type of experiment involving food restriction is much better known and was briefly discussed by Rothstein. The most important result from these experiments, in the writer's view, is that the variance of longevity increases as the rate of food supply is reduced. The third experiment, with mice as the experimental animals, showed that protracted whole-body irradiation with gamma rays led to changes in variance of longevity in a manner similar to that expected to be induced by food supply rate increased over the minimum required for survival.

Thus the work of Hall and Marble shows the manner in which reproductive capacity varies with longevity and implies its genetic basis; that of McKay and collaborators as well as much subsequent work shows how (presumably) hormonal effects of food supply rate may affect the reproductive capacity by changing the ratio of the observed life spans of short- and long-lived portions of a population. The key experiments of Lorenz et al. link the indirect effect of radiation ("indirect" owing to that part oxygen radicals contribute to the total radiation effect aside from that due to direct absorption of radiation energy by target molecules) to life span changes.

The three types of experiments linked together provide a basis for understanding, at the physiological level, the relationships of "active" oxygen to longevity, of longevity to reproductive capacity, and of the latter to selection for longevity by alteration of the ratio of individuals in the population that have longer or shorter life spans or larger and smaller reproductive capacities, hence "fitness" in the sense used by population biologists [see Totter, "Food Restriction, Ionizing Radiation, and Natural Selection," *Mechanisms of Ageing & Development*, **30**, 261 (1985)]. This mechanism is quite obviously a kind of homeostasis that keeps a population in close balance with its food supply rate by adjusting mortality rates of diseases of old age and must be widely observable among animals. The reason it has not been observed frequently is probably because we prefer to employ in the laboratory experimental animals whose natural variances have been reduced to the maximum possible degree by inbreeding, thus throwing away the characteristic most needed to see the effect we look for.

We must all be charged with intellectual laziness for not having brought these experiments together and seen their relationship. The knowledge has been available for about 35 years. Most of all we should chide those radiobiologists who discounted the value of the Lorenz experiments because the control group in that experiment was kept by necessity in a separate room from the exposed groups. The control group, it turns out, is not even necessary for us to see the relationship. Some later experiments (but not all) have failed no doubt because the variance available in the strain used in the experiment was inadequate to show unequivocal differences among the groups. How long must we continue quibbling because we want proofs couched in terms of our own narrow specialties rather than looking at a broader spectrum in what should be considered a single science?

One additional point needs to be made: Because there is involved a true homeostatic mechanism it will not be easy to alter the life span of individuals by intervention except through altering the signal that controls the mechanism—namely the food supply rate and/or the work required to supply the food.

John R. Totter
Institute for Energy Analysis
Oak Ridge Associated Universities
Oak Ridge, Tenn.

Information needed

SIR: We are seeking the help of chemistry faculty who teach upper-division chemistry courses (or modules) for nonscience majors. As a Task Force of the Society Committee on Education (SOCED), Subcommittee B, we have been charged with determining the current state of chemistry offerings for nonscience majors. Our task is part of the overall effort of SOCED to implement the recommendations of the Tomorrow Report issued in 1984 by the ACS Task Force for the Study of Chemistry Education in the United States (chaired by Peter Yankwich).

In the Tomorrow Report, three of the 12 recommendations addressed to the undergraduate area speak to the need for and nature of possible guidelines for chemistry courses or modules for nonscience majors. In some cases these courses might include aspects of chemistry that are germane to curricula of professional programs in business, accounting, law, etc. These recommendations flow, at least partially, from the apparent decline in undergraduate liberal arts majors and increase in majors choosing professional fields. The trend has been that fewer students are being exposed to courses in chemistry.

Our task force seeks to determine what chemistry courses for nonmajors are being offered and what topics are being covered. We are especially interested in upper-level chemistry courses or general science courses with a strong chemistry content.

Anyone who is teaching such a course is being asked to send his or her name and address to: Kenneth E. Kolb, Department of Chemistry, Bradley University, Peoria, Ill. 61625. We have a very brief information form that we would like these people to complete.

Kenneth E. Kolb

Antibiotics in food

SIR: I read with interest the informative article by C. S. Ough entitled "Chemicals Used in Making Wine" (C&EN, Jan. 5, page 19). I would like to point out misleading if not inaccurate statements regarding the use of pimaricin in the tabulation on page 25, "Antibiotics illegal for use in food," and on page 28, "The U.S. does not permit use of antibiotics in food and beverages, however."

Although it is true that, to my knowledge, there is no U.S. regulation permitting the use of pimaricin in wines, 21CFR 172.155 states that Natamycin, also known as pimaricin (CAS Registry No. 768-93-8), may be applied to the surface of cuts and slices of cheese to inhibit mold spoilage (47FR26823 June 22, 1982). The regulation limits the application to only the cheeses in Part 133 for which the standards provide for the use of "safe and suitable" mold-inhibiting ingredients. Thus, pimaricin is permitted for use in at least one food.

Prince G. Harrill
Retired FDA Chemist
Lexington, Ky.

Improve tobacco?

SIR: About a year ago, you published a letter (C&EN, March 17, 1986, page 2) from the vice president for research and development of Agracetus Corp., who minimized my concern (C&EN, Jan. 13, 1986, page 2) that recombinant DNA research was being used to improve the viability of tobacco plants. The official stated that the plant disease that was the target of genetic engineering by Agracetus and W. R. Grace Co. was "not eco-

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ful desert plants and published extensively on their utility as chemical resource crops.

Thomas E. **Mallouk,** chemistry professor, University of Texas, Austin, received the 1986 Exxon Faculty Fellowship Award from the ACS Division of Inorganic Chemistry (Solid-State Chemistry Subdivision). He was cited for significant accomplishments in graphite intercalation studies and his work on indium phosphide, as well as his broad-ranging interests in synthetic aspects of solid-state chemistry.

Alfred **Schneider,** professor of nuclear engineering, Georgia Institute of Technology, received the 1986 Robert E. Wilson Award from the American Institute of Chemical Engineers. He was cited for successfully applying chemical engineering principles to the nuclear fuel cycle, the invention of the electrochemical solvent extraction method, and for his achievements as an educator.

James P. **Shoffner,** research specialist, Signal Research Center Inc., won the 4th Annual Public Affairs Award of the ACS Chicago Section for his work in promoting public understanding of the chemical profession and establishing liaisons between government and the chemical profession.

Michael L. **Shuler,** biochemistry professor, Cornell, received the 1986 Marvin J. Johnson Award from the ACS Division of Microbial & Biochemical Technology. A specialist in biochemical engineering, Shuler was cited for his original research in mathematical models of microbial systems.

Steven L. **Suib,** chemistry professor at the University of Connecticut, was honored with the 1986 ACS Connecticut Valley Section Award for outstanding contributions to chemistry during the formative years of his career. In the six years he has been at UC, he has established an outstanding research program in solid-state inorganic chemistry.

Krishna **Venkataswamy** won the 1986 Sherwin-Williams Student award administered by the ACS Division of Polymeric Materials: Science & Engineering. Venkataswamy graduated from Case Western Reserve University. His award paper was "Photon Correlation Spectroscopy of Polystyrene in Good Solvents: Ethylbenzene and Tetrahydrofuran."

Frank **Westheimer,** professor emeritus of chemistry, Harvard University, was named the fifth recipient of the University of Chicago's G. W. Wheland Medal for his outstanding contributions to chemistry. He was also the recipient of the 1986 National Medal of Science for his "extraordinary investigations of the mechanisms of organic and enzymic reactions." His many contributions include the invention of molecular mechanics.

R. Warren **Wise,** director of technology, rubber chemicals division, Monsanto, won the first annual Fernly H. Banbury Award of the ACS Rubber Division. The award recognizes the contributions of scientists and engineers to the development of production equipment, control systems, and instrumentation used in the manufacture of rubber or rubber-like articles of importance. Wise is being honored for the development of the oscillating disk rheometer.

Winners of the Board of Trustees, Group Insurance Plans for ACS Members CIGNA scholarships were: Region I, John **Mitchell,** Cornell; Region II, Andrea **DeLaat,** University of Cincinnati; Region III, Christopher **Hadad,** University of Delaware; Region IV, Larry **Spears,** Rice University; Region V, Jodi **Johnson,** Iowa State University; Region VI, Andrew **Marcus,** University of California, San Diego.

The 1986 Distinguished Service Awards of the ACS Division of Agricultural & Food Chemistry were presented to: Robert E. **Feeney,** University of California, Davis; Virginia H. **Holsinger,** USDA, Philadelphia; Stanley J. **Kazeniac,** Narberth, Pa.; Constance V. **Kies,** University of Nebraska; Robert L. **Ory,** New Orleans.

The 1986-87 ACS Analytical Division fellowships have been awarded to: Steven **Donahue,** University of Rhode Island; Kurt L. **Haller,** Northwestern University; Gregory W. **Nelson,** Emory University; Stephen L. **Pentoney,** University of California, Riverside; Karen **Sentell,** University of Florida; George H. **Vickers,** Indiana University.

ACS Division of Organic Chemistry graduate fellowship winners for 1986-87 are: Matthew **Callstrom** University of Minnesota; Michael J. **Eis,** Cornell University; Stephen V. **Frye,** University of North Carolina; Douglas **Grotjahn,** University of California, Berkeley; Max **Kopelevich,** University of California, Los Angeles; Bruce A. **Lefker,** Colorado State University; Laurence M. **Principe,** Indiana University; Brett Turner **Watson,** Massachusetts Institute of Technology; Mary Jennifer T. **Young,** Ohio State University.

Letters

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nomically important to the tobacco industry," and that the tobacco plant was merely being used as a convenient model.

The tobacco industry evidently holds different views. A Science/Technology Concentrate (C&EN, Feb. 2, page 28) reports successful introduction of a gene that imparts resistance to certain herbicides into commercial tobacco plants. According to the C&EN report, the developers, Du Pont and Northrup King Co., predict commercial marketability "in four to six years."

There are many important benefits that advanced biotechnology can bring to our society, but a hardier or more economical tobacco crop is not among them. Recombinant research should be directed towards conquering human disease, not producing more of it.

Steven D. Stellman
Assistant Vice President for Technology
American Cancer Society, New York, N.Y.

Alternative doctorate

SIR: In recent years the doctorate has come to be regarded as virtually a prerequisite for a career as a research chemist. Nevertheless, there are a number of competent, productive researchers—many of them middle-aged—who regularly publish in respected journals but who do not hold a doctorate. Although I have no quarrel with the present system by which we use the Ph.D. program to train researchers, I think we should acknowledge that this system is not suitable for everyone nor is it the only way for a chemist to attain knowledge and demonstrate competence. Many fine scientists are forced by financial or family constraints to begin their careers as researchers before they complete their formal graduate education and, despite this handicap, many of these scientists go on to attain knowledge and perform research fully equal to their colleagues who have earned Ph.D.s.

It seems to me only fair that if a chemist is able to consistently perform in the real world at a level we associate with holders of a doctorate, then that individual should be granted a doctorate. I, therefore, suggest that the American Chemical Society establish criteria regarding the level of knowledge and performance expected of a Ph.D. chemist and grant an ACS certified doctorate to any practicing chemist who can demonstrate compliance with such criteria. I suggest the following criteria for consideration: (1) a minimum of 10 years' experience in an ACS-approved re-

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