

letters

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same time as the Third Reich, out of the discovery of the neutron." The early development of nuclear physics was brought about by three remarkable people: Rutherford and the two Curies. I have well known the next generation of French explorers, the Joliot-Curies and describe them at length. And I quote a pupil of Rutherford's, P.M.S. Blackett, himself a famous nuclear physicist, saying about Joliot that if it had not been for the Second World War "there can be no doubt that the first functioning nuclear reactor would have come into existence in France."

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Encouraging innovation

The excellent editorial on innovation by Jack Goldman of Xerox in August (page 88), prompts me to mention a technique used by Singer, Link Division (Binghamton, N.Y.) which I consider useful in encouraging their engineers and scientists to be more innovative. The following two paragraphs are from a letter of J. Rothenberg, their Director of Patents:

"Inventors Recognition Weekend—An annual function offered to employees to whom a patent issues in the previous year. These employees, and their spouses, are guests of the Division at a resort hotel where they participate in a special program to encourage further innovation. The program generally includes a speech by an authority in the field of inventions and/or patents, an informal brainstorming session, and an awards banquet. In addition, the Weekend provides a unique opportunity for creative employees from all operations of the Division to meet and interrelate and for the Division's management and Patent staff to establish stronger bonds with those engineers who have demonstrated an ability to successfully invent."

"The Division benefits from the Patent Awareness and Incentive Program by way of increased innovation, improved employee morale, prompt disclosure of new ideas and full cooperation with the Patent Department. Needless to say, invention and the protection of such invention is a critical factor in maintaining Singer's position of leadership in the highly competitive simulation business."

Prior speakers have included Jack Rabinow, and this year, because of the publication of my latest book, *The Creative Engineer* (Plenum) (see page 62 in August), I was asked to address the group and to participate in the brainstorming

session. The presence of wives is helpful because they encourage their husbands to invent again so as to be invited to another resort hotel weekend!

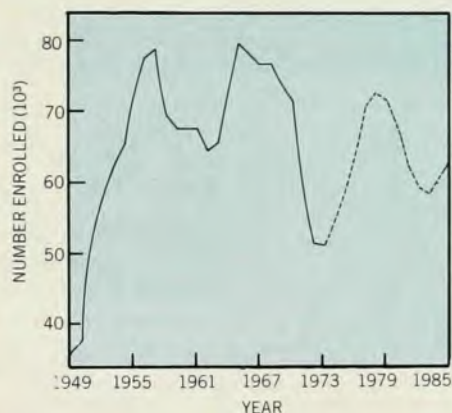
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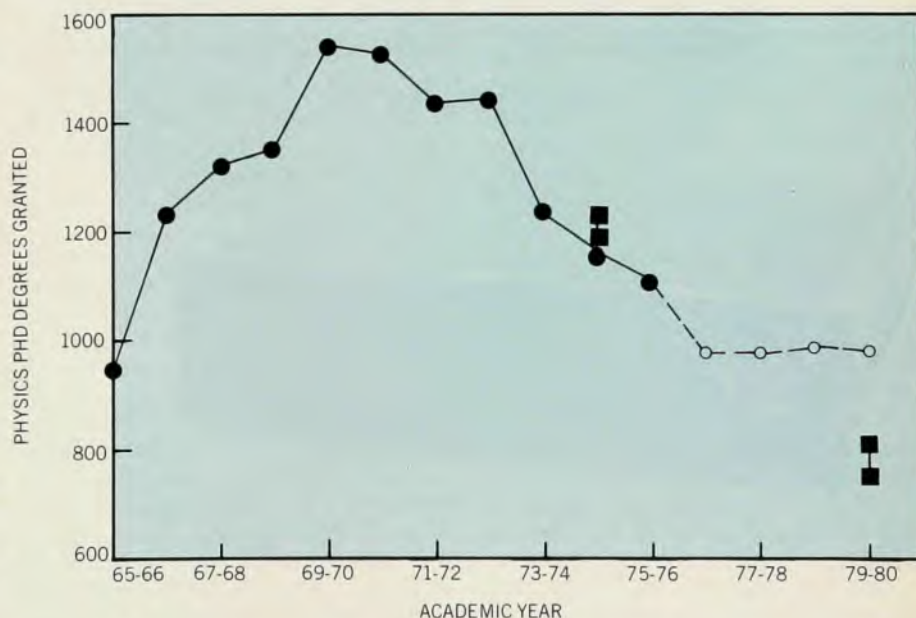
9/5/78

PhD production cycle

In a recent book¹ R. B. Freeman shows that engineering freshman college enrollments went through two minima between the early 1950's and the early 1970's and predicts that another minimum will occur by the early to late 1980's (see figure 1). Of course, the reason for the oscillations is that the system has long response lag times to stimuli.



Freshman engineering enrollment from R. B. Freeman (ref. 1); dashed curve is projection by Freeman for years after 1973. Figure 1



Physics PhD degrees granted as function of academic year. Solid circles are AIP data (ref. 3), open circles are AIP projections, and squares are projections by Freeman (ref. 2). Figure 2

In physics our main concern with cycles of degree production is at the PhD level; we seem to have little difficulty in placing

our bachelor-degree and masters-degree graduates in meaningful employment. In a paper² Freeman claims that the number of physics PhD degrees has shown (see figure 1 of Freeman's paper) and will continue to show a cyclic behavior. Freeman's predictions for physics PhD degrees to be granted in 1975 and 1980 are shown in figure 2, along with AIP data and projections. It appears that, if Freeman's and AIP's projections are reasonably correct, the physics PhD production cycle will have a longer period than does the engineering freshman enrollment, which appears reasonable since the former system has longer response lag times than does the latter. Comparing figure 2 here with figure 1 in Freeman's paper, one arrives at a period of fifteen years or longer.

Note that Freeman's projection for physics PhD's to be granted in 1980 is about 20% lower than the AIP projection. I hope that physics manpower experts will study carefully the different projection methods used by AIP and by Freeman and analyze them for us in future issues of PHYSICS TODAY. Also, I would like to see initiation of and a striving to maintain a continuing dialog in PHYSICS TODAY concerning the following questions on this subject:

- ▶ Will physics PhD degrees again overshoot the demand in the next decade, given the system as it now exists?
- ▶ Are there any changes we can make in the system that will dampen the oscillations?
- ▶ Is it desirable to make such changes in the system?

References

1. R. B. Freeman, *The Overeducated American*, Academic, New York (1976).