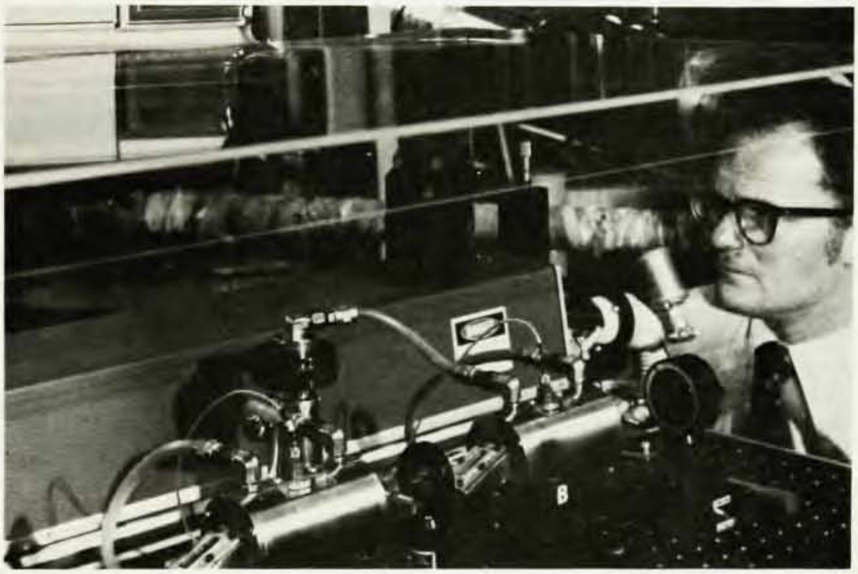
Differences between physics in industry and academia

The interesting and wide-ranging review of "Physicists and their work in the automotive industry" by Frank Jamerson and Nils Muench (December, page 31) will undoubtedly stimulate many PhD students to consider career opportunities in the first-class research environments that exist in these and other large corporations. (Current salary and opportunity levels in academia stimulate such considerations also.) I would like to comment on aspects of these research environments that were not discussed in that review and that should be considered in a professional career decision: What are the professional group dynamics of the corporate physics department and what is it like to work there? I write specifically about the Physics Department of the General Motors Research Laboratories, but I'm sure that many of these observations apply to other corporate research labs.



The biggest difference between an industrial and a university physics department lies in the motivation for, and evaluation of, research—not in the selection of topic; for example, five of the seven group activities listed by Jamerson and Muench are typical research areas of academic physicists. Academia goes by strict *academic* standards: intrinsic scientific interest and importance, as judged by peer review. General Motors has an additional and largely orthogonal standard: *utility* to the company as judged by those outside of the physics department, but inside G.M. To be judged successful, a project or a person should rank very high on either the academic or utility coordinate. It is not necessary for a person (or even a small research group) to rank high on both, although a high utility rating is very helpful for advancement into management. To many scientists this dual standard is a source of tension in budgeting their time; nevertheless, it does allow for a diversity in career styles not present in academia. Furthermore, it adds the real possibility of doing research with fairly short-term societal benefits. For example, it is easier to build and tune diesel engines with low particulate emissions after someone has devised a real-time particulate sensor to replace the filter paper and balance used in the Federal emissions standard.

There are several ways in which the day-to-day experimental life of a newly hired research scientist differs from that of an assistant professor. Because a fraction of the time of a 9-to-5 technician is no substitute for several degree-hungry graduate students, the industrial scientist does much more of the work—including the drudgery—than the academic. On the other hand, resources such as money and the help of professionals in unrelated fields (such as mathematics) are more available. There is less pressure to publish many journal articles per year, but oral and written in-house research reports are required frequently. As opposed to a young professor's commitment of a significant fraction of his time to teaching and fund raising, the automotive researcher is free to spend most of his time on research. However, some of this research may be directed toward a scientific topic that is of short-term interest to higher management. One may be asked, for example, to suggest new ways to solve some current company problem (to "find a simple, reliable way to determine if cars with catalytic converters have been operated with leaded gasoline," for example, or to "devise several ways to detect dirt in diesel fuel") or to review the proposed solution to a problem to see if simple alternatives have been overlooked. These activities are an integral part of life in a corporate research lab; a researcher who doesn't find some of them challenging and enjoyable is somewhat out of place.

Scientists age (ripen?) more slowly in industry than in academia: G.M. scientists 8 years past their PhD will spend most of their time doing research, whereas their academic counterparts, now associate professors, will have to devote a large fraction of their time to fund raising, refereeing papers and proposals, working on departmental or university committees, and teaching (both in the classroom and in the lab)—and worrying about tenure. Even if the corporate researcher has become a group leader, the "selling" of new projects to higher management will be less time-consuming than proposal writing. Moreover, the group (mainly PhDs) will require less supervision than a lab full of students.

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Older scientists at G.M. have a variety of opportunities. The management pyramid at G.M., while not top-heavy, has a high aspect ratio (there are on the order of 10 positions between Group Leader and Board Chairman); supervisors typically have only two or three direct subordinates—in marked contrast to a university. So while there may be no more room at the very top there is lots more room above the bottom. The company-requested projects offer opportunities to move laterally out of pure research into more applied areas or engineering. Finally, an older scientist will not be left alone to stagnate in some no-longer-important research area. If he can no longer come up with good new ideas, management will. It is, in general, much easier to switch research areas[5] for a scientist at G.M. than in a university. Thus while G.M. scientists are unlikely to be regarded by their colleagues as founders of some new field of research, they are also less likely to be buried in an old one.

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This report was written, mainly for PhD students, after a one-week visit to the General Motors Physics Department as part of a university–industry exchange program. □