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Research Productivity and Culture in Different Environments

A guide to senior students contemplating their first professional position after graduation. Academic, commercial and non-profit or government positions are examined.

In seeking career opportunities, graduate and undergraduate students have frequently asked me what it is like to pursue chemical research in the variety of available environments. Applicants for employment with our company also think deeply about this topic and wonder about chemistry at large, established firms versus free-wheeling start-ups or middle-sized companies. The following is my response to this question. I have organized the discussion by three major research laboratory environments. There are several subcategories within each of these cultures.

Academic Research

Goals: Teach, satisfy curiosity, help solve problems of interest to society, disseminate data and knowledge through lectures and publications.

Academia is a place for people with enormous drive, self-confidence and tolerance of bureaucracy. While the bureaucracy in universities, particularly public universities, is broad and deep, successful faculty with tenure frequently stand above it or simply ignore it. Academia generally attracts people who are not prone to take direction well and who are more apt to direct a team rather than serve on one. The work generally requires putting in enormous amounts of time beyond the traditional 40-hour workweek. On the other hand, scheduling these long hours is very flexible over 24/7. This can help add a "family-friendly" component to the work schedule.

Universities value *creativity* and *individuality*, whereas business values *productivity* and *teamwork*. All four characteristics have great value, but few are able to mix them successfully. Often new employees who just finished graduate school have a lot of trouble adjusting from the first two to the second two. They also can have a lot of trouble getting to their new office by 8:00 a.m. The academic tradition of working alone with a limited budget is increasingly under pressure due to the complexity of laboratory methodology now available. For example, this tradition is less effective when an advanced measurement technology such as mass spectrometry, NMR or capillary electrophoresis is attempted by individuals whose expertise is in neuroscience or drug metabolism (or vice versa).

There are substantial differences, too, in the academic setting between private and public universities and also among universities of different size and focus. The standards of excellence that motivate many university administrators are those seen at very broadly based schools that excel in science, engineering, medicine, humanities, business and law. We all know and respect Stanford and Harvard and the like. On the other hand, institutions emulating them often fail and end up with a few centers of excellence among many mediocre departments. The resources to do it all simply are not available. In many cases the will to cut out the weak and feed the strong has not been present. On the other hand, there are great schools with more focus, such as The California Institute of Technology. It strikes me that the budgets (and the talent) simply are not available for every state and region to have it all. Choices must be made. For example, there are few centers of academic excellence in polymer chemistry or analytical chemistry, and those may be enough.

It is common to find that the cost of doing research at private universities far exceeds that at public institutions. All the overheads charged to individual faculty research groups become more of a burden to research grants. Is that balanced by the greater ease of getting such grants? Perhaps, but only at the most prestigious departments.

Overall, research at smaller institutions is pursued in a more relaxed, collegial manner. It is clearly a strong component of the teaching process at all schools, but more so at the primarily undergraduate academies.

Exploratory research is a highly personal liberal arts activity, like writing a poem or a country music song. The subject gets in your head and you can't get it out. You think about it nights and weekends. You lie in bed with it. While this can be done anywhere, it fits best in universities where one is not bound by a restrictive mission. Historically, such people have thrived at 3M or DuPont or Bell Labs, but that history is getting a little old. This kind of work also finds a nice home in so-called start-up companies not burdened by any tradition. Exploratory or scouting work like this is not easily managed, and it often is done by people who may not be very manageable.

The following listing covers several problems and advantages of the academic research environment.

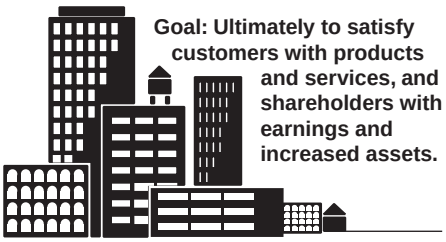
Problems

- Turnover of personnel (by design).
- Lack of funding and the time consumed looking for it.
- There often is a need to secure funding for your own summer salary.
- Projects are often too small and can sometimes lack real importance beyond the teaching goal.
- Quality assurance is not affordable.
- Individuals are dominant vs. teams.
- Response to external research proposals is slow.
- Goal is teaching creativity and integrity, not productivity.
- No management (Only self-motivated faculty and students thrive.)
- Some institutions do not provide mentors to guide young faculty. (They can confuse priorities and not have a chance to recover in time for tenure decision.)
- Pressure to publish often supercedes importance of project.
- Tenure system leads to ossification and complacency.
- Faculty meetings can be too democratic and therefore an unproductive way to make minor decisions.
- Many very good people are discouraged from joining faculty ranks, including many women.

Advantages

- Imagination is not often limited by institutional or departmental will.
- Rapid changes in direction are possible to take advantage of new opportunities.
- Teamwork is gradually becoming more popular.
- Turnover of personnel and regular interactions with outside peers stimulate new ideas.
- The opportunity to travel at will, often globally, is attractive to many.
- No management, few rules, very flexible, you are your own boss.
- There is great satisfaction in following the careers of successful former students.
- Recognition by peers on a global basis is feasible.
- Academics often have opportunities for supplemental income that are not available to scientists in business (patents, royalties, consulting fees, book royalties, speaking fees, government review panels, etc.).
- Retirement benefits frequently are superior to (small) companies.

Commercial Research



Commercial research, especially in large organizations that can accommodate a wider range of personalities, is very accepting of teamwork and generally requires individuals to devote fewer hours on task than does academic work. Thus commercial research is often more family-friendly than academic research of the first rank. Many larger firms even provide child care (for a fee). Such generalizations, however, don't apply to the pressure cooker R&D environment that typically exists in start-up companies faced with limited time and resources. In such cases, survival of the company may well be at stake and child care must be found off campus. In some cases, children are brought to the lab on Saturday morning with a box of crayons and the (faint) hope they won't need attention more than once every twenty minutes or so.

Travel has long been a bone of contention among industrial scientists. Academics simply get on the airplane and go. No permission of any kind is sought or needed. That won't work in industry. There are restrictions, and those restrictions often are arbitrary and contrary to the company's R&D mission.

Colleagues in industry frequently complain (or at least chuckle cynically) about "reorganizations" that disrupt their mission just as they were getting good at it. Some universities, by contrast, have not reorganized much in 100 years. Even getting a course number changed from CHEM 142 to CHEM 143 can engender several years of spirited debate. In universities the following exchange does not occur.

"The Project has been cancelled and the Project Team will be disbanded next month."

"That's great. Now we can publish!"

"What will be the next Project?"

"I've heard nothing yet, but I understand the HR consultants are advocating a team-building exercise where we spend a weekend constructing a soda straw bridge across a pit filled with poisonous snakes."

The role of industrial psychologists in large companies strikes me as an admission that we are all quite weird, and "professional" attempts to organize us to go in one direction are both well-meaning and self-defeating. Some have described the process to be "like herding cats," and that is on target. Doing important work with talented colleagues and an open, understanding management is key. With a seemingly arbitrary, indecisive management and paranoid colleagues spreading blame, you have "cats" scratching each other's eyes out.

I do not have a bias against large companies. Most of my clients are from firms with teams of 10,000 or more. We try to maintain a sense of humor. It is very difficult to manage large groups. You have to work hard to try to achieve cohesion and recognize that it will be elusive.

Colleagues at many companies complain that rapidly changing rules for doing business (imposed both internally and externally) are making simple tasks more difficult. The regulatory climate and focus on accountability for many simple tasks suggests we don't trust one another. Often, support staffs have been downsized, broadening the number of details generalists now are expected to deal with. Scientists often get promoted to positions where their competence as scientists is really no longer needed and where they basically have become signers of documents rather than planners of scientific strategy. In the university, they become grant writers.

One thing I enjoy about industrial research is the quality of the cafeterias. Research makes me hungry. Few universities come close to matching

industry in this regard. Glass-enclosed cafeterias with fountains and duck ponds are not a regular feature of chemistry departments. On the other hand, there are few ivy-covered R&D centers where you can walk along the same paths as the great novelists, historians and scientists of the past.

In any event, most of the dozens of major industrial research labs I've visited have had good soup, especially since they've outsourced the food court concept. Those of us in the small company research environment enjoy our brown bag lunches while plinking away at email. Lunch is, for us, more of a theoretical concept than a social event.

Here is a quote from an industrial scientist with over 20 years' experience:

> "When I first joined industry, I was productive the first week on the job. Now, a person spends months learning SOPs, internal computer systems, internal business processes, external guidances. Productivity in an industrial environment is highly dependent upon being willing to be a 'manager of risk.' There are so many negative influences that productivity means taking a stand on what is needed to get a job done and pushing to completion. People who are not willing to take a stand are inundated with good and bad advice that make it difficult to make progress."

I agree. There is also some of this in the university setting. Whenever something goes wrong, a new rule is made, a new form is created and a new signature is required. I often wonder what happened to common sense and the prediction of a paperless office.

Several colleagues at large companies have said, "We hire Ph.D.s and then take them out of science and have them do work that does not use their education. Meanwhile, we have some excellent B.S. people who could be great administrators and we hold them back because if we don't call someone 'Doctor,' we don't feel we have status as a company."

I recently encountered a fellow who jumped from a $20 billion pharma company to a small drug discovery company with nothing but losses. He said, "I make a little less money here, but I can keep doing neat science. I'm respected. We are encouraged to publish and speak at conferences. We have some research managers here without Ph.Ds. That would never have happened at big pharma. I don't want to be in meetings all day. I want to be in the lab learning new things."

It is fair to ask yourself if you really want to do hands-on science, if you want to design a research strategy, or if you want to organize people. There are still quite a few young people who have the very mistaken notion that success and respect are measured by the number of people reporting to you. This is a military point of view, but keep in mind that a top General or Admiral may have fewer direct reports than a second lieutenant. Great players (with no reports) may be paid more than their coach, and great scientists can have more pay and a lot more recognition than their manager.

I've seen many scientists become frustrated as managers where they first must deal with the egos, emotions and personal foibles of those for whom they are responsible. Humans are non-linear systems with an endless number of environmental influences. The challenge of forming a disconnected group into a well-honed team is always tough. It certainly is not a skill for which a Ph.D. in chemistry provides much preparation. Many scientists and engineers decide, "I don't want to go there," and they rise above the fray based solely on their technical achievements.

As you begin a scientific career, you will likely encounter a good many career bureaucrats with Ph.D.s. Many find themselves in positions where they are no longer contributing technically, yet they don't have the liberal arts skills that are nearly always critical to the most senior management positions. These positions certainly have value. Nevertheless, given a choice, I'd advise either reaching for the highest level of technical achievement, or consciously developing the leadership skills year by year to reach for the highest management ranks. There are alternatives, such as making a move out of the lab into technical sales, but that is beyond the scope of this article.

Let's list some problems and advantages of commercial research to stimulate you to argue with colleagues.

Problems

- Imagination is narrowed by the strategic focus of the organization.
- R&D Centers of the past are of the past.
- Most are burdened by meetings and accountability by committee.
- Institutional impatience (science on a schedule) driven by Wall Street. (Often there is no time to explore new approaches or to think.)
- Cancelled projects discourage personnel.
- Very capable people can be invisible outside their company.
- Travel to professional meetings with peers is often arbitrarily limited.
- Many scientists fall behind in their knowledge of the latest developments.
- The nail that stands out gets hammered down.
- Regulatory issues and documentation may impede scientific progress.
- Mergers can cause stress about job stability.

Advantages

- Teams are valued more than any one individual which enables a wide range of expertise to attack a project.
- Resources are made available once a project is economically justified.
- There is a relative constancy of personnel on task.
- Stock options and defined benefit retirement plans are comforting.
- It's nice to see the results of your work get shelf space at a store and be used by friends and neighbors (goals are practical). There is more opportunity to get out of the lab and assume a wider variety of responsibilities. (In academia, very few become a Dean, or would want to.)

Institutional Research (non-profit and government research labs)

Goal: Basic science and/or solve problems important to both society in general and government agencies in particular.

These institutions are ideal for researchers who feel that teaching and producing a product **both** are distractions. Such places are good for idealists pursuing science and/or for people who are developing skills ultimately to transition either to academia or to business. For example, pursuit of a cure for malaria at the Walter Reed Army Medical Center for the better part of a century has both advanced science and trained people in an extremely worthy cause. The attacks against AIDS, dementia, diabetes, etc., at the National Institutes of Health are also good examples. The search for new materials at Naval Research Laboratories, NIST, and Sandia *et al.* is important work. On the other hand, work in the institutional setting can lack the driving forces present in both academia and business. Some people simply fall asleep. Others, of course, thrive on self-motivation.

Problems

- Intermediate between academia and business.
- Low salaries in some cases.

Advantages

- Large endowment or steady (but modest) government support.
- Relatively stable personnel on task aids productivity.
- Less time is consumed writing extramural grant proposals.
- Teaching students is not a distraction if you don't enjoy it.
- There are far fewer meetings than in industry.
- Mergers and bankruptcies are rare.

Conclusion

There is opportunity to practice scientific research in a variety of environments. Each has distinct advantages and concerns. Capable people can thrive by selecting the environment best suited to their personality and ambition. It is very likely that many scientists will move among these environments several times during their careers. It is natural for young people to spend a lot of time contemplating the first research environment they enter. Quite often they worry about topics that won't make any sense to them until they jump in and get some experience. It may well be only in the second or third position that some of the issues begin to clarify.

In this essay, I have made a number of generalizations I believe to be true, on average. The average, of course, may not matter in any particular situation. Most of us have evolved to be natural complainers; thus the disadvantages listed above tend to be more numerous than the advantages. Surveys of colleagues suggest that those who focus on the advantages are far more successful than the complainers who see greener grass (or a nicer cafeteria) elsewhere.