ASTRONOMICAL SOCIETY OF AUSTRALIA
Incorporated in the ACT
ABN 37 660 297 848

How to Become an Astronomer

A guide for students of all ages

Preface

This webpage was produced by the Astronomical Society of Australia in response to many enquiries from those who share our interest in astronomy. The Society has no permanent headquarters, such as an observatory, but brings together professional scientists and students working in astronomy or a closely related subject, plus astronomy educators and some amateur astronomers who are involved in research projects. The Society represents these people, arranges scientific conferences, and publishes research papers. In general, keen amateur astronomers are best catered for by local amateur astronomy groups as mentioned in the section 'Information and Courses in Astronomy'.

Introduction

Astronomy is a very exciting and challenging subject which involves many of the other sciences such as physics, mathematics, chemistry and geology, and, more recently, even palaeontology and biology.

Many people are fascinated by the splendour and enormity of objects in space and become amateur astronomers while still at school. Astronomy can be an engrossing hobby for people of all ages, and there are many clubs and societies in Australia which provide information and facilities for looking through quite large telescopes that would be out of the range of most lone amateurs. Because of the wide public interest in astronomy, many universities and colleges organise evening courses on the subject, designed for people who do not have an advanced scientific background. Some offer online courses in astronomy. There is a very well-produced local magazine, *Australian Sky & Telescope*, which has lots of useful information for the keen amateur.

Professional Astronomy as a Career

Some people decide at some stage in their lives that they would like to earn their living by working on a particular aspect of astronomical research. They may not have had an amateur interest in astronomy from an early age but have turned to this science through an interest in some astronomical application of mathematics, physics or another subject. Present day astronomers have a wide variety of backgrounds but with a common thread linking them all together. They have demonstrated the ability to master a particular facet of astronomical

research, and they have a curiosity about nature that can drive them to spend long hours in an endeavour to reveal something new about the Universe. Note though that the employment situation in professional astronomy is very competitive, even for students who graduate with excellent PhDs.

How to Start

A professional astronomer is a scientist. The path to becoming a scientist starts with the subject choices made during high-school. Here, the study of the sciences, especially Physics, as well as Mathematics is recommended. However, as for many other careers, a large part of a research scientist's job is also dependent upon the ability to write (a thesis, research papers, telescope proposals, grant applications,...) so English should not be undervalued. After high-school, the vast majority of those who go on to become professional astronomers will go on to university to continue their studies in physics, mathematics, engineering or computing. As part of university studies, students often undertake research projects in astronomy, although maintaining a breadth of studies beyond astronomy can only improve future prospects.

Being a professional astronomer is an intellectually challenging career, and after the completion of an undergraduate degree, those seeking to become professional astronomers continue into postgraduate research degrees, usually a PhD. This path can be either via a Research Masters degree or by achieving a first class Honours degree with a significant research component to demonstrate the ability to undertake research.

This marks the transition from being simply a learner of skills and knowledge to becoming an active researcher.

The move into postgraduate research also provides another opportunity, the chance to travel. Many Australian students make their choice for undergraduate study based upon their personal circumstances, such as the chance to remain living at home. For postgraduate studies, you may have to change university, either because your current university does not offer a research project in the area you are interested in, or you may want to join a large, internationally recognised group. Making such a choice requires you to do your homework and seek out where you want to go; in making such a decision, you should have decided what area of astronomy you wish to follow. There are a number of Summer School Scholarships and projects offered by the major institutions - these provide an excellent opportunity to mix with students already involved in the field as well as researchers and get an idea what is really involved.

What skills do professional astronomers need?

Many astronomers possess skills that are particular to their field. However, there are a number of generic skills that astronomers need to call on (starting with astronomy projects as undergraduates). These include:

- **Computer skills:** All astronomers need to use computers, for tasks ranging from email and web access to extremely complex computations. These may be numerical simulations of the growth of the universe to handling of very large data sets or the design of the next generation of instruments. One issue that often comes as a shock to new students is that astronomers generally do not use WINDOWS-based

systems, but rely on UNIX-like systems. Skill in this area can smooth the beginning stages of postgraduate study, and so experience gained as an undergraduate can be very useful.

- **Scientific Writing:** All scientists must write; papers, reports and even lecture notes, and the skill of scientific writing is extremely important, and a lot harder to learn than many envision. It is a skill that can be gained through practice, and so reading and writing scientific reports as an undergraduate will give important experience that can be taken into a postgraduate degree and developed further.
- **Public Speaking:** As with scientific writing, all scientists must be able to orally present their results to their peers. While some have a flair for public speaking, to others this skill must be learnt through continual experience. For many, the first experience of scientific public speaking comes during their undergraduate years with the presentation of research projects. Again, these can provide important experience that can be taken into postgraduate studies, but it can take quite a while to hone teaching skills and become an effective scientific speaker. Being an effective *public* speaker is also a valuable skill. Local astronomy clubs welcome astronomers to speak at their meetings, while universities have outreach opportunities that also offer valuable experience.

Where to Go

Most universities can give you a good grounding in science, but it does help to attend a university that has an astronomy department or that can provide some astronomy courses taught by astronomers, usually as part of an undergraduate BSc teaching programme. This becomes more important in the honours year of a degree course, or a masters degree, when staff in an astronomy or mathematics department can supervise a research project that can count for a large fraction of the marks for the course. Another advantage is that your ability and interests will be known to the astronomers at your university, who will support you when you apply to commence the next stage of your career as a postgraduate student undertaking an MSc or PhD degree.

Information and Courses in Astronomy

The astronomy course offerings available at universities in Australia may range from some basic lectures in astronomy as part of a degree program (usually Science) to a full astronomy program. Lecture courses range from a survey of the subject intended for students taking astronomy as a General Studies course, to specialist lectures aimed at students undertaking coursework as part of their postgraduate studies. For a list of astronomy coursework subjects and programs offered by Australian universities, see the Higher Education page (http://astronomy.org.au/education/higher-ed/) on the Australian Astronomy web site (http://www.astronomy.org.au/). You should make enquiries of the universities directly shortly before you have to make the choice of which tertiary institution you will ultimately attend.

Many people aim to improve their knowledge of astronomy so that they can get more out of it as a hobby or for other reasons, for example, to aid their work as science educators or science communicators. If that is your major interest area then evening lectures or online courses may be most appropriate option for you. To find out what is available in this area, contact the External Studies Centre of the nearest university or one of the Amateur Astronomy Societies, or do a search for online astronomy courses on the Internet. A list of Astronomical Societies appears regularly in *Australian Sky & Telescope* and many of them have Internet sites (see the list of websites at (http://astronomy.org.au/amateur/amateur-societies/) on the Australian Astronomy web site (http://www.astronomy.org.au/).

The Daily Life of a Professional Astronomer

Professional astronomers are research scientists who strive to understand the properties and behaviour of objects in the Universe beyond (and including) our little planet. Astronomers may

- be involved in taking astronomical observations, using optical, infrared, millimetre or radio ground-based telescopes, or a range of satellite-based telescopes and detectors,
- work on developing astronomical theories, which make predictions which can in turn be tested by observation or computational analysis,
- interpret observations or theories using their knowledge of astronomy and other sciences and use computers to test their ideas mathematically.

The instruments used to analyse radiation from objects in the sky are often at the cutting edge of technology, and astronomers are also heavy users of the latest in computer technology, including the use of supercomputer techniques and robotic telescopes.

Contrary to popular belief, most astronomers do not spend most of their time at telescopes. An astronomer will often record enough data in a week's observations at a telescope to be kept busy back at their home institution for much of the year. Most of the work is done using computer analysis, so computer skills are very important, and astronomy graduates gain a wide range of computer skills.

You might find the following brief video clips entertaining and revealing:

- Physicist Dress Code
- Academic freedom

Where to Find Employment

Here we must be careful not give a false idea of the number of positions available in astronomical research. After finishing your initial training and obtaining your research (PhD) degree, it is a important to gain some experience working as a research fellow at one or more local or overseas universities or observatories. Indeed, most astronomers find it necessary to take a succession of fellowships, each lasting two or three years and often in different countries. There is great demand for these positions and you will need to have a very good academic record to be offered one. There is a similar, if not even greater, demand for almost any kind of position in astronomical research within Australia. If you are able to join the staff of a university, then you will be likely to spend a significant proportion of your time teaching undergraduate and/or postgraduate students.

The typical astronomy postgraduate student becomes very expert in many aspects of computing, mathematical analysis, data reduction and instrumentation. These skills make astronomy MSc and PhD graduates very employable in many fields other than astronomy, with many find employment in areas such as high-performance computing and the finance industry.

As an example of where astronomy can lead a young person, look at the brief description of the career so far of

- **Joss Bland-Hawthorn**, ARC Laureate Fellow at the University of Sydney (see http://asa.astronomy.org.au/profiles/joss.php).
- **Michael Burton**, Professor at the University of New South Wales (see http://asa.astronomy.org.au/profiles/burton.php).
- **Marc Elmouttie**, Research Scientist, CSIRO (see http://asa.astronomy.org.au/profiles/elmouttie.php).
- **Sean Farrell**, Data Scientist, Teradata (see http://asa.astronomy.org.au/profiles/farrell.php).
- **Tanya Hill**, Astronomer at Melbourne Planetarium (see http://asa.astronomy.org.au/profiles/hill.php).
- **Vanessa Moss**, Postdoctoral Scientist at the University of Sydney (see http://asa.astronomy.org.au/profiles/moss.php).

There are other ways to become involved in astronomy beyond "being an astronomer". All observatories and universities depend upon their technical and support staff. Meet some staff of the ATNF who are engineers and technicians, public relations and administration staff as well as astronomers.

Amateur Astronomy

Astronomy has the largest organised amateur following of any of the sciences. Amateur astronomers observe the sky with the naked eye, binoculars, or telescopes, and often meet together in regional astronomy societies for discussions, guest speakers, telescope building workshops and night observing sessions at dark sites. (see the list of astronomical society websites at <http://astronomy.org.au/amateur/amateur-societies/.

Many keen amateur astronomers take part in searches for objects such as supernovae, comets and studies of variable stars, contributing significantly to the advance of astronomy generally. The person who holds the record (over 30!) for the highest number of visual discoveries of supernovae by anyone, amateur or professional, is an Australian amateur, Rev. Robert Evans. Many amateur astronomers combine busy professional careers in other areas with a lifelong recreational interest in astronomy.

More Information on the Internet about Careers in Astronomy

- 'So you want to be a Professional Astronomer' by local astronomer Duncan Forbes (http://astronomy.swin.edu.au/~dforbes/mercury.pdf)
- The American Astronomical Society: A New Universe to Explore: Careers in Astronomy (http://aas.org/education/careers.php)

FAQs

- Astronomy Careers FAQ: http://www.astro.cornell.edu/~brs/faq.html
- The Astronomy Cafe: 61 FAQs about a Career in Astronomy (http://www.astronomycafe.net/qadir/acareer.html)
- US National Optical Astronomy Observatories: FAQs about ... Being an Astronomer (http://www.noao.edu/education/astfaq.html)