these positions under any circumstances - it's the end of research if you do. A good chairman will protect you from the Administration who think they can correct imperfections by passing new rules for everyone to follow; he will intercept these things, or deflect them, and let you get on with your work. Cherish the good chairmen: they are rare.
- g. Committee assignments: the theory here is that everybody should share in the burden of administration, taking time away from their research work in the process. If you are very good and conscientious about this stuff you will be given more and more of it, since you get things done, to the lasting benefit of the department administrators. On the other hand if you thoroughly neglect it, fail to call or attend any committee meetings, and generally do a lousy job, you will get fewer and fewer committee assignments, and you can get on with your research. You should not be too blatant, though. When pressed, have a meeting by email - just send each committee member a copy of the topic to be considered (obscurity here is a virtue) and ask them to respond. Make a single file of all the individual responses and send it back to all of them, and a copy to the department chairman. This should create enough dissention and warring messages that you can tell the chairman you are uncomfortable making a decision without a consensus, and that he had better do it. You won't be assigned to that committee again.

- h. Tenure: Seek it. Job security is comforting, but the main point about tenure is that you get to do what you want in the way of research. You will probably have to pay for it yourself - you won't get departmental funds after that business with the committee assignments - but you can find grant funds if you know what you want to do and can describe it well. You don't have to follow the "mainstream" of current astronomical research, and you shouldn't. If your primary goal is to learn how the universe really works, and not just to get your name in the newspaper, look where others are not exploring. Nature is so rich you are unlikely to look carefully at anything without learning something new, particularly in unexplored territory. New instruments are wonderful here. If you follow current fads in astronomy you'll just be wasting your time - the fad-followers will publish what they find and you can read about it, for free. If you have to rush to publish something, quick before you get scooped, you are doing the wrong research. Stop it, and do something nobody thinks is interesting. Trust me: it will be.
- i. Teaching: Learn from it. Rutherford's adage - that if you can't explain to a barmaid in five minutes what you are doing, you don't really know what you are doing - is true wisdom. Teaching a class on elementary astronomy to undergraduates is the best way I know of to get the basic ideas clearly in mind. If their eyes glaze over at some explanation, and they fail to understand it, chances are you don't really understand it either. It's hard to get enthusiastic about the Doppler shift after a few years, but you can do it. Try doing it without mentioning waves. You can; it works. In particular, cherish the questions students ask. They may sound dumb, but they usually aren't - misinformed, maybe, or naive, which can be corrected - and they are sometimes profound, because the students are using their "common sense" - their own, unique worldmodel - to formulate the question. I have received, gratefully, several research ideas from the questions asked by undergraduate non-science majors. Research institutions usually justify their priorities with the argument that students benefit by learning directly from the researchers themselves. No argument, but they rarely mention that it is a two way street. The idea about the two sets of rules in physics - one set for the future and one for the past - came to me while I was rehearsing an undergraduate lecture on quantum mechanics in the shower.
- j. Research: Do whatever you burn to do. If your innate curiosity doesn't burn to learn about it, perhaps it's not so important. Passion is the key, not mild curiosity. Further, try to keep a mental file of all the astronomical problems you know about, along with a file of things you have real doubts about, even though it may be standard dogma. My mental image of such files is like a row of small baskets, each with its own problem, with a red flag in front of each one. When I learn something new, or hear of a new technology that might be made into a new instrument, I go down the line of flags with it, poking at each one to see if any one of them give - that is, might now be solved or explored with the new idea in hand.
- k. Keep a mental file of research work that will probably pay off, along with a file of how to do it - what instrument to use or build, what measurements to make, how to extract the physics from the data. If you do this routinely, you will end up with a file of more useful research than you can do in a lifetime. When the opportunity arises (e.g. when you have a student looking for a project) give the idea away. If someone else uses it to learn more about the universe, then you will know it too, and you didn't even have to do the work! I have encountered astronomers who like to keep their ideas secret, and not tell anybody, so they can work on them themselves, and get all the glory and credit. I've never understood this. I guess they think they may never have another good research idea, so they covet what they have. In my experience, you can give them away with both hands and still have more than you can ever pursue yourself.
- l. Discoveries: Make them. Newton said he solved problems by keeping them "...continually before the mind" - that is, by thinking about them all the time, any time, when you aren't preoccupied with doing something else. When I am on autopilot - in the shower, driving to work, in a committee meeting - I usually have a problem I'm thinking about. I wake up with it in mind, and go to sleep with it in mind. I don't solve all of them, but every once in a while I do: all the puzzlements, the disconnected fragments that seem relevant, fall into place, and I see that one basic idea can fit them all, comfortably, with no fragments left over. This is sometimes called the "Aha!" experience, and it is wonderful. You suddenly understand something that was mysterious before, it all fits nicely into your worldmodel, and you can now connect it with everything else you know. Once in a while it will be new - that is, will be something nobody else knows. Then the satisfaction of having found it out is really intense, and is the basic reward from doing astronomy in the first place. There is no feeling quite like it.
- m. Careful, now. Be sure it's right, that you can not only defend it, but that you can explain it simply. Also make sure you have not found it just because you wanted to, because you were sure that nature worked this way. Make sure it's really so and you can prove it. Read the history of astronomy so you won't be condemned to repeat it. Look up William Pickering, who thought the moons of Jupiter were elliptical and talked a lot of other (visual) observers into believing it too. Remember Percival Lowell and his canals on Mars. Read about the precession of the orbit of Mercury, and how it was "solved" by finding the planet Vulcan as the nearest planet to the sun. If you really expected nature to behave as you have just found, be doubly suspicious. But if it's both new and right, practice how you will explain it to Rutherford's barmaid in less than five minutes - they are more rushed now than they were then, and probably less interested in science.
- n. Above all, have fun.