SURVIVAL STRATEGIES FOR NEW SCIENTISTS

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CHAPTER 2

COMPORTMENT, DEPORTMENT, AND OTHER DANCES WITHIN THE IVORY TOWER

Probing the Realities of Student–Faculty Boundaries; Coping with the Harassed Department Chairman; Negotiating with the University Administration; The Teaching Fellow in Sickness and Health; Ethics for Beginners; Intuition for Graduate Students; A Sampler of Graduate Student Dilemmas; Behavioral Aspects of Social Functions

INTRODUCTION

The background research for this chapter on comportment and deportment included computer and other searches for handbooks, guidelines, instructional pamphlets, xeroxed handouts, and other literature explaining generally accepted "good manners" in research and/or teaching institutions—especially for aids useful to beginning scientists. Predictably, no such body of literature could be found (at least not with the retrieval
methods used); the subject matter is clearly not "technical" in the usual sense, nor is it a research area that might prove particularly enticing to the average sociologist or psychologist. We are thus left needing a great fund of necessary behavioral information for the new scientist to acquire by observation of role models, by instruction at the knee of the major professor, by trial and error, or never to be acquired at all. This is an appalling condition, not to be tolerated by good, upwardly mobile scientists, since some of that upward mobility may well depend on appropriate responses to personal encounters within the institution (university department, research laboratory, foundation, field station, or other assemblages of professionals).

A logical but na"ive question that should be asked by every incipient scientist is: "Where are my instruction sheets for guidance in critical interpersonal areas, such as coping with department chairmen, loyalty versus freedom of choice in research/teaching organizations, ethical behavior of scientists, scientific group social activities, and a long list of similar topics?" Fortunately, for those who may feel deprived by the absence of such self-improvement literature, this chapter attempts one small but no doubt welcome remedial step to correct a universal deficiency. A chapter is not enough; an entire book on the topic is called for, but this is a beginning. Of the many philosophical and practical issues that could be confronted, a mere half dozen or so, considered most relevant to new scientists, have been chosen for some preliminary discussion, clustered under the following general topic areas:

- Realities of student-faculty boundaries
- Coping with department chairmen

- Dealing with the administration
- Teaching fellowships
- Ethics
- Graduate student dilemmas

This list is clearly only the top scoop of ice cream in the cone; much empty air space beneath it needs to be filled.

PROBING THE REALITIES OF STUDENT-FACULTY BOUNDARIES

The scientific community seems to function with some modest inefficiency most of the time, but it does best when its members live by general rules of conduct. These rules will not be found posted on any bulletin board or inscribed on any museum wall, and there is remarkably little unanimity of support for them among professionals, but they help fend off total chaos in research and teaching institutions. They are unwritten and, being so, can be ignored, modified, accepted, accepted with reservations, rejected, rejected violently, interpreted, misinterpreted, used for selfish advantage, ridiculed, abused, hailed, or hated. Some concern the practice of science—acceptable tests for statistical validity of data, critical evaluation of the findings of others, acceptance of ethical procedures in experimentation, and many others—while some concern the innumerable personal interactions associated with the practice of science.

The boundaries that separate graduate students from faculty constitute an important area in which unwritten rules apply. Superficially, the borders seem clearly defined: relatively permanent paid appointed faculty on
one side, transient paying students on the other. The distinctions can get fuzzy, though, and this blurring can create problems for unwary or overly aggressive students. Consider these examples:

Bob Warner is a bright, congenial Assistant Professor of Physiology, only three years beyond his Ph.D. Because of his youthful appearance and friendliness, some graduate students respond with overfamiliarity, such as calling him by his first name or dropping into his office for informal chats at any time. He secretly resents these minor transgressions, but has chosen to ignore them in order to retain the kind of intimate contact that is important to his style of teaching. He will admit, though, to slight twinges of stress when these overfamiliarities occur.

The take-home lesson here for graduate students has to be to accept the reality of a boundary, regardless of implied invitations to scale the wall, because even if the faculty member involved does not object, some of his or her colleagues—those who like the concept of a wall, or at least a defined boundary—may feel threatened.

Joan Royston is a newly appointed Assistant Professor in the physics department of a relatively small private university. She has been developing graduate and undergraduate courses in her specialty area and applying vigorously for grants to support her research. Her professional manner is correct, but somewhat reserved and impersonal insofar as student contacts are concerned. Some graduate students resent this, as evidence of insensitivity to their needs, and have commented to other faculty members and the Department Chairman about it. The comments have reached her indirectly, increasing the level of insecurity normal for a new staff member, but not resulting in improvement in her rapport with the students. She is remarkably well qualified in her field and is now considering a full-time research position at a nonteaching institution.

Some graduate students are uneasy about their role in what may be construed as meddling in faculty affairs and possibly depriving the university of talents. Others feel that this is a legitimate use of student power, if their best interests are to be served—regardless of the boundary concept.

Mitchell Small is one of a small proportion of Ph.D.'s who remain at their degree-granting institutions as faculty members. Before receiving his degree, he applied for a prestigious two-year postdoctoral fellowship that was approved. The grant-supported research was exceptional, and on its termination he was offered, and he accepted, an Assistant Professor position. He is a normally congenial and assertive person, who had excellent peer relationships as a graduate student, but he is somewhat disturbed about his status as a former student and present faculty member. He finds, with some justification, that he is still considered a "student" by some senior faculty members, even though he crossed the boundary two years ago. His acceptance as a faculty colleague and academic partner has been, in his estimation, slow and reluctant—to the point where he has concluded that he must move to another university if he is ever to achieve a measure of professional recognition by department members.

These examples of "boundary" problems illustrate the perserviveness of the need to sort out interpersonal relationships in academic settings. In the case of Dr. Warner, it seems clear that some behavioral modifications are in order—that for his own peace of mind, he can't continue to be "one of the boys." He needs to accept the role change and act accordingly, despite his
natural inclinations. Dr. Royston has the reverse problem—how to appear more like a concerned human being in her contacts with students. This may take some effort because of her normally somewhat impersonal manner, but should be tractable. Dr. Small’s problem is a more difficult one, and moving to a new environment may be the best solution. The passage of time may modify colleagues’ attitudes, but probably too slowly from his perspective.

There is no correct or ideal solution to any of the problems presented in the examples, and of course the circumstances vary from one situation to another. The only common ingredient is the demonstration that an ephemeral boundary does exist between student and faculty member, so awareness of its reality and its general location can help determine proper etiquette.

COPING WITH DEPARTMENT CHAIRMEN

Perceptive graduate students persist in attempts to empathize with, or at least to communicate with, their Department Chairmen. Such jobs are held by highly harassed individuals, expected to keep order among unruly and often unreasonable faculty members and to maintain a personal research and teaching schedule as well—at least in smaller departments. They are responsible for actions of professionals over whom they have remarkably little direct control. Their responsibilities extend to creating departmental cohesiveness and “esprit,” encouraging a high degree of scholarly productivity and grant-supported research by faculty members, settling intradepartmental squabbles and faculty complaints with tact, and interacting with the administrative hierarchy of the university, especially the Dean, who is an immediate supervisor in the official definition of the term.

Care and feeding of graduate students is an additional responsibility of the job, but fortunately one that can be handed off to the graduate faculty, except for crisis situations. The Chairman thus becomes one step removed from the flow of graduate student activity—always available theoretically, but in practice relating through a faculty member. This is a reality to be kept clearly in mind by graduate students wanting some access to the Chairman. The route in both directions is customarily through a major professor/thesis advisor. Of course, the rigidity or flexibility of this “chain of command” system is at the option of the Chairman, and individual preferences vary widely. In some departments, he or she is easily accessible to faculty and students alike, and personally concerned; in others, the Chairman can seem remote and unconcerned, especially in instances in which student problems are involved. Reeducation of Chairmen in the latter category is feasible if handled with great sensitivity and if pursued through faculty intermediaries—never by one-on-one or group confrontation tactics. Most Department Chairmen that I have known have been appointed to their jobs, or had the jobs thrust upon them, with little training or even clear definition of duties. Each incumbent adopts a comfortable operational style regardless of its shortcomings. These are all intelligent people, and they expect to grow into the new responsibilities. The open-minded Chairman welcomes advice and comment, properly couched and delivered through appropriate channels. The more ego-deficient of them try to establish petty dictatorships (the Papa-Doc Syndrome) during their tenures and may have scant interest in suggestions from students.
NEGOTIATING WITH "THE ADMINISTRATION"

A classic love–hate relationship exists between the university administration and the graduate student population. On one hand, the administration hierarchy (ascending upward from the Department Chairman) must ensure effective education, adequate communication, and minimal chaos, while still suppressing overt or subversive student attempts to take control. On the other hand, the students must keep the administration from expressing its natural dictatorial tendencies without undue disruption of the academic process (and without resorting to actions leading to dismissal).

The dynamic nature of the relationship usually leads to formation of graduate student organizations with members designated to take the lead and the heat in discussions or negotiations with the administration and the faculty. The roles of representatives may include membership on student–faculty academic oversight committees, student membership on university faculty senates or similar bodies, and (in extremis) participation in bargaining sessions to reduce hostilities and impacts of protest meetings or student strikes.

The extent of student activism at the graduate level is always subject to debate; perspectives vary remarkably depending on which side of the academic fence the respondent is found—and even within the herd on either side. Ideally, any action is designed to improve the students’ status and bargaining position and ultimately the level of graduate education—but sometimes things get out of hand and the matter degenerates into a confrontation rather than a cooperative venture. The losers at this level are almost always the activist students and their supporters. Administrators may not be smarter, but they are usually more experienced, and they are in charge. The bottom line has to be the simplistic one, that the students and administrators must be partners and not antagonists in affairs that affect graduate education—and that communication has to be continuous if the whole relationship is to be a successful one.

The delicious feeling of power—new to many graduate students—derived from participating in decisions that affect the nature and quality of their education is a heady one. Unfamiliarity with the abuses of power may lead to occasional excesses that can be destructive.

JOYS AND SORROWS OF TEACHING FELLOWSHIPS

To be an absolutely superb teaching fellow, rather than just another run-of-the-laboratory "T.A.," is one of the most important career decisions that any graduate student can make. Experience on the job can provide insights about depth of interest and potential abilities in college teaching that can be gained in no other way. A fair test, however, requires serious time-consuming physical and mental preparation for lab sessions, attendance at all the course lectures, and conferences with students—not an easy lecture, since it is superimposed on all the other demands on the time of graduate students.

At Harvard, at a time before the almost total integration of Radcliffe students (and that will really date me), the Crimson published an annual critique and assessment of faculty and
teaching fellows for the enlightenment of new undergraduates. A nostalgic review of comments about teaching fellows made in those simpler and purer days (with separate and proper lab sections for females) discloses a list of comments and gripes, which I can recall dimly, about the quality of teaching that are still relevant to lab instruction today (we learn so slowly):

- "Some teaching fellows seem to know less about the subject matter than I do" (these are Bio 1 students, remember).
- "Some teaching fellows have bad breath and need a shave and a clean shirt" (at Harvard, yet).
- "Some teaching fellows are remarkably smug about their tiny hoard of technical information and dole it out with great disdain."
- "Some teaching fellows will go to remarkable distances of obfuscation to avoid admitting that they just don't know."

But the flipside has to be mentioned. Those same yellowing Crimson pages also contain comments from undergraduates about exceptional teaching fellows—comments that must have meant a great deal to outstanding but still uncertain graduate students cum teaching fellows, many of whom undoubtedly went on to great accomplishments in teaching and research. Here is a sampling:

- "...an informed, dedicated, and caring teacher...."
- "...conveys to the student (me) some of the joy of scientific discovery...."
- "...is able to sit down beside me and explain in simple terms the intricacies of the biological systems we are studying."
- "I hope my children encounter teachers like Mr. ______ somewhere in their college careers."

**A PRIMER ON ETHICS FOR NEW SCIENTISTS**

Even those relatively new to science must be concerned with the ethical base of their work. Many are exposed indirectly as graduate students to ethical problems confronting their mentors or other faculty members. Many will have seen examples of practices on the fringes of proper ethics. Some will have witnessed examples of the positive side—in which proper ethics have been adhered to, even at a sacrifice of advancement or good relationships with a few colleagues.

Two examples that could be explored include:

- The "bandwagon syndrome," in which scientists redefine their proposed work to fit specific funding sources interested in research areas in vogue at the moment (e.g., aquaculture, cancer, genetic engineering), even if they have little interest in really modifying their ongoing research programs.
- The "Barnum phenomenon," in which well-meaning but gullible donors or private foundations are treated royally, fed proposals of dubious scientific merit, and promised results that will be next to impossible to achieve, by scientists...
or university administrators interested in their money.

Examples of many other practices that could be construed as marginally ethical may be observed by graduate students. Responses by such students, when evidence of ethical lapses, deceit, or even fraud is observed, should be guided by monumental caution. Professional reputations are among the most cherished possessions of scientists, and are also extremely fragile, so any suggestion of malpractice becomes immediately a most serious matter. It is worth remembering, too, that the system of science is a highly conservative one, which will close ranks against outsiders (and graduate students are still somewhat in that category) unless absolute proof of wrongdoing by a member is presented. Even then, it is often expedient for the establishment to find a scapegoat, and the low person in the organizational hierarchy (who else but the graduate student?) is a prime candidate. There is, however, a concept called “the triumph of principle,” which can be of such overriding importance to some graduate students as to motivate them to take the extreme risks involved in disclosure. If such motivation exists and prevails, though, counsel from experienced faculty members is an absolute requirement. This is no game for amateurs.

WHAT THE PERCEPTIVE GRADUATE STUDENT SHOULD ALREADY KNOW

In doing the research for this chapter, I found many faculty members who wanted to contribute special items of advice to graduate students and new scientists. Some of the offerings seemed slightly extreme, some were too pedestrian, but some seemed worth scribbling on a cocktail napkin or a matchbook cover for eventual inclusion here. These statements were often couched in apologetic terms, as though those offering them felt that most new scientists would already be aware of them—but I’m not convinced that this is so.

Here are a few:

- People who do things—publish research results in profusion, write books, present papers, organize meetings—may not always be the very best for their jobs, but they do them. Many others are sure that they could do better, but, for whatever reason, they never do. Moral: Try it.

- A first departmental seminar may be one of the most traumatic events in a young career. Other than an exhaustive preparation for it, a reasonable approach to the inevitable “discussion” (read inquisition) session, and the desired nondisclosure of ignorance, includes the following admonitions: Don’t act cocky or know-it-all, but don’t admit gross ignorance on any topic. If necessary, disclaim expertise in specific areas while indicating those areas in which you do have expertise. Say “I don’t know” very, very infrequently—no more than once in any presentation, if you can at all avoid it.

- Admittedly, you may be very good and very bright, but you are never entitled to be pompous. The first time you hear this or an equivalent term used and suspect that it may be applicable to you—go out into any situation in which you are unknown, totally, and see who buys your line
(e.g., writers’ conference, singles bar, church social, soup kitchen). Seek out people who have nothing to gain from your good opinion—and push them for evaluations of and reactions to your ideas, attitudes, knowledge, or positions on issues. This can be a chastening experience, to say the least.

- If you elect to join an academic institution, you must produce “scholarly works” continuously and abundantly, or else you will be overlooked or rejected for raises, promotions, and tenure, and you will be given greater teaching loads and trivial departmental assignments (e.g., public relations committee, planning committee, buildings and grounds committee) that further reduce the likelihood of scholarly production.

- When you are considering a university position, remember that many departments have faculties sharply divided between the lords and the peons—with the lords handling graduate seminar courses, with abundant research time, and the peons (often the new hires) teaching large undergraduate lab-heavy courses, with little time left over for research. Postdocs shake out at a still lower level, insofar as status is concerned.

- Many university departments have associated but largely independent research institutes—the staffs of which constitute an untenured but privileged class (as long as grant funds are flowing). These “selected ones” quickly lose status, and are even terminated, if grant funds dry up. Be sure you understand fully the terms of your employment.

- Successful people know how and when to jump on or off research “bandwagons.” They seem to know intuitively how to get in on the ground floor and to stay in the forefront of a developing field. They also seem to know when to get off, when a technique is becoming obsolescent. As a former mentor from the Eastern Shore of Maryland once told me, in the quaint idiom of that area, “Don’t be on the last train from Pokomoke City—be already established in Baltimore.” (I can speak from painful personal experience here, as one of the last to use and to publish results based on a technique in systematic serology that was being replaced rapidly by newer and superficially more sophisticated methods—but I was green and stupid, and nobody warned me in time.)

- Minor, but still important, comments:
  - The departmental administrative staff (and especially secretaries) can be important to you. Establish name and face recognition with them through uncontrived personal contacts.
  - On campus, look people in the eyes; speak to everybody; say “Hello,” “Good morning”—even to bearded faculty members, and even if they don’t respond.
  - In cafeteria, pub, or other discussion areas, talk to people about their research, not yours.

GRADUATE STUDENT DILEMMAS—SOME CASE HISTORIES

Innocent, gullible young graduate students sometimes become enmeshed in professional situations that
are not of their making and with which they are poorly prepared to cope. Although the specifics are normally nonrecurring, some of these events have similar general characteristics and are worth considering here. The approach used is to list some case studies of student dilemmas, to propose possible theoretical remedies, then to indicate the real-life outcomes.

Case 1. Mark Bean, an outstanding graduate student in psychology, submitted his thesis and left the campus to take a job for which a Ph.D. was a stated prerequisite. Award of his degree was delayed repeatedly because one thesis committee member did not sign—first because of extended foreign travel, then because he "simply did not get around to it." Officials at the new location (a teaching hospital) were getting uneasy about Mark's lack of the promised degree.

(Possible actions could include pressure on the committee chairman to take drastic action to obtain the signature, a direct appeal by the student to the errant professor, a direct appeal to the university administration to force the professor to sign or at least to offer some explanation for the delay, or none of the above.)

Case 2. Lester Osgood, another outstanding graduate student, was caught in a personal feud between his major professor and another senior faculty member who despised the major professor. The faculty colleague (a member of the thesis committee) delayed the degree interminably by demanding more and more research before he would approve the thesis.

(Possible actions could include a request by the major professor for appointment of an alternate committee member, a direct appeal to the university administration for a formal review of the entire matter, departure without the degree, or none of the above.)

Case 3. Jim Bitterman was a good student and a campus leader who had been accepted as a "special student" because of a weak undergraduate background in science. He passed his graduate courses (some marginally), but failed his qualifying exam.

(Possible actions could include shifting to a terminal master's degree program; attempting to dig himself out by heroic make-up efforts, including undergraduate courses; admitting total defeat and dropping out; or none of the above.)

Case 4. Jill St. Amand was a brilliant student who came to the university with assurances of critical financial aid. Unfortunately, during her second year of graduate work, several major university grants were withdrawn abruptly, resulting in cancellation of a number of assistantships, including Jill's.

(Possible actions could be full expectation that the university would honor its financial commitment, with support for the displaced students from emergency institutional funds; acceptance of the bad situation accompanied by a scramble for an outside job; withdrawal from the university; or none of the above.)

Cases like these, and many similar or dissimilar ones, abound on most campuses, and every graduate student can recite several. Solutions vary in the extreme;
some students operate through channels, expecting "the system" to correct abuses; some students are pushed to take more direct (and often less effective) steps; some students simply disappear, often with lifelong bitterness toward the university and even toward science as an occupation.

In the real-life cases presented, Mark Bean took the extreme step of requesting a leave of absence from his new job to hound the delinquent professor for an entire week until he finally signed. Les Osgood left the university without a degree, but enjoyed a long and successful government research career (not, however, without enduring hostility toward a system that had failed him miserably). Jim Bitterman tried a comeback, but failed his qualifying exam again, and dropped out of the program. Jill St. Amand dropped out for the remainder of the academic year, then transferred to a more hospitable university, where she received her Ph.D. with distinction—such that she remained there as a faculty member.

SOCIAL FUNCTIONS—PLEASURES AND PITFALLS

It is almost a truism that for many graduate students, events outside the classroom or laboratory can have great influence on their education and future careers. The graduate department is a comfortable microcosm in which to develop all kinds of skills useful or critical to a life in science—including social skills. A surprising number of science majors need all the help they can get in developing such skills.

One of the principal practice fields for this development is the departmental social event, especially receptions after awards ceremonies, cocktail parties for visiting scientists, small-group dinners at faculty residences, or other kinds of group encounters of a nontechnical kind. Perspectives and learning curves can vary among graduate students, postdocs, and junior faculty members—but for all, these events should be stimulating, productive components of the acculturation process in science. They offer opportunities for making and developing potentially important contacts, in what is for some a relaxed environment (for others, though, these events can be highly stress-inducing).

After too many years of casual behavioral research at these functions, I've come up with yet another list of procedures:

- Without doing so obviously, study some of the party activities of individual faculty people—especially the more gregarious ones. Score their good and bad points, but never discuss your scores with them or any of your cohorts—this is a self-improvement exercise.
- Graduate students are sometimes asked to help out at faculty social functions—tending bar, registering guests, setting up tables, arranging refreshments, carrying out trash. This too can be a unique learning experience for the observant, if it is done with grace and a smile, and if you stay in the background.
- Social functions may offer opportunities for fleeting contacts with at least some of the "right people" in your discipline—but don't expect them to remember your name or what you talked about, since they have their own agendas at such affairs.
- Avoid your friends, except for a brief greeting.
Don’t gravitate to a small comfortable circle of co-horts and roost there—mingle, act pushy, ask people about their research.

- Limit alcohol intake to a few weak drinks (but they are usually weak at these affairs, anyway).
- Before the event is over, you should have met most of the participants who are in your field, including the authority figures, but don’t try to monopolize the time and attention of the principal actors, unless they encourage your advances. Some get very impatient with overly aggressive juniors.
- During one-on-one discussions, if your companion begins fidgeting or if his eyes wander, terminate the conversation at once—that person is trying to escape from you.
- Often, there will be guests of honor or power figures for whom the reception/party/affair is given. Usually, these people are attended by a faculty member fingered for the job, but they should never be left alone to stand with a plate of hors d’oeuvres or to wander about the room. If the host committee does not provide support, appoint yourself to cover the gap temporarily with some unobtrusive company. Such people, regardless of their professional accomplishments, may feel ill at ease in a room full of strangers and may appreciate your overtures. Approach this situation very cautiously, though, so as not to convey the impression of pushing your way in.

Obviously, this list is only a beginning. Nuances and variants of social behavior are endless, often shaped by individual preferences and aggressiveness. The one constant is that these so-called social events are important to careers in science as well as in other professional occupations, so they should never be underrated or avoided.
CHAPTER 3

HAVE YOU HUGGED YOUR MAJOR PROFESSOR TODAY?

Mentor Relationships for Graduate Students; Training Your Major Professor; Fate of the Orphaned Graduate Student; A Classification Scheme for Major Professors

INTRODUCTION

Chapter 2 dealt all too briefly with some principal issues in graduate student development, but it ignored completely what is undoubtedly the most important personal relationship for incipient professionals—that of mentor and protégé. The subject was treated broadly in the second volume of this trilogy (The Joy of Science, Plenum Press, 1985), but it deserves a closer examination from the perspective of the junior partner in the relationship, the graduate student, and that is the objective in this chapter.

Professors (many of them, anyway) are people! True, few of them could be described as "average humans,"
and all of them have strengths and weaknesses, lovable and hateful traits, and moods reflecting joy or gloom. But most of all, professors have needs—to be accepted as productive scientists by peers and colleagues, to be promoted and to receive tenure, and even to be thought well of as teachers by students, especially graduate students. Some professors would deny the last need with great vigor, but most would place recognition of teaching accomplishments high on their list of career satisfactions.

The role of “teacher” in graduate education is a complex one, requiring much closer personal relationships with students who have become rapidly maturing new scientists. It is no longer enough, at this level, to be an effective lecturer, a writer of introductory textbooks, and a preparer of fair tests and exams. More is expected, and much of that “more” is commitment to shaping the graduate students who will become tomorrow’s competitors for research grants, journal space, significant breakthroughs, and transient glory in science.

It is unusual to find a graduate faculty member who does not take seriously this commitment to developing new talent. It is also unusual to find faculty members who feel adequately appreciated by students and former students for their efforts. Why, if recognition of teaching accomplishment is important to graduate faculty members, is it parcelled out so stingily? And how can this defect in the system be remedied?

Any reasonable chapter on figurative hugging and other forms of professional intimacy will of course suggest solutions to these and other problems. Appreciation for professional assistance from mentors need not be a scarce commodity among scientists at any level, except for a characteristic reticence on the part of some participants to express it. Sometimes the crush of getting on with a career prevents adequate expression, despite good intentions; sometimes there is fear that expression may be construed as flattery or seeking favor; sometimes there is concern that the expression may be considered naive or emotional. For whatever reason, much of what could be said as an honest expression of gratitude is not said, thereby denying pleasure to both participants in the mentor-protégé relationship. This is not a rational state of affairs for presumably intelligent people, and it is one that can be corrected easily: Tell a mentor that he or she has been important to you. Risk being thought emotional or sentimental or “brown-nosing”—if the expression of feeling is genuine. (Parenthetically, tell colleagues also, if they give you moments of pleasure and satisfaction in science—if their actions make you feel good about being a professional.)

There are other problems inherent in the delicate mentor-protégé balance that are not so easy to resolve. Of mutual concern in any such relationship is the respective amount of assistance to be offered and accepted by each party. The mentor must ask: “How much direction and supervision should I give students in thesis research? I may suppress natural creativity and stultify potential for future independence of thought if I offer too much oversight. On the other hand, if I intervene too little, the student may flounder around and waste time, or become depressed and leave, or (worst of all) defect to another faculty member ready to hand-carry his students through to a degree.”

The student must ask: “How much direction do I want from a mentor?” A common complaint is lack of adequate guidance from major professors. The short-
term pragmatic attitude of graduate students is often: "I want a degree, and I need some direction to help me get it as quickly and efficiently as possible—but this is a critical period for me in learning how to do research, so I can't slight it in any way, and I need to act with at least a modicum of independence.""

**TRAINING YOUR MAJOR PROFESSOR**

Most students, like most professors, are people, and it is especially important to graduate students that their major professor see them as such. Sifting through the many discussions that form part of the foundation for this book, I have found the expectations to be that the professor will view his graduate students as:

- People with some acquired knowledge, not just students.
- Human beings with lives outside the laboratory, even though graduate studies are a major, if transient, part of those lives.
- Psychologically complex entities, with likes and dislikes, strengths and weaknesses.
- Junior partners in the research endeavor, willing to learn but expecting to bring ideas and independent thinking to the work—beyond that of a technician.
- Eager, if relatively uninformed, participants in any broad discussion of science—philosophical, conceptual, or technical.

Most major professors, on reading this list, would say, "Of course I do all these things"—even if they don't. How to help them, unobtrusively, to do them, or to do them better, in the middle of normal daily chaos is another graduate student dilemma, to be addressed here.

A moderately astounding fact, which is not appreciated by many graduate students, is that *most professors are trainable!* This applies to faculty members of any age or status, even though the more "mature" ones may have developed some immunity to being manipulated by students and may therefore require more perceptive handling.

It is most important to establish a dialogue with a major professor early, through brief discussions, using, as logical entry points, subjects such as required and optional courses as well as research matters. If either member of the partnership—student or professor—is by nature reticent, the discussions may never go beyond these required topics, and that is a mistake! The professor has a fund of experience and insight that should be explored, but may not be unless the student takes some initiative. One of the best and simplest approaches is to come to the discussions with a topic or a short list of topics (assuming that the timing is correct and the professor is not grading exams or in the midst of preparing a technical paper). Subjects that might be proposed include, but are certainly not limited to, ethical behavior in science, activism and advocacy positions taken by scientists, student–faculty relationships, the historical development of the professor’s specialty area, journals and publications, techniques in lecturing and seminar presentation, the so-called scientific method and its variations—and on and on through topics of interest and
concern to both parties. It will become apparent quickly which areas the professor enjoys most, or at least feels comfortable in discussing, and this insight can be the basis for future meetings. The student can’t be just a sponge, though, but must bring to the discussions some thinking and opinions beyond a mere succession of questions.

Another training technique that I have seen used effectively is to ask the professor to participate weekly (or at least on some regular basis) in luncheon, brown bag, or similar small-group discussions (usually limited to his graduate students and postdocs) of some of the broader science-related topics mentioned above. This is not the customary brown bag seminar. The conversation should be informal give-and-take, with possibly a rotating student moderator. Such a format serves several purposes: It permits expression of student views on the subject; it leads the professor to examine his own opinions on the matter at hand, beyond mere top-of-the-head comments; and it may lead to subsequent reexamination of positions by all participants (including the professor). None of these “group therapy” approaches, though, is as effective as continuing one-on-one conversations, always at the option of the professor but often at the gentle insistence of the protégé.

The most fortunate graduate students are those able to work as teaching fellows in courses offered by their major professors or as research assistants in his grant-supported studies. These jobs offer superb opportunities for visibility and continuous interaction. For the bright and competent, there are no better routes to a more personal yet professional relationship with a person who has a good piece of any future prospects in his hands.

HAVE YOU HUGGED YOUR MAJOR PROFESSOR TODAY?

FATE OF THE ORPHANED GRADUATE STUDENT

The ending of an intimate relationship is never easy. Few associations in science are closer than those of graduate students and major professors; some of them persevere long after the degree is awarded, and most are characterized by mutual respect and often friendship. Occasionally, though, events lead to premature termination of the arrangement. A major professor may accept a position elsewhere, or may retire prematurely because of illness, or may die; a graduate student may be unable, financially, to complete thesis work, or may feel it necessary to enter the family business.

Separation becomes especially acute if the graduate student is left as an orphan in a harsh world because of the sudden disappearance of a mentor. What was projected as an orderly progression toward a degree becomes chaotic, with much scurrying around for a replacement major professor, for a reconstituted thesis committee, for new laboratory space, and even for a changed emphasis in thesis research. The student may have been supported partially by the former mentor’s grant, so new financial backing must be located, if it is available at all. The student may become depressed by the apparent collapse of his or her universe and may actually withdraw from graduate school. Usually, though, the separation is like a divorce, with time healing all but the most severe wounds. A new major professor is found, often one just as compatible and knowledgeable as the former one; thesis research resumes with only minor delays, and the student’s universe is gradually reconstituted. Sometimes, the change is even beneficial, with new perspectives and directions supplied by the
replacement mentor. Only rarely is the change harmful in the long term, regardless of initial predictions.

Graduate students and postdocs who have gone through the process of becoming orphans are almost unanimous in declaring it a traumatic and stressful period in their careers—but one with few if any lasting effects beyond a possible transient delay in thesis completion. Most retained affection for the former mentor, but many found the new relationship to be equally satisfying.

It is worth mentioning that there are instances when graduate students are consigned to the orphanage by a voluntary act of their major professor. Such a traumatic event may be the consequence of severe personality conflict or dissatisfaction with the student's capabilities or rate of progress. For the student, becoming a ''free agent'' after some period of graduate studies is not a desirable state to be in, especially if his former major professor has been outspoken among colleagues about the reasons for separation. Most graduate schools, however, are tolerant, provided course grades are satisfactory, and a replacement professor may be assigned or may be coerced into volunteering. Sometimes the new relationship is successful, if the conditions that led to the first divorce do not reappear. Fortunately, these events are infrequent; most mentor-protégé unions persevere.

A CLASSIFICATION SCHEME FOR MAJOR PROFESSORS

This chapter began with the intuitive assertion that professors are people. If this is accepted on faith, at least provisionally, then any attempt to put them into the pigeonholes of a classification scheme should fail. Even so, the average graduate student needs some guidelines for selecting a major professor—some preferably quantitative way of reducing risks of an incorrect or inappropriate choice. Until now, there has been no extensive literature on the subject, but this section outlines a classification and evaluation scheme that should reduce the burden of decision-making for graduate students already overwhelmed by the need to make choices about sex partners, vegetarian diets, dropping out, which sports car to buy, which bank to rob next, and a host of others. The scheme—actually a simplified risk analysis—yields a comforting final number that can be stirred into the pot, along with results of applying other more subjective criteria, as a crutch in the mentor-selection process.

The analytic procedure consists of weighted responses to questions in five categories:

1. Level of accomplishment in specialty area
2. Faculty status
3. Number of years at present institution
4. Amount of professional but nonresearch activity
5. Extent and nature of outside activities not related to science

The complete list of questions is included in Figure 4, together with grading instructions. Note that there is no category headed ''Don't know''; if you are tempted to give that response, find out! Note, too, that standard tests for significance should be applied to observed differences in total scores obtained by professors competing for your favor.
### Analysis of Professor

#### Category 1. Level of Accomplishment in Specialty

*Scoring: high, 3; medium, 2; low, 1.*

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Has he/she published several substantive papers in the past three years?</td>
</tr>
<tr>
<td>b.</td>
<td>Does he/she present papers regularly at professional society meetings?</td>
</tr>
<tr>
<td>c.</td>
<td>Is he/she invited to give seminars at other institutions?</td>
</tr>
<tr>
<td>d.</td>
<td>Does he/she give invited/keynote/review papers at symposia?</td>
</tr>
<tr>
<td>e.</td>
<td>Do others in his/her specialty visit/consult/phone/meet with him/her?</td>
</tr>
<tr>
<td>f.</td>
<td>Does he/she have major research grants in effect at present?</td>
</tr>
<tr>
<td>g.</td>
<td>Does he/she spend at least three hours in the lab each day?</td>
</tr>
<tr>
<td>h.</td>
<td>Does he/she subscribe personally to more than five professional journals?</td>
</tr>
<tr>
<td>i.</td>
<td>Has he/she published review papers or books in his/her specialty area?</td>
</tr>
</tbody>
</table>

#### Category 2. Faculty Status

*Scoring: high, 3; medium, 2; low, 1.*

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Is he/she tenured?</td>
</tr>
<tr>
<td>b.</td>
<td>If tenured, does he/she hold an endowed chair?</td>
</tr>
<tr>
<td>c.</td>
<td>Is he/she a member of the faculty senate or comparable faculty organization?</td>
</tr>
<tr>
<td>d.</td>
<td>Is he/she a member of important academic committees (awards, tenure, ethics, other)?</td>
</tr>
<tr>
<td>e.</td>
<td>Has he/she advanced in rank at a normal rate?</td>
</tr>
</tbody>
</table>

*Figure 4. Risk-analysis questionnaire for selecting a major professor.*

### Category 3. Number of Years at Present Institution

*Scoring: high, 3; medium, 2; low, 1.*

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Has he/she been at present institution for at least three years?</td>
</tr>
<tr>
<td>b.</td>
<td>If a full professor, was this rank achieved rapidly or slowly?</td>
</tr>
<tr>
<td>c.</td>
<td>If a long-term faculty member, has he/she been granted sabbaticals?</td>
</tr>
<tr>
<td>d.</td>
<td>If a long-term faculty member, has he/she been invited to serve in a visiting capacity at other institutions?</td>
</tr>
<tr>
<td>e.</td>
<td>Is he/she more than four years from minimum voluntary retirement age?</td>
</tr>
<tr>
<td>f.</td>
<td>If over 50 (or more than 20 years beyond his/her Ph.D.), is he/she physically active and in apparent good health?</td>
</tr>
</tbody>
</table>

### Category 4. Amount of Professional but Nonresearch Activity

*Scoring: high, 3; medium, 2; low, 1.*

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Is he/she a member of the principal professional societies in his/her specialty area?</td>
</tr>
<tr>
<td>b.</td>
<td>Does he/she hold office or membership on the board of directors of a scientific society?</td>
</tr>
<tr>
<td>c.</td>
<td>Is he/she a member of the editorial board of a national journal?</td>
</tr>
<tr>
<td>d.</td>
<td>Does he/she attend national and international conferences?</td>
</tr>
<tr>
<td>e.</td>
<td>Does he/she serve on grant review panels for government research funding agencies or foundations?</td>
</tr>
</tbody>
</table>
I. Does he/she serve on a number of institutional committees other than those listed in Category 2, item d?

Category 5. Extent and Nature of Outside Activities
Not Related to Science

Scoring: high, 1; medium, 2; low, 3

a. Does he/she have an overriding interest in a hobby (gardening, mountain climbing, sex, jogging)?

b. Does he/she often cancel lectures or lab sections, or find substitutes to fill in for him/her?

c. Is he/she often unavailable during the normal class day?

d. Is he/she known as an activist for or against some current public issue?

e. Is he/she an active participant in public education lecture series or in adult education programs?

These objective criteria seem harsh and almost impossible to satisfy, but the high scorers are the ones to be associated with as a graduate student. They are the movers and producers, the leaders in research areas, the participants in significant meetings (to which students might be dragged along), the ones to whom colleagues turn when a good junior position becomes available.

Unfortunately, these criteria are deficient in not considering more personal and hence more subjective ingredients in selection of a major professor—those concerned with individual rapport. These critical ingredients can with some effort be manipulated into a roughly quantitative assessment, using the format in Figure 5.
These more personal aspects of the selection of a major professor are important, but may not warrant equal rank with the more objective criteria presented earlier. The purpose, after all, is to obtain the best possible graduate education. If this must be done at some sacrifice of a wholly comfortable daily relationship, then let it be so!

It must be emphasized that these semiquantitative analyses are only aids in decision-making; other factors may intrude to modify any final choice of a mentor. Probably the most important of these factors is that the faculty member whom you choose may not want you as a student, for reasons such as a current overstock of graduate students, uneasiness about an unimpressive undergraduate record, or instant personal dislike. Beyond this uncontrollable factor, there are others that should enter into the decision process. Early interviews may disclose sharp personality differences that could make a long-term relationship stressful or unproductive. Some professors are noted for requiring more and more research results, so that a thesis is rarely completed. Some professors are thoroughly disliked by a majority of the faculty, and some of this dislike can be transferred to students of that professor. Some professors are so completely engaged in their own research that they have no time or patience for graduate students. Any of these deficiencies may present major problems for innocent graduate students.

So, the choice of a mentor is not an easy one, but it is an important one. Fortunately, it is not immutable. The relationship can be terminated with good cause by frank discussion and a substitute selected—preferably on the basis of greater experience as well as simple questionnaire results.

Before we leave this topic of selection of a mentor major professor, it might be instructive to look at the flip side—the factors that he might use in deciding for or against your candidacy as a protégé. The decision process will probably be far less formalized than that just proposed for students, but some sample questions that may be important in decision-making include these:

- Does the student have a good, sound undergraduate record in science and mathematics?
- Does the student make a reasonable public appearance— is he reasonably tidy; does he talk logically and in an organized fashion?
- Does the student give evidence of enthusiasm for science, beyond being enthralled by the perceived glamor?
- Does the student give any evidence of reading in the subject-matter area?
- Does the student give evidence of ability to handle equipment efficiently?
- Will the student be able to coexist with cohorts as part of a team in a laboratory environment?
- Does the student appear motivated, with some indications of a high energy level?
- Is the student able to plan and synthesize, as well as merely to absorb factual information?

Faculty people of course search constantly for the ideal student, but usually accept a reasonable compromise, if answers to these questions are mostly positive.
of gender, regardless of good words about equality. Some risk factors for women are not the same as those for men and must be evaluated from different perspectives.

And this, I think, is enough for the moment about the joys and discomforts of female graduate students in science. Certainly much more could be said, and undoubtedly greater insights could be gained, from additional interviews and introspection—preferably by a female inquisitor, or at least by a male–female team. We have touched on some of the sensitive areas—relationships with male faculty members, relationships with male cohorts, sex in graduate education, and assessing risks for females in a still-male-dominated community. The trip, although it has had its disappointments, has revealed a field in which change is finally being realized.

CHAPTER 5

NEW SCIENTISTS ON STAGE: LIVE PERFORMANCES

Presenting Scientific Papers at Society Meetings; Organizing and Presenting Seminars; “Outreach” Activities—Talking to General Audiences; Preparing Lecture Notes; Coping with Visual Equipment

INTRODUCTION

New scientists, including graduate students, are thrust quickly—sometimes before they are ready—into the specialized arenas of their trade, to prosper or flounder, depending on innate and acquired abilities. Oral presentations constitute severe tests for most beginners and even for many who are no longer beginners. Scientists do not always need to win prizes in public speaking contests, but they are expected to conduct themselves as professionals in a variety of public forums—whether the forum be a seminar attended by colleagues or an after-dinner talk at the local Rotary Club.
Much has been written about effective oral communication, but scientists usually have little time for such peripheral literature—often to their sorrow and to the detriment of their careers. The hope persists, though, that some stray piece of published advice will capture momentary attention, and it is for this reason that a brief discourse on live performances seems useful here—especially for new scientists. Next to doing good science, effectively communicating results (oral and written) is most important.

This chapter explores some of the more significant functions of spoken words in science. It offers some advice gleaned from discussions with colleagues who are skilled performers, largely as a consequence of long experience. It even tries to make the point that good oral presentations don't just happen—they are the result of painstaking preparation, constant practice, and study of the performances of others.

PRESENTING SCIENTIFIC PAPERS
AT SOCIETY MEETINGS

Research on any topic in science is incomplete until results and analyses are made known to colleagues, in either oral or written form, or both. Good research demands good presentations of findings, but variability is extreme—particularly in oral presentations, in which effectiveness depends so much on practice and on conscious efforts toward excellence.

The presentation of a scientific paper, especially in a society meeting, is a stylized form of public speaking, with a generally accepted format and a selected, often critical, audience. The usual expectations of good public speaking obtain, but superimposed on them are added requirements of scientific credibility, lucidity of thesis development, and placement of findings in the general context of existing technical information and concepts. This is a large requirement, especially since most research papers must be presented in 10 minutes (rarely more than 20 minutes). Superb oral scientific papers are consequences of good research and continuing attempts at self-improvement in delivery—either independently or through specialized training programs. There are so many admonitions, instructions, guidelines, and cautions about speaking in scientific forums that some professionals try to avoid such commitments altogether. For those who are not frightened into silence, probably the best route to continuing improvement is through close study of the presentations of others—good and bad—with analysis of strong and weak aspects. A special study of outstanding scientific speakers is a subset of this recommendation, applicable particularly to those with fears of persistent mediocrity.

Any listing of guidelines for good oral scientific presentations could easily occupy 50 pages of text. Some seem to have greater value to new scientists, and a sampling of favorites follows:

- Professionals should be able to read an audience and to pitch a talk at just the right level—neither too simple nor too complex (even for a general scientific audience), and with visual material neither too sparse nor too abundant. Most audiences that confront scientists consist of colleagues, scien-
Most professionals do not give "slide shows" when invited to give a paper or seminar, but they do have a few carefully selected and excellent slides as adjuncts to the presentation.

Many papers have multiple authors, each of whom may have a different speciality and may have made a unique contribution to the research. The oral presentation is usually (but not always) made by the first author; the other authors should be acknowledged, and if at all possible they should be close at hand in the audience, in case the speaker gets out of his/her depth during the discussion period.

Most professionals make a sincere effort to reduce use of jargon in scientific presentations and to eliminate equations with more than three elements.

Most professionals dress as such and avoid "under-dressing" if they are to perform at the front of the session room. (Note, though, that there is a small cadre of usually very bright junior scientists who appear in jeans and plaid shirts, regardless of the occasion and regardless of their roles.)

Many professionals spend what seems like an inordinate amount of time preparing for any oral presentation—recognizing the difficulty involved in doing the assignment well. Literally hours of fine tuning are required after the structure and content of the talk are roughed out; included are final selection of choice slides, painstaking review of the progression of ideas and data, reexamina-
tion of the validity of every statement, and careful construction of introduction and conclusions.

- A final word on variability is in order. Regardless of how complete the preparation, some presentations may be superb and others just average—for no good reason, except possibly the phase of the moon, barometric pressure, or minor physiological imbalances. This is a reality that scientists live with—as do actors, priests, politicians, nightclub entertainers, and any others who stand up before audiences.

Good oral presentations are an expected component of professionalism, regardless of individual personality traits. The ability to talk intelligently and well—in every kind of situation from informal discussion of research results to a keynote speech—is a necessary part of the scientist's armamentarium, surpassed only by the need for thorough knowledge of the subject matter and for skill in written presentation of research findings.

SEMINARS: THEIR ORGANIZATION AND PRESENTATION

Few treasured institutions in current science are more ubiquitous or more abused than "the seminar." It is a form of presenting scientific information that has become standard in any scientific organization, large or small. The word "seminar" usually connotes a small gathering of colleagues who listens to, and comment on, an informal progress report from an investigator. But it seems safe to say that of all the so-called seminars I have attended in the past decade, no more than a scant handful really fitted this definition. Most of them were formal presentations of completed research, with minimal time allocated for discussion, usually conducted in a venue more suitable for a lecture. Some of them were nothing but slide shows, with brief interspersed commentary on the slides.

The trend can be reversed, though, but the initiative has to be taken by seminar organizers. Part of the existing problem is that the role of seminar leader usually degenerates into a scramble to fill weekly or bimonthly slots in the schedule; to invite, transport, and house speakers; and to locate standbys for the inevitable no-shows. Neither is the job treated with much respect by administrators in awarding course credit for faculty people who accept the organizing assignment. Often, the seminar series is even treated as an extracurricular activity (which it surely is not) by those same administrators. Often, too, more junior members of any scientific group get tagged with the responsibility. The correct perception of the seminar series, and one held by many scientists, is that it is integral to the vitality of the organization and is an important component of the networking system of science.

A principal complaint about seminars, voiced with some consistency by a few in any scientific organization, is that they waste valuable research time, especially if some of the subjects are not immediately related to the narrow interests of those few. Some members of the staff are sufficiently hostile as to boycott the entire series, except for the rare presentations that may happen to be in their specialties. Somehow, the concept of broader communication within a discipline eludes such holdouts; the
scientist-politician, and even the scientist-PR person. For such specialized categories (some colleagues would not even consider them to be within science), public contact is often a principal or even an exclusive job requirement. Quite often, these people are professionals with varying degrees of training, who discovered quite early that they had skills and interests that took them outside the laboratory, or they found out sometime during their careers that research and teaching were inadequate goals, and exploited different capabilities or interests. Some hyphenated scientists established credibility in research before turning to other vocations; some were spirited away or deliberately left research too early to have achieved any great competence or recognition there. Whatever the route to their present positions, these quasi-scientists are, as individuals, usually very clever, people-oriented, energetic, diplomatic, dynamic, and perceptive. They operate in environments that rarely include laboratories or classrooms, yet they are considered scientists by the general public (and they often think of themselves as scientists). Discerning research and academic colleagues recognize the need for these "peripheral professionals" who constitute much of the public interface of science, although they may deplore the sheer numbers of "nonpractitioners" in the various hyphenated categories listed earlier.

So the public facade of science, as often represented by individual professionals "on stage," is integral to perceptions of the role of scientists in today’s society. The relatively small proportion of the total technical community that is able to interact well with groups of nonscientists should be applauded and encouraged. The messages conveyed must, of course, be correct ones—

that science is an important component of the present-day human experience, that scientists are really human beings, and that the technical advances can be forces for good as well as evil, with the balance heavily weighted on the side of the angels.

PREPARING NOTES FOR A LECTURE

Here and there on this planet, there are a few people with thought processes so highly organized that they can speak beautifully on technical subjects unassisted by outlines, typed notes, or other props. Most of us are not that fortunate; we require and depend on written support material for oral presentations.

A first response to this need—and one that seems superficially logical—is to have the entire presentation typed and to read it word for word. This may ensure technical accuracy, but it absolutely guarantees a deadly dull oral presentation, and to members of the audience, it implies unwillingness of the speaker to make any real effort at effective oral communication. It represents a retreat behind the printed word and is little better than distributing copies of the talk to the audience and standing silently at the podium until everyone has read the material. So please don’t read a paper, regardless of the temptation.

One of the worst examples of slavery to typed speeches occurred at a recent workshop, with an invited distinguished evening speaker. For some obscure reason—possibly an attempt by the session organizers to promote an atmosphere of informality—the
speaker, the chairman, and assorted dignitaries were assembled on stage, but in chairs arranged around a coffee table. The speaker, unfortunately, had planned to read his speech, but could not sensibly hunch over his prepared pages laid out on the low table. He picked up the pages and stood up to speak, but of course there was no lectern in sight. He was obviously disturbed; his hands trembled perceptibly; and at one point he dropped several pages of the doomed speech, which of course threw the presentation totally off course while they were reshuffled. Such amateurishness from an outstanding researcher was both embarrassing and regrettable; he had, obviously, much still to learn about professionalism.

A better alternative is to rough out the entire paper and prepare a detailed key-word outline that will serve as your visual crutch during the oral presentation. The outline can be in typed capital letters, with colored underlining for various levels of organization of the material, and with anecdotes, references to slides, and other notes inserted at appropriate points. The length and detail of the outline will reflect the self-confidence level of the speaker—ranging from a few key words on a matchbook cover or a cocktail napkin to an elaborate typed and annotated near-manuscript. But regardless of the simplicity or complexity of the outline, it is essential to rehearse the presentation that will spring from it, since only in this way can its adequacy be tested. If it is too skimpy, then some important information may be overlooked under the stress of the event itself; if it is too detailed, there is a tendency to simply read it (which we have already declared a no-no).

In the end, though, the nature and detail of notes—of visual props for an oral presentation—are matters of individual preference and prior experience. Some speakers cling to 3 by 5 cards, which free them from any dependency on a podium, but which can get dreadfully mixed up if there are too many of them. Some speakers type an outline and then project it (usually in sections) on a screen, as a visual aid for themselves and the audience. This can be effective, if not carried to extremes—such as the speaker simply reading the entire speech from the screen, which smacks a little too much of elementary school. Still other speakers (who, I am convinced, have strong self-destructive tendencies) depend on projected slides as the backbone of their talks. This technique has two major pitfalls: (1) The presentation may easily degenerate into a slide show, consisting of slides presented in rapid sequence (this may be OK in someone’s living room, but it is not a scientific presentation). (2) The bulb may burn out or the projector may quit, leaving the speaker mute in the dark, unable to move ahead without the vanished visual material. Even after such a catastrophe, though, it is hard to convince some speakers that a few well-chosen and excellent slides may be useful adjuncts to a talk, but that projected material must never be in control.

Special precautions apply to lecture notes for outdoor presentations. The best and cleverest I have seen were notes prepared with waterproof marking pencil on pieces of composition board 1/16th inch thick and fastened together with a binder clip. The speaker had every right to the utmost confidence in these almost indestructible aids—windproof and waterproof—and received
excellent grades for ingenuity as well as approving comments from participants (the content of the talk was good too).

COPING WITH VISUAL EQUIPMENT

Long ago, in the dim days of "lantern-slide projectors," when large glass-mounted slides were inserted and projected one by one on a bedsheets hung at the front of the session room, scientific presentations seemed more relaxed. Those ancient projectors seemed almost indestructible and were uncomplicated enough to be operated by a trained chimpanzee. The greatest mishap could be the sudden appearance of cracks in the glass slides because of heat from the lamp or jamming caused by unfortunate attempts to force slides of nonstandard size into the simple wooden holders. Today, though, in an era of beaded screens and complex carousel machines equipped with independent and malevolent mentalities, presentations using slides have become tense affairs, in which both speaker and audience wait with dread for some abnormality to appear (and it usually does). True stories about carousel projectors never end, and they seem to get weirder as new information comes in. Some recent additions to the lore are these:

At a meeting in a large downtown Atlanta hotel, in one of those cavernous chandelier-hung ballrooms, the projector’s electricity source was connected, unaccountably, to the overhead lighting, which was equipped with dimmers. Every time the lights were dimmed, the projected slides also got dimmer, and they disappeared when the lights were turned out. No electri-

ician was in sight, of course, and much amateurish scurrying around by bellhops did little good, until a long, long extension cord was located that could connect the projector to an outlet in the hallway—which was independent of the ballroom lighting. This solution worked sporadically throughout the session, with sudden interruptions when people tripped over and disconnected the cord in the corridor.

At a well-known Southeastern university, classroom slide projectors are mounted high on a rear wall (presumably to put the projection path well above the students’ heads and also to save space). In normal class use, this plan is awkward but workable, but it fell apart conceptually and operationally when a recent seminar by a visiting scientist had to be rescheduled into a classroom from a larger auditorium. The first hint of disaster was that the projector would move the carousel only in reverse—so the slides had to be removed and reinserted from last to first. The remote control was also inoperative, and no graduate student gofer had been designated as projectionist, so the seminar organizer, a full professor, spent what remained of the hour perched on a folding chair, changing slides manually. Fortunately, the slides were good, but even so, the take-home message for participants—as in so many other instances—had more to do with the errant projector than with the subject matter of the seminar.

Evidence for the truly destructive potential of carousel projectors is so overwhelming, and the total amount of professional time wasted while waiting for amateur repairs in darkened rooms is so awesome, that one foundation, the Wade Institute for Deep Ocean Research of Oxford, Maryland, has just announced a substantial prize, and assurance of a total monopoly market
position, to any company that will produce a projector that is absolutely foolproof and amateur-proof. It is a sad commentary on the state of our technology that we can send a camera into space to photograph Saturn's rings, but we seem unable to suppress the time-destroying antics of carousel projectors.

The situation with projectors is serious enough to have inspired the elaboration of a series of dicta, known locally as "Sindermann's Laws of Projection." Followed rigorously, these dicta can do much to reduce, but not to eliminate, the negative impact of equipment malfunction:

- Never, never build a presentation on visual material—especially not on 2 by 2 slides in a carousel projector. To do so exposes you to the risk of enforced silence in a darkened room, with nothing but the frenzied activity of bumbler to amuse your erstwhile audience.
- Carry your own well-tested projector, spare bulbs, long extension cord, screen, and portable electric generator for every talk or seminar in which slides are to be used. Have this standby equipment stacked in the rear of the session room, ready for use.
- If at all possible, slip into the session room early and actually run through your collection of precious slides, to make sure they are right side up and in proper sequence. (This won't always work, though, since the projectionist may be unionized and you may have to turn in your slides the day before the presentation to a technician in a dim basement cubbyhole.)

- For any presentation in which you expect to use projection equipment, always have Plan A and Plan B. Plan B calls for a talk that is absolutely devoid of any visual crutches and is to be used after you have stormed out into the audience and pulled the plug on a terrorist projector. Plan B should become operational early, at the first sign of an equipment problem.
- For the supercautious speaker, there is an alternative Plan B-1, in which, after the projector plug is pulled, designated assistants (a few of your friends) move quickly through the audience handing out previously prepared xeroxed copies of your most critical illustrations to everyone in the room (in fact, for line drawings, this may be a better method than projecting a transient image on a screen and could do much to reduce permanently the tyranny of projectors).
- From long years of experience with second-hand cars, it has become increasingly apparent to me that machines have feelings and are hypersensitive to hostility emanating from humans. Their response is also humanlike—retaliation. Always spend a few seconds thinking good thoughts about the projector before your paper is announced.
CHAPTER 6

NEW SCIENTISTS OFF CAMERA:
PUBLICATIONS

Writing Scientific Manuscripts: Computerized Manuscript Preparation—A Response to the Data Explosion; Reviewing Scientific Manuscripts—A Part of the Mutual Support System of Science

INTRODUCTION

The published record of research findings is an irreplaceable ingredient of science as we know it today. Because of its importance, the record should be concise, precise, and understandable, with results, conclusions, and interpretations clearly identified. Preparation of such contributions to the onward movement of science should therefore be a principal activity of every professional and an integral part of every research project.

Faced with these beautiful, high-minded statements, one can be only surprised and a little disillusioned to find
that much scientific writing must be described as ranging from mediocre to terrible and that effective communication of research results is not a major goal for every professional. Proficiency in writing scientific papers is an acquired skill, best mastered early in any career. It builds on competence in spelling, grammar, paragraph construction, and logical presentation of information, which normally begins in elementary school and progresses haltingly through secondary school and college. New scientists bring to their other professional functions such varied backgrounds of training in writing that significant efforts are often required on the part of mentors, reviewers, and editors to ensure that adequate communication levels are attained.

This chapter skips lightly through some very selected aspects of the evolution of written contributions to an already overcrowded literature, with the hope that somewhere—in a tiny office–lab on some remote campus—a single manuscript in preparation may be improved to some imperceptible degree.

WRITING SCIENTIFIC MANUSCRIPTS

Just as oral presentations of research results at professional society meetings are part of the stylized, almost ritualistic structure of current science, so too are written papers reporting results of research—papers submitted to specialized journals for publication. The format for such papers is rigid, designed to present, in a seemingly logical sequence: (1) the problem to be approached and its background, (2) the design of the study, (3) methods used, (4) results obtained, and (5) discussion of results as related to the findings of others. Brevity, precise language, adequate statistical tests, concise tabular presentation of data, and sparse but highly informative illustrations are all desirable attributes.

With such seeming inflexibility, one would think that most scientific papers are uniform, standard, and of average dullness. One would be wrong. Some papers are examples of beautiful expository writing, encased within the prescribed format, while some are hopelessly obscure and imprecise, even though they may follow that same format. The elements that separate the best manuscripts from the poorest include the design and execution of the research plan, the significance of results obtained, and the writing skills used in reporting the results.

After scrutinizing literally thousands of manuscripts, ranging from the superb to the deplorable, I find it possible to perceive sources of strengths and weaknesses in all sections of the documents. As might be expected, from all this reading and weeping has come a flood of suggestions, admonitions, and dicta that may be useful to beginning scientists—in that they may help them avoid the twin traumas of harsh criticism and rejection. It would seem sensible in offering these comments to march grimly from one standard section to the next, casting pearls and epithets along the way.

1. Title. Readers have every right to expect a title that describes the content of the paper. Unfortunately, this is not always feasible if the title is to be kept reasonably short (as it should be for referencing purposes). Brevity, however, invites
abuses of syntax that may yield comical results; brevity may also lead to misconceptions about the content of the paper, resulting in loss of readership. The construction of a title deserves attention; it may easily determine whether the paper will be read by colleagues. Since most scientific writing is a somber business, catchy titles such as those used for many works of fiction are, unfortunately, out of place, even though the temptation to try one may be great (how about such titles as “Stable environmental requirements for seahorses” or “Worms, germs, and maladies of sperm whales”?).

2. Abstract. Most journals now publish, in tiny, almost unreadable type, an abstract at the beginning of the paper. As can be deduced from its name, this section should abstract the essence of the paper in a brief form for the journal skimmers or for those who may be undecided about reading the whole paper. Since this short section may be the only part of the paper ever read by most colleagues, it should be executed with great care. It should emphasize the objective(s), the research plan, and significant findings, and deemphasize techniques or the work of others. It should not (as many do) merely describe what the paper is about or make general references to what will be discovered in later sections. It would be well if it could be printed in bold type rather than in miniature, but this is a matter of style for journal editors.

3. Introduction. Some authors say too much and others too little in introducing a paper. The ideal would be a brief description of the problem to be approached and a short summary of the status of knowledge—followed by a statement of objectives and research plan. The introduction is not the place for an exhaustive literature review; it is the place to describe exactly what the paper is about.

4. Methods. Many authors make a hash of this section. They may describe in great and unnecessary detail the excruciating minutiae of techniques, or they may simply refer to methods described in other papers—either of which is unsatisfactory. A good rule of thumb could be that enough information should be provided to enable a colleague to replicate the work, if he/she were so inclined (even though this seems to be a vanishing practice in most areas of modern science). If detailed statistical tests are performed, this is the place to describe them, unless derivation of models is a part of findings to be reported.

5. Results. This section is the core of any paper and should be a lucid, straightforward presentation of findings unclouded by discussion of the significance of the results or relevance to findings of others. If graphs or tables are included, they should be described and considered and not be left as unidentified orphans in the middle of a page. If illustrations are used (photographs, for example), they too should be described.

6. Discussion. This section provides the only real elbow room for the author, but the privilege must be used judiciously. The discussion should concentrate on placing the results being reported
within a larger framework, by comparison with other published literature and by elaborating on the significance of the findings. It is not a place for poorly supported speculations or for an extended literature review. It should derive its structure from that used in the “Results” section, and its length should not exceed one fifth of the total text material.

7. Conclusions. Many scientific reports trail off with a discussion of findings, occasionally with a terminal sentence or two of generalizations. A much better structure (subject of course to the whims of the journal editor) is to create a separate section headed “Conclusions” in which the author’s assessment of the findings can be presented in a paragraph or a page. This section should be more than a restatement of results and less than a summary of the discussion. It is not easy to prepare, but it does bring the paper to a more satisfying end point.

8. Acknowledgments. Many people contribute to the research reported in a scientific paper; few of them can be squeezed into the list of authors. It costs little, and accomplishes much, if people who applied significant efforts to the work are identified, together with the nature of their roles. Such acknowledgments should not be effusive and obviously cannot and should not include all who assisted in a minor or routine way, in accord with their normal job assignments. Key words here seem to be “reasonable generosity” on the part of the author(s).

9. Literature Cited. On rare occasions, a colleague may be interested in some of the published information in the specialized area being reported and may turn to the references cited. Citations should therefore be complete, accurate, relevant, and in quantity adequate to demonstrate that the author is aware of the status of research in his/her field. It is not ill-mannered to cite your own papers, provided they are pertinent to the subject of the paper and provided these citations do not number more than one tenth of the references in the section. It is poor form to deliberately and obviously ignore significant related papers published by a colleague whom you dislike or by serious competitors in the priority game.

Much of the foregoing discussion seems to concern writing skill—which indeed it does. Not to be obscured, however, is the basic requirement of good science on which to base a well-written paper. The “silk purse” concept applies here: Poor or mediocre science will remain so, regardless of how elaborately it is presented. The converse is not true, though—good science can be and should be materially enhanced by good written presentation.

Manuscripts receive final scrutiny within a system of reviews of manuscripts before and/or after submission to journals. Good reviewers may point out incomprehensible sentences or paragraphs, major errors in syntax, repetition of words, excessive use of jargon, or other grammatical abuses—even though their primary role is assessment of the science on which the paper is based.
COMPUTERIZED MANUSCRIPT PREPARATION: A RESPONSE TO THE DATA EXPLOSION

Increasingly unable to cope with the flood of new scientific papers, scientists retreat to narrower and narrower specialty zones, where they can comfortably claim that they are "on top of" what is going on in their field. While this course of action is ego-preserving, it plays directly into the hands of those who claim that by failing to stay current in a broader discipline because of the physical impossibility of reading an adequate portion of the literature, scientists are becoming more and more ignorant (if ignorance can be defined as a low ratio of what an individual knows to what is available to be known). This thesis was explored recently by George A. Bartholomew (1986). Bartholomew's point seems well taken, yet there is a vague gut feeling on my part that we are not all that ignorant, but that the world is forcing us to become microspecialists, or minimicrospecialists, as a logical consequence of the obvious deluge of new information. One of the best illustrations of this trend is that few scientists write books today; they edit books, in part because not many professionals feel comfortable enough with an entire subdiscipline to write a book about it. Editing a book, with contributions from many microspecialists—ah, that is easier to live with, and so much less demanding.

But there is a partial solution: automation of data summarization, literature review, and even data analysis for manuscript preparation. Some elements of this emerging phenomenon are already operational. Every graduate student knows about (or should know about) computerized literature searches on almost any topic in science and about the availability of specialized abstracting services, once appropriate key words are fed to machines.

What is less widely known, even among practicing scientists, is a recent development in manuscript preparation. An astonishing proportion of scientists have writing blocks of various kinds—induced or exacerbated by harsh reviewers, by kindergarten teachers, by supervisors, or by mothers. For those most seriously afflicted, an extraordinary cure exists that can be described as "formula writing" or "programmed writing." It depends only on access to a modern word processor that has been programmed to select from a number of coded choices in preparing each section and subsection of a manuscript. The paper is constructed by selection from a series of preprogrammed alternative words, phrases, and sentences for each paragraph of a scientific paper—section by section. This procedure is much like preparing preprogrammed form letters that can be constructed paragraph by paragraph. Each type of paper—survey, experimental, ecosystems—would have its own series of programs.

With this approach, the structure of a paper emerges automatically—needing only assignment of a title, insertion of data, addition of acknowledgments, and minor editorial changes to suit individual styles. To illustrate the method, there follows a sampling of some of the programmed elements for each major section of a scientific paper.

Introduction

- Always include in the first paragraph of the introduction one of the following phrases: "There
have been few investigations of...” “There is little published literature on...” or “Data are remarkably incomplete on...” Such a statement establishes you instantly as a pioneer and a trailblazer.

- In the second paragraph of the introduction, gently dismiss as obviously trivial the published work of others, with catchy belittling phrases such as “Preliminary findings of Sauerwein (1980)...” or “Earlier exploratory work of Sauerwein (1980)...” Any of these phrases suggests that what has gone before is of small consequence, and yours is the definitive study.

- In the third paragraph of the introduction, make it clear that you are proposing a new concept or synthesis, without actually claiming to be the originator and without ever fully defining the concept.

- In the fourth paragraph of the introduction, make unmistakable but nonspecific allusions to the fact that your approach is innovative, clever, and sophisticated—even if it is routine, mundane, and plodding.

- In the fifth paragraph of the introduction, make occasional but not too obtrusive reference to significant unpublished data that are still in your possession but are not to be revealed in their entirety until some vague later date, if at all.

Results

- The first paragraph of the results section must make use of your new terms or categories, describing your findings as unique and different from those of others. This device will keep readers off balance for the entire section.

- Early in the results section, several long, complex tables of data should be inserted. Column head-
ings should be impressive but noninformative, and the tables should lack enough basic data, such as numbers of individuals examined or tested, to prevent meaningful interpretation.

• With this judicious lack of vital tabular information, you are perfectly free in the second paragraph to summarize experimental results as you wish—always with careful statements of the level of significance and adequacy of sample size.

• Late in the results section, a series of complex graphs should be inserted. Those of choice include a mass of data points through which a completely arbitrary curve has been drawn or a family of derived curves with no relation to real data or to the experimental parameters.

Discussion

• The first paragraph of every discussion should reemphasize the important conceptual advances and the generic significance of the reported work. A selection of several of the following words must appear in this paragraph: “concept [conceptual],” “insights,” “synthesis,” “generic,” “analyses of complex variables.”

• The second paragraph of the discussion section should cast the results of the study, however trivial, in the broader framework of solutions to fundamental and persistent problems in the scientific discipline.

• Subsequent paragraphs should explore areas of disagreement with the results of others, making sure that the present work is seen as a closer approximation of reality.

• Later paragraphs should rationalize deficiencies in data or anomalous results, making sure that these are suitably minimized and thereby shortcutting negative comments from reviewers.

• A concluding paragraph should consist of reassuring but vague generalizations, supported only marginally by results contained in the paper.

Using this programmed or formula writing, every manuscript can be a masterpiece, invulnerable to assault by reviewers, attractive to journal editors, esthetically pleasing to casual readers, and—most important—simple to prepare, even by those with terminal cases of writing block.

Try it. You’ll like it! It works! One small private and hypothetical company is now beginning to produce and market tapes with prepared alternative sentences and paragraphs for each section of a scientific paper. The company, Autosci, Inc., will soon be able to provide, at a price, tapes and user’s handbooks for all types of scientific manuscripts.

Future directions for “programmed writing” are also emerging. Being tested are systems of computer-produced entire papers, requiring only the insertion of data into the program. These papers can then be reviewed by other machines for proper format, use of appropriate key words, and correct application of formula terminology; they can then be abstracted and accessioned by computerized bibliographic data centers, without ever being read by a human being. At the moment, though, a principal hangup is in methods to achieve the syntheses
necessary to produce good review papers by computer. This seems to be just beyond the current state of the art, despite Autosci's pioneering work in programmed writing.°

If all the preceding seems a tad too mechanical and cynical, one should be reminded here that any astute scientist knows that somewhere in all this automation, the human mind must intrude. Despite increasing dependence on computers, preparation of outstanding manuscripts is to many practitioners still an art form, not to be surrendered totally to machines. Examples of the art intermingled with the science exist, in the exquisitely crafted scientific papers that appear (all too rarely) in professional journals. Lucid, logical, and structurally perfect, they present good science in a form that is not only readable, but also a joy to examine.

Those who persist in preparing, often by what might be considered obsolescent methods, professional papers of gem quality, when queried about their talents and products, have offered these guidelines:

- The science on which the manuscript is based must be impeccable; inadequate or sloppily planned research seldom results in data that can be massaged or manipulated into anything but a paper that transmits the deficiencies.

°Other organizations are of course very interested in programmed writing. According to a recent news release, two mathematicians at Bell Laboratories, Howell, New Jersey, have reported on a two-year programming effort that will revise manuscripts, finding misused words, even sexist words. The machine will suggest better choices for overused or incorrectly used words and even give nonexistent alternative words for the "no-no's."

- In rapidly expanding, hence highly competitive, research areas, strong temptations to rush into print should be resisted vigorously, even at the expense of losing some priority. Quality is always enhanced by more-than-adequate data and by at least a few days of quiet contemplation of research results before the word processor keyboard is approached.

- The paper must have historical perspective, preferably summarized in the introduction and expanded upon in the discussion of findings. To do this well, much more of the background and contemporary literature in the research area should be read than would be expected.

- Results of research should not be intermingled with discussions of those results or conclusions drawn therefrom. Furthermore, and probably more important, professionals should be conservative about conclusions and downright reactionary about speculations.

- Drafts of manuscripts should be placed gently in the hands of caring but knowledgeable colleagues for some frank comments long before the definitive draft is typed. Feedback from this jury must be considered very carefully.

So, if there is any conclusion here, it might be that all available mechanical aids to manuscript preparation should be seized and assimilated, but in the end they are only devices and will never supplant the application of an informed intellect to the problem of effective scientific communication.
REVIEWING SCIENTIFIC MANUSCRIPTS

Once a professional scientist has prepared a manuscript for publication, he normally sends it out for examination by reviewers. This is an important networking and support activity, more common in some disciplines than in others but still widespread. It constitutes part of the self-regulating and self-policing system of science, in which colleagues try to protect an author from error, embarrassment, or mediocrity by suggesting changes in the soon-to-be-published document.

Reviews of scientific manuscripts can occur at several levels:

1. Informal reviews of drafts by colleagues who are also friends—usually done at the request of the author.
2. More formal reviews by colleagues who are not necessarily friendly, usually at the request of the laboratory director or other institutional head (such reviews may also be conducted by in-house editors and may include examination for adherence to agency or company policy).
3. Formal reviews by members of editorial boards of journals or by other designated reviewers (also called referees) at the request of journal editors.

Reviews at level (1) are optional, with the author retaining the prerogative of accepting or rejecting the comments or advice offered. At this level, the review process has some similarities to activities of "support groups" of novelists or short story writers, who exchange "pieces" with other members of the group for comments (frequently, but by no means always, positive and supportive). Reviews at levels (2) and (3) may be more binding. Journal editors, for example, tend to heed reviewers'/referees' advice about acceptance or rejection of manuscripts and about the need for revisions. Institutional heads can prevent publication, acting on the advice of in-house editors or reviewers (a practice not uncommon in industrial research and development organizations).

Since manuscript reviews are such an integral part of the support system of science, and since even introductory-level scientists are expected to participate, some guidelines are surely in order:

- A critical question that should be foremost in any reviewer's mind is: "Does the manuscript report good (or at least acceptable) science?" If it does, then advice and comments should concern how to improve the presentation; if it does not, then advice to the editor or other authority figure should be to reject it.
- Reviewers can preserve the author's ego by saying something positive first, before making any really critical comments (provided, of course, that there is something positive to say).
- Reviewers must remember that a big chunk of the author's self-esteem as a professional is wrapped up in any scientific manuscript—so any tampering with it must be done very gently. To some authors, every word is a precious artifact, to be defended stubbornly and enshrined without change on the printed page.
- A temptation exists in reviewing to lean hard on poorly prepared manuscripts. That urge should be
resisted; reviews should always be objective and constructive, never nasty or abusive. Mean or hostile reviews, after initial trauma to the author, may remain dormant for a while (sometimes for years), but will never be forgotten. Retaliation can be sweet in science, as anywhere else.

- A review should be undertaken from the perspective that this is the work of a colleague—who, in some instances, clearly needs help.

- Some journals state the criteria on which a manuscript should be judged; some editors even prepare evaluation sheets with a checkoff system for easy reviewing. High on any such lists are quantity and significance of new information, appropriateness of statistical treatment, validity of conclusions, and clarity of writing. Subsidiary but not unimportant items are adequacy and necessity of illustrations, relevance of discussion section, and suitability of historical framework.

- Authors should learn the important lesson that reviews, even the negative ones, are gifts, representing the time and experience of the reviewer (even if he is anonymous, as most journal reviewers are). Comments should be considered seriously, even if the situation is such that their acceptance or dismissal rests with the author.

- Authors should remember, too, that once a paper is in print, it can’t be withdrawn or changed. Any errors or misconceptions will remain in that document for as long as the journal exists and will haunt the author for his entire career. Speaking from my own experience, and that of many professionals, it is much better to know early if something is wrong with a manuscript and to be informed of it—even harshly if that is necessary to get the author’s attention.

The discussion thus far has concerned reviews of manuscripts prior to publication. There is a final type of review, not at all unique to science, that can be described as a “public” review, which is often published in news-oriented journals such as Nature or Science and normally restricted to books. It suffers from the principal shortcoming of any book review—it appears after the document is published and is thus not useful to the author, except for ego inflation or deflation. Public reviews may serve other purposes, such as selling copies of the book, but they cannot improve or change what is already published.
CHAPTER 9

RECRUITMENT AND RECRUITING

Guidelines for Potential Recruits; Balance Sheets for Entry-Level Positions; Recruiter's Dilemmas

INTRODUCTION

Some of the most critical people interactions in science are those clustered around the process of filling vacant or new positions. Whether in research, teaching, research and teaching, or management, there are two distinct perspectives—that of the person being recruited and that of the person(s) doing the recruiting. Innumerable guidelines could be proposed for those on each side of the fence, but especially for those being recruited. Since this book is oriented toward the entry-level professional, most of this chapter focuses, sensibly, on those being recruited.

The contact period that will help determine success in acquiring the job may be distressingly short, consist-
CHAPTER 9

ing of an interview with a Department Chairman or Dean or both, or it may be very long, consisting of a seminar followed by several almost endless days of intensive grilling by present faculty or staff members, singly or in small groups. This contact time, and the impressions made, may be truly critical to selection, or it may be a facade, if a preselection for the job has already been made by the Dean or Department Chairman. There is often no easy way to determine which game is being played, so the only option available to the applicant is to assume that the wheel has not been rigged in advance.

The preparatory steps to be taken before facing the very important cut period of selection or rejection for a job in science can be grouped into three categories: (1) long-term, (2) near-term, and (3) short-term. Most of the really critical preparation has to be long-term—a solid foundation in science, excellent ability to present thoughts orally, self-confidence without overconfidence, a physical appearance commensurate with the hoped-for position—selection factors that you can’t buy or cram for.

Beyond these, near-term steps should be considered seriously during the several months immediately preceding departure from the protective ecosystem of the university graduate department or the safe, if temporary, cocoon of a postdoctoral fellowship. Some of the near-term measures are easy, others are less so, but all can enhance visibility and desirability in the job market. A few that seem feasible are:

- Publish early and well—preferably in major journals and preferably with your thesis advisor. Precocious paper production can be an important factor in decisions about first interviews and first jobs.
- Write an outstanding letter of application, presenting yourself as a professional able to augment significantly the present staff and research efforts of the institution. Such a letter should be accompanied by appropriate documents, especially publications.
- Write and send the perfect résumé, one that emphasizes current professional information rather than past events and that is prepared on a high-quality word processor.
- Give very careful thought to letters of recommendation. Insofar as possible, people who write those letters must know you as a person as well as a scientist, and it is helpful if they are known to at least one member of the institutional search committee. In asking for such letters, it is better to be frank but delicate—indicating that if the person cannot write a positive letter, you would prefer to know it and to select someone else.
- If the prospective job is with a government agency, many additional rules and strictures apply. Any interaction with government bureaucrats is difficult, beyond the form-letter level. It is important to write an initial letter to a person and not just to an office. Be prepared to be ignored and then to send a follow-up letter, followed in turn by a phone call to the appropriate contact level—too high, and you irritate; too low, and you get no response from the system. The key in such initial
contacts is to be aggressive but very polite, emphasizing your particular talents or expertise. If available, internships or temporary positions are advantageous, since they allow you to study this complex system from within and place you in a favorable position for something a little more permanent. Additionally, contacts with the agency through state and Federal legislators can be productive at an entry level. Persistence is an absolute requisite, though, especially in the current climate of funding reductions in some programs and concomitant restrictions on hiring new government employees.

Beyond the near-term job-hunting steps just listed, some short-term preparatory steps can be taken (assuming that you have survived initial screening and have been invited to the institution for an obligatory and highly stressful interview). They include such obvious measures as these:

- Review the literature in your area of presumed expertise, so that you can discuss it comfortably and adequately if pressured by an inquisitor.
- Project enthusiasm for your own research and for science in general.
- Develop (and even write down) potential questions that could be asked by inquisitors during the job interview—and then outline well-rounded responses to them.
- Review in your own mind your existing contributions to science, being sure that you have a well-thought-out plan for your future research activities—which should be in accord with your perception of what the institution expects.
- Prepare, if the job involves teaching, to project knowledge of good teaching methods and approaches—preferably from your own experience.
- Review your attitudes toward personal relationships in science, ethics in science, and women in science.
- Reexamine your record in grant applications and research funding, and give some consideration to your future grant proposal plans, so that you can discuss these matters easily.
- Provide a number of copies of your résumé to the laboratory/department head, so that most of the inquisitors will have had the opportunity to review your qualifications at their leisure if they wish (some won’t bother, of course, until five minutes before the session).

In addition to these obvious short-term measures, there are other steps that could be taken but are not so obvious:

- Get an up-to-date list of current professional staff/faculty members (if only from the catalog) and find out the specialties of key members who may well turn up as inquisitors. Then try to indicate during the interview that you are aware of their great contributions to science (but only if you take the time to make yourself aware).
- Spend some time with the book American Men and Women of Science (15th ed., Cattell Press, eds., R. R. Bowker, New York, 1982), so that you will have
some knowledge of the ages, specialties, and interests of the staff/faculty people who may form part of the interview team (this is particularly important for the Dean and Department Chairman).

- If a seminar or a series of seminars is to be part of the selection process, invest at least three times the number of hours that you might otherwise spend in preparation, being absolutely positive that timing, visuals, and presentation of results are not just good, but impeccable, and that the presentation has breadth beyond your own work.
- Recognize that physical appearance is, to some inquisitors at least, an important factor. Simple things like appropriate clothes and clean fingernails should not be discounted.
- Keep in mind the easily overlooked point that such inquisitions may be stressful to members of the interview group as well as to you—in that they are expected to ask intelligent, relevant questions that will lead to proper evaluation of candidates, without revealing inadequacies in their own retentive abilities or breadth of knowledge.
- Avoid overt signs of excessive nervousness during the interview—which can make the whole process a less-than-pleasant event for everybody.
- The recruitment interview is a time when what you are, in terms of ability, intellect, background, attitudes, and accomplishments, will be on the line as at few other times in an entire career. At other times, you can plead ignorance, bluster, obfuscate, withdraw, or deny—but not at this interview.

I recently witnessed an excellent illustration of the value of preparation for the all-important final selection process. A large New England university was recruiting for an entry-level position, and the list of candidates had been cut to three. Each was invited to appear on the campus in turn, to present a seminar and to "chat" with current faculty members (the chats turned out to be a succession of half-hour inquisitions by small groups of staff members).

Candidate A did well in presenting the seminar, but concentrated totally on somewhat pedestrian and narrowly oriented research. The interviews later also disclosed a restricted view of the discipline and a vagueness about future plans for research. Responses to questions were guarded and surrounded by caveats.

Candidate B gave a good seminar presentation, couching personal research in the broader context of knowledge in the discipline area. She was direct and enthusiastic during the interviews and seemed to actually enjoy the give and take with faculty members.

Candidate C also gave a reasonable seminar presentation, with adequate responses during the discussion. The subsequent interviews were painful, though, since he reacted defensively to questions and was clearly ill at ease during the sessions—to the extent that some responses were mumbled and almost inaudible.

Later discussions with the department chairman and written comments from members of the various interview teams disclosed that although all three candidates appeared in their résumés to be qualified scientifically for the position, the on-site performances weighed heavily in favor of Candidate B, and
she was subsequently picked for the job. I wondered at the
time—and I still wonder—whether the unsuccessful candidates
ever understood the reasons why they were not selected.

All the foregoing suggestions and admonitions might
be useful, but there are no guarantees. The selection
process is ultimately a subjective one, and what seem to
be strong points in your favor may actually be perceived
as deficiencies. Good research may be viewed as too nar-
row or too "practical," self-confidence may be inter-
preted as "cockiness," and interest in good teaching
may be seen as disinterest in research. The situation isn't
"no-win," however, since excellent credentials are not
easy to ignore.

BALANCE SHEETS FOR ENTRY-LEVEL POSITIONS

Often, while selection committees and administrators
are interviewing applicants for science positions, it be-
comes apparent that these prospective employees are
pretty naive—that they have made only a superficial
analysis of the benefits and pitfalls of each of the prin-
cipal types of science employment (university, industry,
and government). This is a dreadful state of affairs, con-
sidering that a decision about type of employment is one
of the most important to be made in an entire career. The
acquisition of any position in science is difficult, but there
is no excuse for inadequate assessment of advantages
and disadvantages—even for temporary jobs. Many per-
sonal preferences enter into selection of the type of
employment in science, but each major employer

RECRUITMENT AND RECRUITING

group—university, industry, and government—has par-
ticular favorable and unpleasant attributes. Some of these
are listed in Table 1, one section of which summarizes
benefits and the other pitfalls.

From an examination of this table, it is obvious that
nobody promises a rose garden. Perspectives on type of
employment depend to a great degree on individual at-
titudes, as well as on availability of niches. Some new
scientists thrive in an environment in which other new
scientists are totally miserable. For example, some pros-
per in team-oriented, hard-driving, industrial develop-
ment laboratories, whereas others much prefer the
academic calm and independent research of a midsize
university department. Whatever the workplace char-
acteristics, it behooves any recruit to match them with
his/her own personal preferences before signing an em-
ployment agreement.

RECRUITING

At a recent scientific society meeting in Canada, I
heard an assistant professor serving on an evening panel
state that "old-boy networks" no longer apply in today's
job market. Reaction from the audience was instantane-
ous and audible, and later comments suggested wide-
spread disagreement with his point of view. A few
participants even offered first-hand evidence to disprove
it. During the cocktail party that followed the panel ses-
tion, I asked some of the attendees what they thought
of this interesting exchange. Many of the participants
were not at all sure what an "old-boy network" was, but
concluded that it had to be something repugnant. Others
### Table 1: Benefits and Risks of Scientific Employment

<table>
<thead>
<tr>
<th>University</th>
<th>Industry</th>
<th>Government</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Employment benefits</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A familiar academic environment with opportunity to explore new research areas.</td>
<td>Salary in a range that permits repayment of earlier loans and a standard of living compatible with professional expectations.</td>
<td>Reasonably stable research environment despite vagaries in funding.</td>
</tr>
<tr>
<td>Challenges and satisfactions in organizing and presenting courses in specialty area.</td>
<td>Equipment usually state of the art and with adequate technician support.</td>
<td>Equipment budgets usually adequate, even though acquisition may be on &quot;feast-or-famine&quot; schedule.</td>
</tr>
<tr>
<td>Satisfactions in meaningful contacts with interested and well-prepared students, at graduate and undergraduate levels.</td>
<td>Encouragement for postdoctoral training and opportunity for professional travel.</td>
<td>Programs usually well defined, with remarkable continuity despite popular misconceptions.</td>
</tr>
<tr>
<td>Pleasures in informal daily contacts with upwardly mobile, well-trained peers and more senior colleagues.</td>
<td>Colleagues often among &quot;the best and the brightest.&quot;</td>
<td>Salary and fringe benefits excellent, despite recent nibbling by political administrations.</td>
</tr>
<tr>
<td><strong>Employment pitfalls</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enraged, vertically aligned, and held hostage by an apathetic administration.</td>
<td>Company may be paranoid about release of data through publication.</td>
<td>Changes in administration invariably reverberate down through the career bureaucracy, affecting research groups as well as service groups.</td>
</tr>
<tr>
<td>Hierarchy of business-oriented administrators.</td>
<td>Restrictive employment contracts prevent normal dialogue with colleagues.</td>
<td>Some agencies are narrowly mission-oriented, and judgmental.</td>
</tr>
<tr>
<td>Low starting salary and minuscule annual raises, leading</td>
<td>Company may revise its corporate structure.</td>
<td></td>
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</tbody>
</table>

### Table 1 (Continued)

<table>
<thead>
<tr>
<th>University</th>
<th>Industry</th>
<th>Government</th>
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</thead>
<tbody>
<tr>
<td>to a perpetual scramble for an adequate standard of living.</td>
<td></td>
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<tr>
<td>Constant stress from required grant acquisition as source of funding for the institution and for graduate student support.</td>
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<tr>
<td>Often heavy teaching loads with many lab sections and endless student conferences in undergraduate courses.</td>
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<tr>
<td>Necessity to grind out publications constantly, as evidence of &quot;scholarly achievement&quot; (the classic &quot;publish or perish&quot; syndrome, which is still very much alive in most university science departments).</td>
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</tr>
<tr>
<td>Difficulty in discerning real institutional attitudes on teaching vs. research and in achieving a personally satisfactory balance of these professional responsibilities.</td>
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</tbody>
</table>

- Enraged, with the new organization unable or unwilling to support preexisting research effort.
- Research supervisors and managers may be totally business-oriented, without sensitivity for value of research.
- Tenure in government positions is almost immutable— for the incompetent as well as the competent.
- Initial civil service positions are hard to get, the best route being through very uncertain "temporary" jobs.
thought it meant a system in which members of "the club" used their influence to ensure selection of the other club members' Ph.D. candidates for available positions. Still others thought it meant that informal networks, operating among club members, transmitted the word about good positions that were open or would be open, well in advance of any public announcement. A generally accepted definition of an "old-boy network" probably does not exist, but its essence would be "a system of communication and mutually supportive activities perpetuated by established members of a subdiscipline." Whatever the definition, the implication was clear—that methods of announcing vacancies and selecting candidates beyond those accepted as standard Equal Employment Opportunity practices are in operation. This may be true for many science positions, especially those in universities.

Selection techniques may vary from institution to institution, but the appearance of a newly recruited faculty member or staff member elicits a mixed bag of responses from existing faculty or staff, again based on individual perceptions:

- **Relief**—if the position has been vacant for a year or more and present faculty has had to fill in.
- **Disbelief**—that anyone as young as the recruit could have a Ph.D., let alone postdoctoral experience and several publications (some of the new people do look like undergraduates).
- **Curiosity**—especially about the recruit's starting salary compared to the present salaries of long-time faculty members.

- **A vague sense of unease**—about professional backgrounds acquired so long ago, when compared with the obvious state-of-the-art status of the recruit's information.
- **Uncertainty**—about why the university did not recruit at a more senior level for a new faculty member with established reputation and status in a specialty.
- **Concern**—that this action represents part of a program to phase out long-time faculty as quickly as possible and to replace them with relatively inexpensive newcomers.
- **Pleasure**—that the institution has been able to attract and hire an obviously well-qualified new scientist (or, conversely, amazement at the absence of superior qualifications among the applicants from which the recruit was chosen).

Recruiting, then, regardless of the problems that the process presents to administrators, is a bittersweet experience for existing faculty and staff, combining the pleasure of participating in selecting competent if very junior colleagues and the worry about disturbing a comfortable status quo in the department.