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SOME CHARACTERISTICS OF YOUNG VERSUS ESTABLISHED
AMERICAN ASTRONOMERS

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ABSTRACT

The applicants for election to the International Astronomical Union from the United States in 1988 and for two tenure-track positions in astronomy or astrophysics provide a sample of 269 mostly-young astronomers (median date of Ph.D. 1982), who appear to be representative of the population intending to pursue research-oriented astronomical careers in the U.S. Out of many questions that might be asked about this population, we here explore national origins (27% are foreign born) and the length of time elapsed between B.A./B.S. and Ph.D. (the median is 6 years and increases with time). In a comparison sample of 304 established astronomers (median date of Ph.D. 1962.5), about the same fraction (23% to 28%) are foreign born, but the median time from B.A./B.S. to Ph.D. is only 5 years and was 4 years for degrees received before 1954. Both samples are about 10% female.

Key words: astronomy careers

I. Introduction

The younger generation has been either going to the dogs or repairing the damage done by its elders (depending on which side of the fence you sit on) at least since the time of Quintus Horatius Flaccus (c. 25 BCE). One hears, for instance, that young astronomers are more prompt in publishing their data, but less likely to read the archival literature, than their predecessors. Neither of these is easily susceptible of quantitative testing. Some other possible differences are testable, given data on enough members of each generation. Chance simultaneous service on several committees placed on my desk résumés of 269 mostly-young (median Ph.D. 1982) astronomers who have recently applied either for tenure-track positions in astronomy/astrophysics in the U.S. or for election to membership in the International Astronomical Union from the U.S.A.

Many questions could be asked about these young astronomers. The two addressed here arose in discussion with colleagues: (a) is the U.S. becoming increasingly dependent on immigrant scientists? and (b) is the average length of time taken to earn a Ph.D. increasing? In comparison with a sample of 304 established astronomers, the answers turn out to be no and yes, respectively.

II. The Samples of Applicant and
Established Astronomers

Applications for IAU membership from the U.S.A.

were filed by 184 people in 1988. (The opportunity arises every three years.) Two recently advertised, assistant-professor positions in astronomy or astrophysics attracted 92 applications, seven from people who had also applied for IAU membership (and who were analyzed as part of the IAU sample). Thus, the "applicant astronomer" group contains 269 people. The median applicant received his Ph.D. in 1982, with 68% between 1978 and 1986. A few of them did not provide information on places of birth or on dates and places of degrees or never received formal Ph.D. (or B.A./B.S.) degrees. Thus, some total numbers in the tables and figures are slightly smaller than 269.

The two applicant samples are statistically not quite the same. The ground rules for IAU election from the U.S. include a record of publication for at least three years past the Ph.D. or equivalent and citizenship or permanent residence. In effect, the academic community and the Immigration and Naturalization Service ask for rather similar characteristics in assistant professors, but the requirements are not formalized and so the job-applicant pool includes a few very recent Ph.D.s and a few who have never worked or studied in the U.S. The differences are, however, small, and the two groups are largely treated together in the next section.

A comparison group of "established astronomers" had to be created. This was done by selecting (a) all current officers, councilors, and committee members of the American Astronomical Society from its 1988 directory,

(b) all living prize winners and former officers and councilors of the AAS, and (c) a subsample of people elected to the IAU at or before its 1982 General Assembly who listed U.S. addresses at the time of their election, taken from every tenth page of the 1983 IAU directory. About ten astronomers who had not spent a significant part of their careers in the U.S. were eliminated from subsamples (a) and (b).

This yielded 418 people reasonably describable as established American astronomers. Data on their places of birth and dates and institutions of academic degrees were then extracted from the 16th edition of *American Men and Women of Science* (AMWS). There were no listings for about one-quarter of them, reducing the usable sample to 304. The median established astronomer received his Ph.D. in 1962.5 (68% between 1952 and 1972). Incomplete data in some AMWS listings slightly reduce some of the tabulated total numbers.

One worries about systematic differences between the listed and unlisted astronomers as a source of bias. The unlisted are, on average, younger than the listed (both because of the way AMWS selects its biographees and because such volumes have, in recent years, proliferated to the point where no one can fill out all the forms that arrive on his desk!). This merely separates our applicant and established samples a bit more in time and is all to the good. The unlisted are not, on average, employed at more or less prestigious places than the listed and show no other evidence of higher or lower competence or repute that might somehow be correlated with earning degrees rapidly or slowly. Finally, foreign-born astronomers may be slightly overrepresented among the unlisted (either because they find a form labeled "American something or other" unattractive or because they are just not questionnaire minded). The statistical effect of this is addressed briefly in the next section.

III. Characteristics of the Samples

Tables I and II indicate nations of birth and first degree (B.A./B.S.) of the applicant and established astronomers. Ph.D.s were earned in either the U.S. or the country of first degree, except where indicated. Present employment or residence is in the U.S. except where indicated. Country names are those in effect at the time of first degree or birth.

A large majority of both groups is U.S. born and educated. But 27% of the applicants (72 of 269) and 23% of the established astronomers (71 of 304) are foreign born. In addition, 21% of the applicants (57 of 269) and 19% of the established sample (58 of 304) received their first degrees (B.A./B.S.) abroad.

The applicant and established groups are really even less different in this parameter than they at first appear. Four or five of the job applicants have never actually worked or studied in the U.S. and may well never, in fact,

TABLE I
Countries of Origin of Applicant Astronomers

BIRTH	BA/BS	NUMBER
US	US	197 (PhDs 1UK, 1 GFR; 2 employed NL, 1 UK, 1 Israel)
UK	UK	13
Canada	Canada	10 (1 NL PhD, 1 employed Canada)
	US	1
Israel	Israel	3 (1 GFR PhD)
	US	1
Taiwan	Taiwan	2
	US	2
Argentina	Argentina	3
India	India	3 (1 employed Italy)
Mexico	Mexico	3 (1 UK PhD; 1 employed Canada)
	Poland	3 (1 refugee)
	DDR	1
	GFR	1
	Spain	1
Australia	Australia	2 (1 UK PhD)
Japan	Japan	2 (1 employed Japan)
Finland	Finland	1
	US	1
Iran	US	1
	Belgium	1 (employed Switzerland)
	Chile	1 (employed Switzerland)
	Italy	1
	Australia	1
	Lebanon (Am. Univ.)	1
	Netherlands	1
	Netherlands	1
	New Zealand	1
	PR China	1
	PR China	1
	Romania	1
	Yugoslavia	1
	Czechoslovakia	1
	US	1
	Hong Kong	1
	US	1
	US	1
	Sweden	1
	Switzerland	1
	US	1
	Thailand	1
	US	1
	Venezuela	1
	US	1
	Stateless	1

do so, reducing the real foreign-born fraction here to about 25%. Among established astronomers, on the other hand, a disproportionate fraction of the foreign born were lost through not being listed in AMWS. Most of the 114 unlisted people are at least personal acquaintances, of whom 25 were definitely and eight probably born outside the U.S. Thus the total group of established astronomers is also about 25% (104 of 418) foreign born.

The corresponding numbers may well be higher or lower or changing for other sciences, but astronomy in the U.S. has been remarkably stable in drawing about one-quarter of its practitioners from other countries. The distribution among countries of origin also looks about as stable as shifting politics and statistics of small numbers would permit. In particular, the United Kingdom has contributed about 5% of both the applicant (13 of 269) and established (15 of 304 or 24 of 418) astronomers. It is perhaps significant that the colleagues who originally suggested that American astronomy was becoming rather parasitic is British.

The length of time required to earn a Ph.D., in contrast, differs significantly between the two samples. Figures 1 and 2 show the distributions of numbers of years between B.A./B.S. and Ph.D. for the applicant and estab-

TABLE II

Countries of Origin of Established Astronomers

BIRTH	BA/BS	NUMBER
US	US	232 (PhDs 2 UK, 2 Australia, 1 Canada, 1 Israel) (2 now in Canada)
US	Canada	1
UK	UK	13
	Australia	2
	UK	1
Canada	Canada	8
	US	1 (now in Canada)
Germany	Germany	1
	GFR	3
	Israel	1
	US	3
Netherlands	Netherlands	6 (1 now in GFR)
Australia	Australia	1
	UK	1
	US	1
India	India	3
Italy	Italy	2
Ireland	Ireland	1
	UK	1
Israel	Israel	1
	US	1
Switzerland	Switzerland	1
	US	1
Hungary	Hungary	1
	US	1
China	US	2
Argentina	Argentina	1 (PhD Italy)
Denmark	Denmark	1
Mexico	Mexico	1 (now in GFR)
Greece	Greece	1
South Africa	South Africa	1
Czechoslovakia	Canada	1
Hong Kong	Canada	1
Morocco	Canada	1
Austria	Australia	1 (PhD UK)
Danzig	US	1
France	US	1
Latvia	US	1
Monaco	US	1
Russia	US	1

FIG. 1—The distribution of numbers of years between B.A./B.S. and Ph.D. for applicant astronomers.

lished astronomers, respectively. The shapes are rather similar, but the two histograms are displaced by a year, the applicant plot peaking at 6 years and the established one at 5 years. In both samples, intervals of 10 or more

FIG. 2—The distribution of number of years between B.A./B.S. and Ph.D. for established astronomers.

years typically reflect the intervention of some major nonacademic activity. Military service is the commonest in both groups, but the range includes child raising, the ministry, and beachcombing.

What are we to make of the difference? The first, happy, reaction is that the established community has been through a filter which has removed those who were slow to earn Ph.D.s because they were less interested or less productive than average. This would be a comforting thought, especially to members of committees who decide the number of years a student is permitted to spend on graduate work. Unfortunately, the breakdown of the data shown in Table III suggests that this first thought is not the whole story. Instead, the dominant effect seems to be a gradual increase with time in years required to earn a Ph.D., in both samples separately and in their sum.

Table III lists numbers of applicant, established, and total astronomers who took from 2 to ≥ 11 years from B.A./B.S. to Ph.D. The median is underlined in each column and can be seen to have increased from 4 years for Ph.D.s earned before 1954 to 5 years for those between 1954 and 1974 and to 6 years after 1974. Another way to look at the numbers is as the fraction of Ph.D. recipients who took 7 or more years. This increases monotonically from 0.18 (1931–53) through 0.27 (1954–74) and 0.36 (1975–79) to 0.48 (1980–88). The change has not been an increase in very long (≥ 10 yr) times, but rather a gradual replacement of 4- and 5-year degrees by 6- and, increasingly, 7- and 8-year degrees. The change would look even more extreme without the U.K. immigrants, who contributed disproportionately to the shorter times in the applicant (but not in the established) sample. The 4-year Ph.D. may still be the norm in many of our minds, but it has not been the average for more than 30 years.

TABLE III

Distribution of Years Between B.A./B.S. and Ph.D. for Applicant (A), Established (D), and Total (T) Astronomer Samples Subdivided by Year of Ph.D.
(Median of Each Subsample Underlined)

YEARS BA/BS - Ph.D.	PhD RECEIVED IN																							
	1931-53			1954-62			1963-68			1969-74			1975-79			1980-83			1984-88					
	A	E	T	A	E	T	A	E	T	A	E	T	A	E	T	A	E	T	A	E	T	A	E	T
2	0	4	4	0	1	1	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
3	1	13	14	0	9	9	0	3	3	1	2	3	0	0	0	1	0	1	2	0	2			
4	<u>2</u>	<u>19</u>	<u>21</u>	<u>2</u>	9	11	0	14	14	4	11	15	5	7	12	8	0	8	5	0	5			
5	1	8	9	0	<u>16</u>	<u>16</u>	2	<u>20</u>	<u>22</u>	<u>8</u>	<u>17</u>	<u>25</u>	8	<u>5</u>	13	23	0	23	12	0	12			
6	0	11	11	0	12	12	<u>2</u>	12	14	3	11	14	<u>13</u>	3	<u>16</u>	<u>13</u>	0	<u>13</u>	<u>28</u>	0	<u>28</u>			
7	0	2	2	1	7	8	0	7	7	2	11	13	6	3	9	16	0	16	23	0	23			
8	0	1	1	0	5	5	1	5	6	2	0	2	4	1	5	13	0	13	12	0	12			
9	0	3	3	0	1	1	0	1	1	2	1	3	3	1	4	4	1	5	5	0	5			
10	0	2	2	0	1	1	1	3	4	1	0	1	2	1	3	0	1	1	2	0	2			
≥ 11	0	5	5	0	4	4	0	2	2	1	2	3	3	0	3	7	0	7	2	0	2			
Total	4	68	72	3	65	68	6	68	74	24	56	80	44	23	67	85	2	87	91	0	91			

About three-quarters of the astronomers in both samples received M.A. or M.S. degrees between the B.A./B.S. and Ph.D., very typically two years after the first degree. It is not clear, however, that the intervals between B.A./B.S. and M.A./M.S. or between M.A./M.S. and Ph.D. contain any additional information, since many institutions award these degrees more or less automatically to graduate students who have completed a certain number of units, passed (or failed!) their qualifying exams, or otherwise simply made normal progress.

One final datum is readily available. Of the applicant astronomers, about 9% are women (18 of 184 for the IAU and 7 of 85 for the assistant professorships) as are 11% of the established astronomers (30 of the 304 with AMWS listings and 17 of the 114 not listed). This 10% level seems to be typical of many current populations. A count of every sixth page (28, 34, 40 . . . 94) of the 1988 AAS directory found 88–92 women among 817 members, or 11%. The uncertainty reflects four probably but not uniquely feminine given names among members not personally known to me. Among other possible samples, authors in *Annual Reviews of Astronomy and Astrophysics* under the present editor are 9% (29 of 315) female, and 1987 PASP authors are at least 10% (40 of 415) female, representing a lower limit owing to the assumption that all authors are men who give only initials and are not known to be women.

Other subsets over- or underrepresent women, who make up 18% of AAS officers and committee members in both the 1988 and 1984 (Trimble 1985) directories but only 5%–6% of astronomers at prestigious institutions (Trimble 1985) and of living winners of AAS prizes excluding the Cannon Prize (8 of 132 and 6 of 117, respectively.)

What about secular trends? Counting every sixth page of the 1973 AAS directory yielded 33 women among 530

members (6%). *Annual Reviews* authors under the previous editor (1962–73) were only 4% female (9 of 226), and the 299 PASP authors in 1972 included 19 (6%) women. The difference between about 10% now and about 5% then is probably real, but it is not part of a monotonic, long-term trend: a photograph of the founding members in Williams Bay in 1899 included 9 women in a group of about 92.

IV. Potential Sources of Error

The 304 established astronomers were selected from American Astronomical Society officers and prize winners and International Astronomical Union members and so are largely people who really do astronomy (research, advanced teaching, organizing) for a living. The sample is thus more or less by definition representative of established astronomers and includes 20%–30% of full-time American ones with pre-1975 Ph.D.s.

The chief remaining possible source of error here is the foreign-born component of established astronomers not listed in AMWS. One does not often go up to a colleague and say something like “you have a beautiful mid-Western accent and seem to know nothing whatever about the rest of the world. Where were you born?”. Still less often is the answer “Vladivostok”. But it happens: one (though only one) of the 304 listed astronomers who I had always assumed was native born, despite a somewhat exotic name, is not. Thus the immigrant fraction may be a little larger than 25%.

The 269 young astronomers were self-selected through applying for IAU membership or recently-advertised tenure-track jobs. They have, therefore, declared their intention to remain or become part of the professional American astronomical community. Given that something like 40–50 new Ph.D.s seek first positions in astron-

omy each year, the sample must include 1/3–1/2 of the 1978–86 cohort and a somewhat larger fraction of those who will, in fact, remain part of the community, since there has already been some filtering.

It is possible that those who have chosen not to join the IAU at this time (and have applied for other jobs or are content with their present ones) are somehow different from the present samples in ways that would undermine the main conclusions. They might, for instance, have earned their Ph.D.s faster on average or include more immigrants. A review of acquaintances not in the sample does not support this possibility. In any case, nonapplicants are quite unlikely to be more *typical* representatives of future astronomers than the applicants.

V. Conclusions

Data on samples of young and established American astronomers (median Ph.D.s 1982 and 1962.5, respectively) have been examined for countries of origin and length of time elapsed between first degrees (B.A./B.S.)

and Ph.D. Both groups are about 25% foreign born with the U.K. contributing one-fifth of the immigrants, or 5% of both samples. Both samples are about 10% female, as is the present general AAS membership. Times elapsed between B.A./B.S. and Ph.D., on the other hand, are not constant. The median has increased from 4 years before 1954 to 5 years for 1954–74, to 6 years for degrees earned after 1974. Of the youngest astronomers (Ph.D.s 1980–88), 48% took 7 or more years to earn their Ph.D.s. Though we may think of 4 years in graduate school as a desirable standard, it has not been average for more than 30 years, and 7- and 8-year degrees are by no means uncommon today.

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