

How To Get A Research Job in Academia and Industry

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Invites nominations and applications for the Abraham A. Mitchell Distinguished Chair in Infectious Diseases. Candidates for this position should have a national reputation for accomplishment in the field of infectious diseases, particularly but not exclusively in the area of tropical diseases.

POSITIONS AVAILABLE

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POSITIONS AVAILABLE

UNIVERSITY OF KANSAS RESEARCH AIDE/ASSISTANT/ASSOCIATE

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CAREER OPPORTUNITIES

POSITIONS AVAILABLE

DIRECTOR

FOR RESEARCH PROGRAMS

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The University of Pittsburgh School of Medicine invites applications for two tenure-track positions at the Assistant or Associate Professor level. Preference will be given to individuals with primary training in molecular biology/cell biology with research interests in the area of cancer biology.

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POSITIONS WANTED

FOREWORD

This handbook was originally written and copyrighted by Dr. Susan Goldhor in 1976, incorporating materials from the Women in Cell Biology Newsletter and from discussions at a series of workshops on the academic job market held at Yale University in 1974 and 1976. Drs. Mary Clutter and Virginia Walbot contributed significantly to the original handbook. With Dr. Goldhor's permission, the Steering Committee of the Women in Cell Biology revised the handbook for the 1990s job market in 1989 and again in 1993. The Publication Committee of the ASCB revised it again in 1996. It is primarily intended for those at the postdoctoral level seeking a position with a large research component. However, information for students at earlier stages of their careers is also included to help prepare them for their first "real job" hunt.

HOW TO GET A RESEARCH JOB IN ACADEMIA AND INDUSTRY

I. FINDING A JOB

How do you start looking for a research job? Most people begin by searching the advertisements in *Science* and *Nature*. Classified ads can also be found in other journals and on the web. A listing of web sites can be found by a search for “science jobs.” In addition, your field’s professional societies (which are well worth joining) often maintain their own registry. They may keep the registry at their offices, publish it in their own journal or at their web sites, and have placement services at meetings. (These are often better for postdoctoral positions than for academic jobs, but they do have some of the latter.) The Association of Women in Science (AWIS) publishes job listings in its newsletter and maintains a registry in their office.

It is important to begin to think about your job search while you are in graduate school. In order for you to get a job, your application needs to stand out in the pool of very good applicants. For this to happen you must first be doing good work. Secondly you need to be known in the scientific community. For this reason, networking while a grad student and postdoc is vital. So travel, go to meetings, take summer courses, and go to other labs for short durations. Today, with essentially every scientist using e-mail, you may also get to know people via the internet when you write them for advice or reagents.

Your application will stand out if someone at the target institution, preferably someone on the search committee, knows you. Your advisor is also a good source of employment opportunities through his or her own contacts. If you let people know that you are job-hunting, other professors in your department, or even some you get to know through meetings or while they are passing through on the seminar circuit, may unexpectedly help you. Frequently, through these contacts, you will be invited to apply for a position. Whether you are invited to apply or apply in response to an ad, the record you build in graduate school, your proposed research, and your letters of recommendation are the flags that make members of search committees stop and take notice.

II. PAVING THE WAY: GRAD SCHOOL AND POSTDOC YEARS

Today, there are many different types of jobs for people with PhDs in science. However, the scientific training for these different positions is surprisingly similar. Whether you plan to go to industry or academia, you should do everything possible to ensure that you get your Ph.D. and, especially, do your postdoctoral work at a top notch laboratory. What is a top notch laboratory? It should be in an environment where research is preeminent. It should be an environment that provides good support and excellent training and an environment in which the students and postdocs are reading and talking about the literature and excited about science. Most of all it should be in a laboratory where people are doing work that receives worldwide attention, through publication in good journals and through word-of-mouth. Such laboratories and the institutions where they are found are in demand.

What do you do if your undergraduate record does not qualify you for such an institution (although it doesn’t hurt to apply anyway). One course of action is to get a position at a good research laboratory as a technician. Plan to spend two years in this position. Don’t be afraid to start out doing more menial tasks such as washing dishes. Work like mad and take time to be intellectually involved in the research of the laboratory, read papers, and go to seminars. Most P.I.s will reward such enthusiasm with increased responsibility and independence. If your GRE scores were a problem, study to do better the second time. This course of action will have three rewards. First and most important you will get a stellar letter of recommendation from your boss that can help overcome deficiencies in your grades and GRE scores. Second you will learn whether you like doing research. Third, when you get to grad school, you will be advanced in experience and maturity over students who arrive directly from their undergraduate work. Alternatively, if you are determined to go directly from undergrad to grad school and your record does not make you competitive for the very top institutions then enter a good “second tier” institution and find a good lab (there will be many there). Try to be the best graduate student your advisor has ever had and allow that recommendation to carry you to a top notch laboratory for your postdoctoral work. In the long run your postdoctoral work will have the most impact in getting your first job. It is not unusual or detrimental to do two postdocs to improve your scientific credentials.

One extremely practical way to increase your chances for success when looking for a job is to research, in advance, how your professor's former graduate students and postdocs have done in the job market. You may discover a very clear pattern. There are laboratories where every person passing through seems to do a nice piece of research, publish, and find a good job. There are others where people drift, fall away, fail to publish, and have spotty employment records. It is up to you to make sure that you maximize your chances by working with a professor who has a reasonable record. Beware of the mentor whose former graduate students have fallen by the wayside, or have had to overcome tremendous handicaps, even if he or she seems genuinely interested in having you in the lab. What makes you think you are so different? Others were probably treated the same, as long as they represented willing workers for the research problems.

If the professor you would like to work with is quite young, there will be no record to look at, and you will have to trust your judgement. In general, a young, not yet tenured assistant professor is a good bet because this person is as desperate to publish and make a name for himself or herself as you are. The young professor will be in the lab more than almost anyone else, will push you like mad, and will probably do everything possible to help you to a good position, because your success will help him or her garner prestige and future collaborators. However, this strategy has its risks as well. If the young assistant professor does not receive tenure in the next two to three years, you could be in trouble. Also there will be fewer "crumbs from the table," e.g., giving talks that your advisor was originally invited to give, authoring or co-authoring reviews, etc. These can be very helpful in meeting other people in the field and getting your name known. The very fact that your advisor feels you can do a good job standing in for him speaks well of his opinion of you. You, of course still have to do a good job!

The sections below are written with the assumption that you have targeted jobs at first-rate research institutions. However, it is very important at this juncture in your career to carefully assess your talents and interests. For example, the ambiance at such institutions may be deeply unappealing to you and you may have no desire to take on the project of trying to change them. Or you may have strong social/political/personal reasons to want to bring excellent research/teaching to less renowned institutions or to those with different commitments. The jobs that you apply for should be jobs that you, not your advisor/friends/family, feel genuinely enthusiastic about. Enthusiasm is a major factor in getting, and keeping, the job you seek and remaining happy at your work.

III. APPLYING FOR THE JOB

Having located a job, you must now start the process of applying for it. Usually, this means sending out a curriculum vitae (a C.V.) and a cover letter. It will help a great deal at this stage if a colleague you know can write or telephone someone at the institution to which you are applying, and tell them that you are a superior candidate who warrants careful consideration. This will help to differentiate your application from the others that the department will almost certainly receive. Nevertheless, if you cannot arrange this, do not despair.

IV. THE C.V.

The C.V. should include the following information: your degrees, where and when they were awarded; positions held; membership in professional societies; fellowships, grants and honors; publications (including theses and advisors); areas of interest and experience in research and teaching; and three to five names and addresses of (preferably highly regarded) people in your field who have agreed to provide letters of reference for you. Make sure that you ask their permission before you send out their names and telephone numbers and try to determine that what they will write will be very complimentary. Check the final draft carefully for typographical errors and make certain that you have included your name, current address, telephone number, fax number, and e-mail address. For a first job, your C.V. is unlikely to be longer than a few pages. Make sure that those pages are neat, clear, easy to read, and accurate. If you have any doubts about format, ask some of the assistant professors in your department to show you their C.V.s or to look yours over. A sample C.V. is found at the end of this publication.

Many job advertisements request a statement of future research and teaching interests. Even if they don't, it is an excellent idea to include such a statement. This should be separate from your C.V. so you can tailor it to any specifics in the ad (e.g., molecular geneticist, membrane biochemist, etc.) The research statement should convince the often bored and

exhausted reader of application folders that you have a clear, original, and eminently fundable plan of projects to be undertaken in your lab during the first three to five years of your job. In your statement about teaching it is a good idea to outline both an undergraduate and a graduate course that you would like to develop, and to indicate any unique features that would make them interesting.

The C.V. should not have to include truly personal data; it has nothing to do with whether you should be hired for the position. After reading hundreds of C.V.s, a selection committee may use these as elimination mechanisms either intentionally or subliminally. Sex (if not obvious from the name), citizenship, and date of birth are generally included; however, if you started college at the age of 40, you may not wish to include your birth date—let them extrapolate from your degree dates. You should not give your marital status, nor should you have to list the number and age of your children. You should not put in your height, weight, hobbies, etc. It will appear unprofessional. There will be plenty of time during the interview process to let your prospective colleagues know that you are a well rounded individual with an interest in athletics, music, etc.

Your C.V. should include professionally relevant data. You should list sources of funding for your graduate career, particularly if you were able to obtain your own independent fellowships. Be sure to include invited talks at other universities, including those that were job seminars (but do not list them as such). Book chapters and proceedings of meetings should be listed and can be included in publications, or listed separately. Abstracts can be listed but always list these separately to avoid being accused of “padding.” When you have several publications you might want to drop the abstracts. Be sure to list all articles “in press” (this should mean you have returned the proofs, or, at the very least, have made all revisions and the articles have been accepted in final form) and “submitted for publication” (already sent out). If you are applying for a first job, you might want to list articles “in preparation.” However, remember someone may ask for a preprint or ask your collaborator about the manuscript “in preparation” so do not list something that is not at hand. Keep these up-to-date, i.e., if a “submitted” manuscript is returned, drop it or call it “in preparation.” Do not include honors (or indeed anything) from high school, with the exception of such prestigious, college-oriented awards as Westinghouse or National Merit. It may look as if you have not done anything since.

V. LETTERS OF RECOMMENDATION

You will most likely be asked to provide letters of recommendations by a certain date. When you ask people to write letters on your behalf, be sure to acquaint them with the details of kinds of jobs for which you are applying. In addition, it is essential to determine if the individual is going to write you a helpful letter. Ideally, this will be a “glowing” letter rather than a bland acknowledgment or, worse, one that is negative. This can be a delicate task. However it is so important that if you are unsure, it is best to just come out and ask “Can you write me a *good* letter of recommendation.” It also helps to ask in person or at least by phone. The expression on a person’s face and tone of voice can tell you a great deal. At best, recommenders will tailor each letter to fit the job you are seeking, but more realistically, they will compose a single generic letter and reiterate it via word processing. You should also supply recommenders with your C.V. and publications, and include a brief cover letter mentioning a recent achievement which they are likely to cite in their letter. If the institutions to which you are applying seem to lose interest in you as soon as they have received your letters of reference, it may be that you are being eliminated because of a bad letter.

In theory you have the legal right to read your letters of recommendation. However, this course of action would probably generate ill will on the part of your recommenders. If you suspect that a “bad” letter is derailing your job search, the best approach is to ask a colleague that you know at one of the institutions to which you have applied if there are problems in your application. They likely would be willing to advise you to seek new recommenders. Keep in mind that some individuals are more critical (some would say more honest) than others. The search committee recognizes this as well. Also keep in mind that a letter that points to a genuine but minor flaw may not do you a disservice; indeed, it may add credibility to the praise offered otherwise.

You may discover that you are being done in by someone you could just as easily leave out as a reference, or replace by someone else. If you are being done in by, say, your thesis advisor, things are somewhat more complicated, although still not hopeless. First, try not be too upset, because it happens more frequently than most people realize. Second, if you are far enough along, and have other people to write on your behalf, you might consider leaving that particular per-

son out, no matter how big a role he or she played in your career. Third, you can occasionally have one of your other references, or someone who knows you and knows someone at the institution to which you are applying, call up and warn them that a letter of this sort should be expected but not believed. This may even work to your advantage. Your prospective employers may feel sympathetic and also experience a delightful sense of nobility at rising above someone else's unfortunate prejudices. More practically, they may recognize that you are capable of working productively in a non-ideal environment. And, of course, it will distinguish you from the crowd of other applicants.

VI. THE COVER LETTER

The cover letter, which almost always accompanies the C.V. in a job application, is tricky to write because there is no standard format to follow. On the other hand, this may be regarded as an advantage. Here is your chance to present yourself to the search committee as a person. Use it with great discretion and care.

The cover letter should present *concisely* your major accomplishments and where you plan to go with them. It should announce to the search committee why you are the best candidate for the position, or, at least, why you deserve an interview. Never forget that institutions have egos, and can be insulted. The aim of the letter and, indeed, the whole elaborate ritual of searching and hiring, is to suggest that this particular institution is so well known and so excellent that you, in all of your superiority, have been attracted by it, and wish to improve it further by joining it. Naturally, you have to do this without sounding phony and show the humility appropriate to a junior faculty member. However, you should indicate that you are perfectly confident in your own abilities and that you will succeed tremendously should you be hired. A problem that applicants often create for themselves in cover letters is a tendency to present themselves in an overly humble manner. By downgrading yourself you are indirectly insulting any institution that might hire you. As in personal relations, institutions tend to take you at your own self-evaluation.

VII. THE DUAL CAREER HUNT

Many couples, in which both partners are scientists, find themselves looking for jobs together. Although there are many different dual career situations, most can be divided into two categories—where both spouses are at approximately the same level of their careers or where one spouse is more well established. Some regions are more densely populated with research institutions. On the surface those regions might seem more hospitable to a job-seeking couple. However, different institutions are very unlikely to work together in recruiting. Thus, in such a situation, each of you will have to obtain an independent offer that are both acceptable and both available about the same time. It is generally easier to negotiate two positions within a single institution, either within the same department or in different ones. Indeed an institution that is not surrounded by other research centers may work harder to accommodate a spouse, knowing that they are the only game in town.

Initially your approach to the job market should not vary from what an unattached individual would do. You simply apply aggressively to obtain an interview. It is not necessary to bring up the situation in your initial written application. At the interview the fact that you have a spouse who is seeking a job will probably come up. It is best to be honest. The scientific community is fairly small. It is likely that your situation will be known by your interviewers before you arrive.

If you successfully receive a job offer, be sure to drive the best bargain you can *before* you accept the appointment and arrive at the institution. If a search committee invests the time and energy and thinks you will make a good colleague, they will do everything in their power to accommodate your spouse rather than lose you. Each situation is different but you must make decisions about what you will accept. You and your spouse may have to make compromises. For example, if it is the best you can do at the time, one of you may accept a research track (non-tenure track) position. Particularly for couples in the early stages of their careers, it is important to decide beforehand what you will accept in terms of lab space, start-up funds, etc. for each position. Have it set down clearly in writing before accepting the offers. One unfortunate situation occurs repeatedly. The less well established partner, although ready for an independent position, accepts a postdoctoral position as a temporary measure in the new location. Once there, the postdoc partner is unable to secure a permanent position. If you accept a less than optimal position from your point of view, (e.g., non-tenure track appointment, postdoc, or senior technician) be aware that it may be very difficult to advance once you have arrived. Once

in a town you are a “captive.” For some reason, the prejudice against appointing “captives” to permanent tenure-track positions is strong. The best advice is to avoid getting caught in the trap.

A happy situation is one in which the institution is extremely anxious to attract one spouse and makes good accommodation for the other. In this situation it is best to overcome the tendency to bemoan the fact that “They only want me because of my spouse.” Instead see the appointment as an opportunity and challenge to show your colleagues that they made an extraordinarily wise decision in attracting you as well. Another approach to the situation where one spouse is well established and the other less so is for the less established spouse to be the primary job hunter. An institution making an offer in that case is often delighted to be able also to attract the more well established member.

Finally, the threat of a well established investigator leaving an institution with an offer from elsewhere is a long used method of extracting concessions from the home institution. This threat can be used to open up a position for a spouse. However, this card must be played with caution since you must be willing to move to the new institution if your requests are not met.

VIII. THE INTERVIEW

With luck, at least some of the institutions to which you have applied will invite you to visit them, at their expense, for one to three days.

If you apply for many jobs in a few months, apply as well for several credit cards for charging airline tickets; if you go on interviews you may be financially pressed to pay all the airline tickets. Some schools require six weeks or more to repay you. You should not expect honoraria.

How should you behave so as to maximize your chance of being offered the job? A useful thing to ask ahead of time is where you will be staying. Think up, in advance, tactful ways to insist that it be a hotel rather than someone’s home. This will enable you to relax and be alone at the end of the day, when you will certainly be exhausted.

If you have other offers or interviews at good places it may help your case if the interviewer knows about this. But such information must be worked into a conversation smoothly so it does not appear obvious that you are trying to drop information. If you have applied for many jobs and this is your only interview, do not tell them. They will think they have made a mistake in inviting you. If asked directly about your prospects, you can say how you have applied for a number of positions-period.

Do your homework before you go. Ask to speak with individuals. You should be aware of any in your field at the institution. If possible obtain your interview schedule before leaving so you can see with whom you will be meeting. Alternatively obtain the institution’s catalog or list of faculty in the department and in other departments who are in your general field. Review the recent publications of your likely interviewers and think of some questions to ask each one. When you are interviewed don’t tell the individual that you have just read their recent publications but let it come out in your questions that you are familiar with the field. It is also important to speak to individuals who have been hired within the last few years to gauge their satisfaction with the way they have been treated.

You will probably be shuffled from office to office for at least a day, in a series of interviews with individual faculty members and, perhaps, graduate students. There is nothing worse at such meetings than an embarrassed silence, and it is up to you to prevent it. If you are able to schedule your seminar so that it occurs before these interviews, it will be a tremendous help. On the other hand, some of these people are in fields so far from yours that your seminar was almost incomprehensible to them; others will not have liked it, and there are always a few who couldn’t make it. Many of these people are waiting to hear what you have to say, and what sorts of questions you ask them. Here is where the candidate who has done her/his homework will reap the greatest awards. Essentially before you arrive you should try to find out as much as you can about the faculty, the department, and the institution. You should have intelligent questions ready to ask that will let the faculty know that you know about their work and have broad interests. With faculty close to your own interests, look for areas of collaboration and areas of competition. If you do not know the person’s area of expertise, ask them about their latest results.

If you run into a situation where you can not maintain an active conversation (1) ask about shared equipment and facilities, the library, vivarium, greenhouse, etc., (2) ask about the students and the administration, (3) ask about the community or about house prices, (4) ask for a cup of coffee, (5) ask about recreational facilities. The main point is to be interested in this person. At this point before you have an offer, it is probably wise to refrain from initiating conversations about things that makes your situation look even slightly complicated (day-care, a job for your spouse). Interviewers are not supposed to ask you about these and other personal matters but some of the scientists you speak with may not be aware of the legal niceties regarding job interviews. If you find yourself asked such questions at your initial interview, the best approach is to be honest but very positive about being able to overcome any prospective difficulties in your being able to accept a position at the institution.

At this stage of the proceedings, when the job has not yet been offered to you, do not attempt to settle contractual details. However, this is a perfectly logical time to find out about salary range, available lab space, teaching duties, length of contract, chances at tenure (this may require some clever deduction on your part, rather than outright questioning), library holdings, laboratory facilities, shared equipment, institutional research funds, etc., in a general way.

Make a list of the major facilities and equipment pieces you require and note who in the department controls each piece. If asked, list all of the equipment you need. Do not overlook dishwashing, autoclaves, distilled or deionized water, cold room, warm room, darkroom, secretarial, and shop services. If your research requires animals, find out animal care costs and what assistance you can expect in carrying out your experiments from the vivarium staff. What joint facilities are available for production of molecular biology reagents, monoclonal antibodies, transgenic mice, etc.? Does the library contain your first-choice journals? Who pays for postage, Xerox, computer costs, and telephone bills? If you need special culture facilities for your organisms, check on availability. When you are shown your prospective space, make sure it contains adequate water, electricity, gas, on-line air, and vacuum. Are there unsafe features such as floor plugs next to the drains? Have the windows been washed? Are janitorial services regular and adequate? Do you pay for equipment hook-up and minor architectural modifications? Don't be overly concerned with very small details at this point of the process. However your interest in everyday life and conditions at the institution sends the message that you would seriously consider accepting an offer.

Request a meeting with students. Are they satisfied with the department? What do they think are the strengths and weaknesses? What are the grades and GRE scores of entering students? What do most students from this department do after graduation? Are there training grants for student and postdoctoral support to which you will have access. Are there institutional student fellowships? Are any students supported by independent fellowships (NSF or Howard Hughes). Are some students supported as teaching assistants or are most paid from their advisor's grants?

There will be times during interviews when you will feel absolutely exhausted, and you are sitting in the office of someone for whom you feel absolute trust and instant rapport, and you want to tell everything, including how you felt about the grilling you went through by the guy down the hall. **DO NOT DO IT.** Never forget that you are being interviewed all the time. Anything you say, to anyone, is going to be thought about and, very likely, repeated. No matter what schisms and animosities the faculty members may display, they are still a group, bound to each other by a complex network of ties, and you are still the outsider. At least one candidate in the past lost any chance at a job because of comments dropped to the undergraduate who drove him to the airport. Never let your guard down or forget that you are being interviewed until you have the job. Never imply that you are relieved or grateful for the interview. This will make you appear desperate and less desirable. Also, even if you do get the job, your negotiating power will have been reduced.

This is also true when changing jobs. Everyone will want to know why you are leaving your present position. Concentrate on how attractive you find the job you are interviewing for rather than how awful your last job was. If pressed you might state that you do not like living in your current location. Any personal reasons you have for wanting to move are none of their business and any professional ones are far better left unstated. If you are a postdoc, the reason for looking for a job should be obvious but, again, do not let any complaints about the university, lab, or people you are working with come out even to the most sympathetic listener. It cannot possibly help your cause and may get you labeled as a malcontent.

On the practical side, try not to exhaust yourself. You can not be at your best if you are tired. Interviewing can be a grueling process. Dress neatly and professionally but be comfortable. You should be comfortable enough in what you are wearing to forget about it. You are not likely to be comfortable in jeans if everyone else is wearing three piece suits or vice versa. Be careful of alcohol. It is probably best to avoid it since you will tend to be very tired at the end of the day.

To further avoid exhaustion, try not to schedule interviews at two institutions back to back. Do your best to stay at a hotel rather than a private home, where you will have little or no privacy, and constant talk and offers of food and drink. When a party in your honor looks as if it might go on all night, ask to be taken back to your hotel. Be sure to say a polite goodbye to your hosts and leave. If you desperately need a nap before dinner, say so, and let people know about your scheduling needs in advance. They will often be grateful that they do not have to fill every minute of available time.

IX. THE SEMINAR

You will almost certainly be told that you are expected to present a seminar. If not, ask. Make sure ahead of time that they will have the proper projectors ready, and find out how long your presentation will be expected to last. Also—and this is more important than it sounds—if you will be there longer than one day, and, if you have any sort of control over the dates, try to ensure that your seminar will be given on the first day of your visit. This confers two benefits. First, you will be relatively fresh and rested for your presentation. Second, when you are stuck in someone's office a day or so later for an hour-long *tete-a-tete*, the other person will have some ideas about your work, and the conversation will flow a lot more easily.

As to the seminar itself, there is no excuse for you not to be totally prepared and give a superb presentation. You will have found out what length is expected for your seminar. Be sure that it is no longer.

It is essential to practice your seminar. Preferably you should run through your talk several times with different audiences, preferably critical ones such as your fellow graduate students or postdocs. Many people work for years to get good data and then feel that it is a waste of time to spend an hour practicing the presentation. Good data is essential but is not sufficient. You have to convince your audience that your data and ideas are both good and interesting. It is useful to have both people familiar with your work and those unfamiliar with it and with your field listen to a practice session. Never speak on a topic with which you are not comfortable. However, you can borrow some slides from other lab members or published work if it adds to the presentation and proper credit is given. Some people feel that they must have personally done every experiment that they present.

You can't help but be nervous in the situation. If this causes you to have a great deal of trouble remembering what to say under pressure, write it all out but do not read it, or at least try not to read it. A presentation, memorized word for word, usually comes across as bland. One useful technique is to memorize the first few lines and the last few lines, the summary of your talk. In between you can speak more extemporaneously. You can also design your slides with good clear titles—this will cue you, and make it easier for your audience to follow. Remember all the tedious seminar speakers you have been forced to listen to, and try not to repeat their mistakes. Enthusiasm is the first ingredient. If you are not excited about your work, no one else will be either. Think about the good speakers that you have heard, and try to analyze why (apart from the Nobel quality of their ideas) you thought they were good. No matter what agonies or fear of embarrassment you may suffer, try to present your seminar as if you are enjoying it.

There is a difference between a really good, well-prepared seminar and a canned seminar. You will probably have fifty minutes. This requires a very different approach from the ten- or fifteen-minute slot at a large meeting where you simply spew out the data as fast as you can in a dark room. If your work includes fifty minutes of fast-spewed data, do not present all of your work. No one will be able to follow it all anyway. You may tell them that you have also accomplished such and such, and would be delighted to discuss it with anyone who is interested after the seminar. Then present one or two major lines of your work in the most interesting way possible. If jokes come naturally, use them but do not force them into your seminar just for the sake of humor. If you are comfortable using humor, it can be very powerful in getting the audience on your side. Even a failed joke will elicit some sympathy and gratitude for attempting to liven things up. If you made a funny or a serendipitous mistake which led to interesting data, tell them that. These people are not looking for a computer, they are looking for a colleague: a human being with whom they will have to talk

work, and attend parties for up to forty years. If a mischievous sense of humor is one of your major characteristics, and you manage to suppress it totally for three days and get hired by a stodgy humorless department, what have you gained? You will end up suffering if you are a misfit in that particular place. Also, it is often useful at the end of the seminar to take five minutes to summarize major points, make conclusions, and indicate future directions of your research.

When you prepare this seminar, remember that it differs from one presented to colleagues in your field in another important way. A job seminar will draw individuals who are far outside your field, and it is important to win them over to the importance of your work. Indeed if you are being interviewed for this particular job because this department is missing a representative of your field, i.e., there may be no single person in that entire audience who really understands the details and significance of your work. Therefore, a ten-minute introduction to the area for a general audience and care in pointing out why your work is new and significant are well worthwhile. Frequently some of the most powerful senior faculty will know the least about your field. They are an important part of that “general audience.”

An hour or so before seminar time, check to be sure that your slides are right side up and in order and that they have the right projectors. Unless your slides absolutely demand it, try not to leave the lights out continuously (people fall asleep), face the audience as much as possible while talking, make eye contact with those who show the most interest, and make an effort to have your voice loud and clear. Bring your own collapsible pointer just in case.

When your seminar is over, there will be a question period. Some of the questions may indicate that the questioner has missed a very basic aspect of your talk. Be diplomatic, never insulting, with your answer. It will give you an opportunity to reinforce that aspect of your seminar. In other cases you may feel that the questioner is hostile and out to get you. It is unlikely that this is true. The real point of this question period is to see how you think on your feet, how self-possessed you are, and how you handle this sort of situation. But even if someone should be hostile, you ought to give the impression of enjoying the challenge immensely—never show anger or lose control. Even in cases where you do not know the answer to a question (or where the question is such that a factual answer could not possibly exist) there are several positive messages you can give in your answers, which will serve the dual purpose of making you look good and saving face for the questioner. For example, you can say, “No, I haven’t tried that, but so and so published something very similar in the last issue of *Nature*, and showed that . . . etc.” This shows that you keep up with the literature. You can also say, “I really don’t know the answer, but I have the feeling that problem could be approached using such and such a new technique or system.” This shows that you think about such problems and/or that you think very fast. Never say, “I don’t know, that’s a hard question,” (end of comment) and never tell anyone that their question was stupid. Finally if you think you have given a miserable seminar, don’t be depressed. You may be hypercritical of your own performance. Whatever happens, remember there is no such thing as a perfect seminar. Good presenters learn something from every seminar they give and use that information to improve.

X. NEGOTIATING A CONTRACT

During the months that follow the interview, before the institution has made its decision, it would be wise to keep in touch, taking care not to be pushy or annoying. An ideal way to do this would be to send them reprints or preprints of your papers, should you be so fortunate as to have some come out at this point. You are trying to ensure against the possibility of their forgetting you or losing your dossier or, simply, having your memory dulled in retrospect.

One day you receive a telephone call from the department chairperson offering you a job as assistant professor at “x” thousand dollars per year. Of all the institutions at which you interviewed, it was this one that you preferred. Furthermore, the chairperson, as well as all the other faculty members you met, struck you as being very decent and honorable people. Your initial impulse will be to shout “yes” on the spot, write letters of rejection to all the other positions for which you are currently being considered, and throw a huge party to celebrate. Do not do it. Be prepared for this telephone call, and, resisting saying yes instantly, tell the chairperson that you are absolutely delighted, that you are very interested in joining his or her department. Almost certainly the next step is that you will be invited back for a second visit.

On this trip the shoe is on the other foot. Whereas before you were trying to impress the department and institution, it is now their turn to try and impress you enough for you to accept their offer. On the second visit you should make clear everything you expect and what is expected of you. Meet with all the faculty of the department, particularly those you

were unable to speak with during your first interview. Take this opportunity to ask probing questions about the politics of the department and institution. Find out precisely what you can expect in terms of lab space and start-up funds. If you are asked to provide a list of needed equipment, be sure that it is complete for the experiments that you have planned. It is unlikely that you will get everything you request but it is even less likely that you will get more than you request.

Most schools base all future cost-of-living increases, merit increases, etc., on your starting salary, so it is important to negotiate for the best possible salary at the start. Find out what the range is for someone of your experience and rank in your prospective department and in other departments at the institution. You may be able to get this information from the department chairman or the administrative secretary for the department, or the personnel office. Argue for the highest salary possible. Talk to your friends who have recently been hired in comparable positions to get an idea of salary level, etc. At the very least, hold out for the median. Many find this sort of haggling difficult and painful. It is important to remember the following facts. Although you may disagree with it, the system you are about to enter judges you, at least partly, by salary. By acceding easily to a low salary, you are hurting your image in the eyes of your colleagues and supervisors. After years of graduate student and postdoctoral fellowships, almost any salary will look good. Remember you will be expected to maintain quite a different style of living, that your tax base will change, and that your salary may, over the long run, have to maintain dependents as well as yourself. Many young people justify accepting low salaries on the somewhat contradictory grounds that either they are single, and therefore have only themselves to support, or that they are married, and therefore are providing the second salary of the family. Since all of your future salaries will depend upon this first one, you should keep in mind that the fact that you have no current dependents does not mean that you will never have them. Your parents or a sibling may require financial support from you. You may, in the future, have children; you may also be divorced or widowed or have to support an unemployed or disabled husband. So argue for the highest salary you can fairly get with a clear conscience and the knowledge that you are worth it. Finally, check into the fringe benefits available. They may include moving allowance, retirement benefits, health coverage, subsidized housing, day care, etc. They may add significantly to the actual value of your salary. Moving allowances can vary, so negotiate.

The most important aspects of your negotiations will involve resources for the advancement of your career. Will the promised laboratory space be sufficient? Is there any equipment included? Will start-up funds be sufficient to hire a technician and carry you through at least a few rounds of revising your grant proposals. In today's climate it is essential to be prepared to resubmit a revised proposal after an unsuccessful first try.

The cost of setting up a laboratory will vary depending upon your needs. Don't underestimate how much it will cost. It can easily cost \$100,000 to equip only a portion of a laboratory, e.g., to outfit a high quality research microscope or obtain basic molecular biology equipment. You need to carefully consider all the equipment and supplies you will need to get started, even the mundane items such as pipettes and glassware. Talk to friends in your field who have recently set up laboratories. This will also enable you to gauge the "going rate" for start-up packages being offered in your field. You also need to factor in what already may be available at the position. What pieces of existing equipment will they give you, and what bits of common equipment exist. There are two categories of common equipment: that which is truly common and that which is part of some other investigator's laboratory. Access to a centrifuge two buildings away from your laboratory is not useful. The department head may promise you the use of a piece of equipment that another faculty member regards as private property. You could, if you had it in writing, insist on using it, but you would probably end up making at least two enemies. It is this sort of thing that must be scouted out during the second visit. You may find it better to ask for funds to buy a certain piece of equipment that you know you will need, rather than asking for a promise to use older equipment that may be in disrepair.

Be sure to see the space where your laboratory is to be located. Is it located near colleagues with whom you can interact? This is very important for a starting faculty member who will not start out with a laboratory full of postdocs and grad students to talk about new ideas. Negotiate hard for needed renovations to be done prior to your arrival at the expense of the institution. They are invariably very expensive to carry out with your own funds. If your prospective laboratory is occupied or undergoing renovation, obtain a firm date in writing when it will be available. Delays will happen, but your ability to rise higher on the list of departmental and institutional priorities will be greater if you have a firm date and promise in writing.

One aspect you need to establish on your visit at your particular institution is the importance of research versus teaching in deciding promotion. In some high level research institutions, teaching is not a major factor in these decisions. This

may be true even if the institution's policy statement indicates otherwise. At other institutions teaching will be an important factor in promotion decisions. In either case you need to decide if your teaching role is reasonable and will allow you the time to carry out your research. It is best to talk with faculty at the institution who have recently been through the tenure process, those who have been successful and those who have not. They can also help you gauge whether the faculty, the department, and the institution are supportive in helping a new faculty member to become established or whether newcomers are left to "sink or swim" on their own. A common and tremendously helpful form of support is for the senior faculty to read *and critically evaluate* a starting faculty member's initial grant proposals. Another helpful concession to a new faculty member is to delay teaching and committee assignments to allow time for grant writing and setting up the lab. Alternatively, do they expect you to show up grant in hand? If so, this will not only take a certain amount of time, but also their grants and contract office will have to process it. What kind of help will they offer you here? When do they expect you to start? The exact starting date can be important due to the year-long cycles of promotion and tenure committees. Find out how the system works. It may turn out that coming a month early means that you lose almost a year of the time before you are evaluated for promotion and tenure. If your current position allows it, don't hesitate to negotiate for a delay in your starting appointment to allow time to finish up papers for your postdoctoral work or to get started on grant proposals. It is important to see how people are treated in the department where you are going. Are technicians' salaries paid during breaks in funding? Does the department have money for postdocs and graduate students? Have there been recent "rearrangements"? This can mean that a number of people were left with tenure but no department and, therefore, no space and no salary.

Bringing up these issues may seem very adversarial and you may feel uncomfortable asking about them. Don't. Your initial reaction is probably that if you request anything more than what is offered, and if you ask a lot of questions, they will simply retract their offer. This is exceedingly unlikely. There are two very important things to keep in mind. The first is that they have spent a great deal of time and effort and money searching for a colleague, and after looking over hundreds of dossiers and as many candidates as they could afford, after sitting through many boring seminars, and even worse search committee meetings, after arguing and compromising all up and down the institutional hierarchy, they have finally found one: you. You represent the end of a tiresome, tedious, and expensive search. They want you. You can afford to request a few favors from them now. But make sure to get them in writing, and make sure to request them now, because two months after you get there, your special status will be gone and you will be one of the herd of assistant professors trying to make it in academia.

This brings up the second point, which is that being offered a job as an assistant professor does not mean you have made it. You have made it up another step, but you cannot rest secure until you have received tenure. Thus, the reason for making sure in advance that you have the facilities (and the time) to do research, is that even at the moment of signing the contract for your very first job, you should be certain that you have done everything possible to give yourself a fair crack at tenure, two contract periods hence. There are departments that will permit you to come to an empty laboratory, to put off getting your first grant, to use all of your energy in carrying an unusually heavy teaching load and to accept a surfeit of committee assignments, and then will refuse you tenure on the grounds that you have not published enough original research papers since your arrival. Don't let this happen. Find out what output is rewarded, and behave accordingly. Depending on the institution, your first contract period may be only two or three years. Making preparations before you even arrive on campus is the only way to accomplish anything within this short time.

There are certain excellent universities in which to get started but where you should not really expect tenure. If you clearly accept this reality and plan on changing institutions in five years, these can be good job options, but bear in mind, as detailed below, that it is often more difficult to obtain a job at a later state. Don't minimize the costs of having to set up two laboratories during this time period and the disruptions to your personal life. In addition, most people who claim to accept the reality of not getting tenure at such institutions still suffer from feelings of rejection and inferiority when it happens. Don't forget, unless you quit first, you will be considered and turned down.

Finally don't forget to attend to the non-scientific aspects of life before you arrive. Try to obtain a copy of the town newspaper. What kind of cultural events are listed? Do the stores advertise things you buy? How much does housing cost? If you have children, does the university have a child-care center, and can you enroll your child? Where are the best school districts? On the second visit you should try to actually arrange with a real estate or rental agent to look at apartments or houses. This is especially important if you are not familiar with the area where the potential job is located. A New York salary may sound great until you see what you will have to pay for even passable housing, transportation, etc. Write to the local and state Chamber of Commerce to get information on the area.

In many of the more expensive cities, subsidized faculty housing is available. Check into this. Find out how long the waiting list is and get on the waiting list immediately. If you can, even make renting an apartment a condition of your arrival. This can save a lot of time and energy that you will need for setting up the lab. Do not be put off by long explanations about how the slums are really more charming. If faculty housing exists, you will probably never need it more than when you just arrive. It usually has the additional advantage of having no lease, so it is a good place to be while you look at other options.

At this point you will sign the official institutional contract, which will have been countersigned by the Dean or President. Congratulations! You have finally been hired. Now, and only now, you may telephone or write to the other institutions that have been considering your candidacy, and tell them that you have accepted another position. Remember that a verbal or even a written offer from the department head is not a legally binding contract. There have been cases where the candidate was offered a job by phone and told that a formal offer would follow. After much delay and the appearance of a “problem,” the job was never offered in writing. The lesson to be learned is that it is imperative to have the offer in writing, signed by the appropriate institutional official.

You are now aware of the amount of energy, time, and money that both sides must put into the first contract of a tenure-track appointment. A careful consideration of this, as well as of the economics of the job market, should lead you to the following conclusions: Do not apply for a job that you do not want. Do not accept a job that you do not want. No matter what difficulties you have had in getting an assistant professorship, the fact that you have been offered one implies that you will probably be offered others. Unless you are very unusual, you are probably at your most salable now. This does not imply that you will go downhill, but simply that as you get older and more experienced, you will be even more expensive, and demand more of a commitment from the hiring institution. If you wish to leave your first job when you have achieved the rank of associate professor (or if your institution awards you the rank of associate professor but denies you tenure), you will be out on the job market at the associate rank, which at some institutions carries obligatory tenure. The first contract period before the tenure decision comes up will have been a short one and it will be difficult for you to have really shown your department what you can accomplish in the way of research. So try to make sure that your first academic job is at an institution where you think that you would like to stay and work your hardest for the first five or six years.

XI. APPLYING FOR JOBS IN INDUSTRY

Unless you absolutely cannot imagine a life without teaching, a position in industry can be very appealing. Compared to academia, money for equipment, travel, and technicians’ salaries is usually less of a problem. This means that you have a better chance of attracting and keeping experienced first-rate technical people. Salaries are higher and overall support facilities are frequently better and more up-to-date than in academic institutions. More and more, presentations at major meetings and articles in major journals are authored or co-authored by people working in industry. This reflects a growing recognition of the importance of first-rate research in industry.

You must remember though that “industry” is an extremely diverse group of opportunities ranging from giant chemical and pharmaceutical companies to very small (20-60 employees) start-up companies. The experience of actually working in these places will be very different. You need to do a lot of research to get the feel of a place and be very hardheaded about how well you feel you would fit into that particular environment, as these microenvironments have a more isolated feeling than an academic institution. If you are a woman, you should keep in mind that many industries are still behind academia in providing equal opportunities for women; others, especially newer industries with younger leadership, are often more advanced in that respect. Overt discrimination is illegal in industry too, but you may need to be more aggressive about “reminding” people of your existence when job openings or promotion time come around.

You also need to think carefully through what it is that you can bring to industry that they need. Do you like to work on a number of different projects at once? Do you get along well and enjoy working on team efforts? Do you like practical problems? Do you like to be part of a project that is moving very fast in a competitive environment? Do you get satisfaction out of seeing your work put to practical, immediate use? Would you enjoy having the opportunity to learn more about other aspects of where your work might lead, e.g., patent writing, designing clinical trials, etc.? Would you like to combine any of the above with working on the more long-range basic research questions? Are you willing to change fields if the company’s objectives change? If the answer to some of the above questions is “yes,” you might enjoy working in industry.

On the other hand, you will have less control over what you work on and who you work with than you would have as the head of a typical academic lab. Many of the biotech industries sound and feel almost like research institutes when you visit. They are not. Their purpose is to make money, and you should realize that helping them do so is part of your job. (And having your job next year can depend on how successful they are.) If you cannot live with this for whatever reason, do not accept a job in industry.

If, after all of this you think you might be interested, you need to become aggressive in your search strategy. First of all, unlike academic positions, not all openings at companies are advertised. Secondly, if they are advertised, they rarely include the name of the person who is actually doing the hiring (aka, the “hiring manager”). Rather, most job advertisements tell you to send your C.V. and cover letter to their Human Resources Department. This is not the way to get a research job in industry. In 9 out of 10 cases, your C.V. will sit in a big pile of unfiled paperwork and will never be seen by the hiring manager. Therefore, the following strategy is recommended:

First, search the usual advertisements in journals and at scientific meetings places for jobs that are of interest to you. In addition, identify other companies that you might like to work for, even if they are not currently advertising positions. Your criteria might include the company’s location, size, products, research directions, etc. One way to obtain more of this information is to contact their corporate communications department and request an annual report. This is loaded with lots of great information, but beware. The annual report is designed to make the company LOOK fantastic, even if it’s about to go under at any moment. Alternatively, many companies have web pages which not only list job openings, but can give you good insight into their research and other activities.

Next get on the phone. Speak with anyone you can think of who might have a contact at those companies. Even if it’s a friend of a friend of a friend, follow up and call that person. Then, use this connection to contact someone at the company. If they seem willing to chat, ask them if they would be willing to do a short informational interview in person. This requires no commitment on their part, but it does give you a foot in the door and can help you assess the environment of the company. If the person you contact is unwilling or too busy to provide the interview, ask if they can suggest someone else at the company you might contact, perhaps someone whose interests are more aligned with your own. When you visit the company bring along a copy of your C.V., whether the company has an advertised opening or not. Have a well-researched list of questions to ask about what it’s like to work at that particular company. If nothing else, this type of search strategy will help you focus on the type of company you prefer. That’s important since most academically trained scientists have never before stepped inside the hallowed halls of a biotech firm. Make sure you get your C.V. into the hands of a scientist there, or even better, into the hands of a scientist who is hiring.

Keep following up on your contacts. For every person you call, ask them for the names of three other people they know in the industry who might talk to you, and call them. Ask if you can send them your C.V., and then ask each of them for three more names, etc. Soon, you’ll have an extensive network of contacts such that, when a job does come along, one of them might remember you and dig up your C.V. from their files. Again, it’s always better if you can meet these people in person, by way of an informational interview, so that they have a sense of who you are and can connect a face to the name.

When your strategy pays off and you are invited to interview, go give it a try. Again, it is important to be as knowledgeable and as enthusiastic as you can honestly be about working in that company. Chances are the people interviewing you are going to be depending on you (if hired) to do your part to see that the company survives (if it is a small company) or, at the very least, for intellectual stimulation since much confidential work cannot be discussed outside the company.

All the points discussed in the context of academia about giving a seminar and the interview apply here too. If you are being hired as a scientist, they are interested in your science. And many companies will consider only the best scientists; the days of “second-rate” science in companies are over, and you will only insult your interviewers by assuming that they ever existed. Find out as much as you can about the science done in the company. Ask for a list of publications from the department or company. When visiting, ask people what they are doing and what their major interests are (these may or may not be the same).

Find out what you will be expected to do, how much time will be allowed to follow your own interests, what the publication policy is, how much space you will get, and where and how many people will be working for you and at what

level. Find out if the company takes postdocs and how to get one in your lab. Can you have a joint appointment with a local university and, if so, do you want to? This is extra work since you might be asked to teach, but it may make an eventual move back to academia easier if that becomes necessary. Find out the equipment budget and what shared equipment is available, and have a list available of what you need to do your work. Try to find out something about the company structure. Find out what the reporting structure is and as much as you can about the person to whom you will be reporting. Ask what other people in the area/department where you are interviewing do with their time. This can vary from doing predominantly basic research to running a service lab (e.g., making monoclonal antibodies for other people). In any case, assume that you will be spending a significant percentage of your time on things of interest to the company. The more you can see what is needed before others do and voluntarily take it on, the more control you will have over how you spend your time and the more you will be seen as valuable. In comparison with academia you will not have to spend time writing grant proposals and teaching (unless you become associated with a university). However you will be required to write many reports and attend many company meetings. Just how extensive these duties will be depends on company policy.

Find out what your title and grade or rank will be and then get a complete listing of the titles and grades along the entire professional ladder. This is especially important in industry since some companies are quite creative in naming, and there is no way of knowing whether a “staff scientist” is equivalent to a postdoc or a vice-president without further information. Find out the median and range of salaries for your position, the details of all the fringe benefits and the relocation program, including possible interest-free or forgivable loans to help you buy a house. The benefits and hiring package may include some type of stock program or stock options. If you do not follow the market and especially if it is a small company, you might want to ask the opinion of a stock broker, investment banker, analyst, or at least someone knowledgeable. In some cases the stock options may turn out to be worth far more than your salary, or nothing. You should be particularly aware of stock-based pension plans. As with any investment, the bigger and more established companies offer more security, less flexibility, and less potential for a big gain either financially or through fast promotion than do rapidly growing companies.

When you have the above information, negotiate everything. In companies this seems to be the norm. One can even come back with counter offers several times. Everything from moving expenses to salary to headcount should be discussed. Some things are less flexible than others (stock is regulated by the SEC) but you should get a clear idea of what these are. There is frequently no contract but you can and should have everything in writing as with any other job. When you interview you might ask some people, discretely, if they were given what had been promised. This is probably the best guide to what you can expect.

Make up your mind about taking the job with some speed but do not be rushed. Request a second visit if you have any doubts and it is not already offered. Many companies will bring you out on a “house-hunting” visit after you have accepted a job, or they may pay for an apartment while you find a place to live. Once the job is accepted, some companies will want you to show up the next week. Try to make a reasonable and mutually agreeable time for arrival. Finish up as much as you can of paper writing, etc., before you arrive. You will need to be able to concentrate on your new job and may well find an entire stack of deadlines waiting for you there.

Now that you have a job, this is a perfect time to take a short vacation. You will need it to get through the very hectic first year or two, whether you have accepted a job in academia or industry. Good luck!

SAMPLE C.V.

Your Name

Address

Telephone

E-mail

SSN

EDUCATION

B.A., Honors Program in Biology, Your College, 1989

M.S., Your University, 1991

Ph.D., Department of, Your University, 1994, thesis title, thesis advisor

Postdoctoral, Department of, Your University 1994–present, postdoctoral project title, advisor

HONORS AND FELLOWSHIPS

National Science Foundation Predoctoral Fellowship, 1989–1993

National Institutes of Health Postdoctoral Fellowship, 1994–present

Sigma Xi, 1990

TEACHING EXPERIENCE

Teaching Assistant, Introductory Biology, Your College, 1988–1989: prepared materials for lab and taught one section each semester. Lecturer, Macromolecule, Your University, 1990–1992; presented several lectures on structure determination to graduate students. Lecturer, Molecular Biology, Your University, 1992–1994; presented four lectures on PCR cloning to undergraduate course each year.

GRANTS AND RESEARCH SUPPORT

National Institutes of Health GM-000000 #100,000 1/96-1/97 Co-Principal Investigator
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PROFESSIONAL SOCIETIES

The American Society for Cell Biology

The American Association for the Advancement of Science

INVITED LECTURES

State University, Dept of Cell Biology, 1994

State College, Dept of Biology, 1995

RESEARCH AND PUBLICATIONS

A major puzzle of biology has been the determination of the number of angels that can “dance” on the head of a pin. Early anatomical studies indicated that angels exist but the question of how many can dance has remained unanswered. My first introduction to this field involved a determination of the shoe size of angels; we reasoned that no more angels could be packed onto the head of a pin than the closest packing array of angels’ shoes.

Jones, W. and S. Smith. 1990. Angels Wear Size AAA Shoes. *Science*. 145: 5-7.

For my master's thesis, I designed a technique for purification of angel shoes and discovered that the shoes will easily detach from angels in high salt buffer.

Smith, S. and W. Jones. 1991. Purification of Angel Shoes. *J. Biochem.* 14: 123-133.

Reassembly of shoes and angels was subsequently accomplished in the presence of an extract from angel-free pins. In the absence of pin, extract angels and shoes formed a regular crystal lattice which was subsequently characterized using X-ray diffraction. In the presence of pin extract only a limited number of angels and shoes reassembled, and each angel was accompanied by two shoes. Subsequent scanning electron microscopic study showed that each angel was in fact wearing a pair of shoes in the reconstituted system.

Smith, S. and W. Jones. 1992. Reassembled Angels. *Mol. Biol. Cell.* 80: 11-21.

Smith, S. and W. Jones. 1993. Angels Wear Two Shoes. *Mol. Biol. Cell.* 84: 22-32.

Frank, F., Smith, S. and W. Jones. 1994. X-ray Diffraction of Angles Wearing and Associated with Shoes. *J. Cell Biol.* 222: 1-19.

The question of whether angels can dance has been the subject of my postdoctoral study. The metal composition of the pin was found to be the determining factor in dance behavior; only pins that conduct electricity have dancing angels. To study this process kinetically, advantage was taken of the propensity of angels for losing their shoes while dancing on an electrically activated pin; dance behavior under these *in vitro* conditions mimics normal behavior, although more angels dance than in non-electrically stimulated situations.

Smith, S. and J. White. 1995. Angels Get a Charge From Dancing. *Nature* 250: 25-29.

A fine structural map of the head of a pin after an angel dance revealed the presence of a set of box-like demarcations; the presence of this "dance floor" develops as a function of time and angel concentration. A non-dancing angel mutant spontaneously arising in laboratory stocks was detected by its inability to lose its shoes; the angel and all parthenogenetic progeny were both unable to dance and unable to design a dance floor.

Smith, S. and J. White. 1996a. Angels Build a Disco. *Mol. Biol. Cell* 7: 1-30.

Smith, S. and J. White. 1996b. Non-Dancing Angels Fail to Lose Shoes or Design Dance Floors. *Mol. Biol. Cell* 7: 30-41.

Currently I am determining the relationship among shoe structure, shoe loss, and the ability to lay down a dance floor. Preliminary evidence indicates that non-dancing angels wear, on the average, a size smaller shoe than dancing angels and may be restricted from dancing by foot problems.

In the future my research will continue to be directed toward understanding the relationship between structure and function of excitable units such as angels.

REFERENCES

Dr. W. Jones, State College, address, phone, and e-mail

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Notes

Notes

Notes

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