jacent to the unconformities give no indication of shoaling depths. These relations suggest that sedimentation was absent over a long period of geologic time or that pre-existing pelagic deposits were eroded by bottom currents. The area of missing post-Oligocene strata underlies the present Gulf Stream. Soundings and seismic reflection profiles reveal maximum erosion of Tertiary units along the base of the slope parallel to the Gulf Stream axis. Furthermore, underwater photographs show that bottom currents are actively moving sediment on the inner part of the Blake Plateau (*31*).

The picture which emerges shows the continental margin as a wedge-shaped constructional feature, thinning seaward. What has been the role of contemporaneous deformation in modifying this wedge? Drill holes and seismic evidence (*6, 12*) show a gentle warping of Tertiary strata (Fig. 3) on the inner part of the continental shelf. The strata also appear to be warped downward beneath the Florida-Hatteras Slope, but in fact they were deposited at about their present depth when the shelf and slope were prograded during the Tertiary. No evidence was found for a major rift under the Florida-Hatteras Slope, as had been postulated (*7*). The continuity of seismic reflectors beneath the slope, as shown on the seismic profile, precludes major faulting between the continental shelf and the Blake Plateau during the Tertiary; hence, if a fault is present, it is Cretaceous or earlier. Some minor offsets may have occurred in connection with warping of Tertiary strata on the shelf, but the close similarity between Tertiary and modern depositional environments suggests that the continental margin has slowly subsided.

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33. The drilling program was made possible by NSF grant GP4233 to Lamont Geological Observatory acting as operating institution for JOIDES (Woods Hole Oceanographic Institution, Lamont Geological Observatory, University of Miami, and Scripps Institution of Oceanography). The continuous seismic profiles were obtained during part of R.V. *Chain* Cruise 46, supported by ONR contract Nonr-4029(00). Transit costs for the drilling vessel were underwritten by Pan American Petroleum Corporation. Lamont Geological Observatory Contribution No. 857; Contribution No. 1707 of the Woods Hole Oceanographic Institution; Contribution No. 626 from Institute of Marine Science, University of Miami. Reprints may be obtained from these organizations. Publication authorized by the Director, U.S. Geological Survey. Successful completion of the drilling program is due to the efforts of many workers who studied the region in previous years, made preliminary surveys, organized multi-institutional cooperation, or served aboard M.V. *Caldrill I.*

Mature Research Institutions and the Older Scientist

The dominance of youth in professional research is disappearing in favor of experience and maturity.

Leslie G. Cook and George W. Hazzard

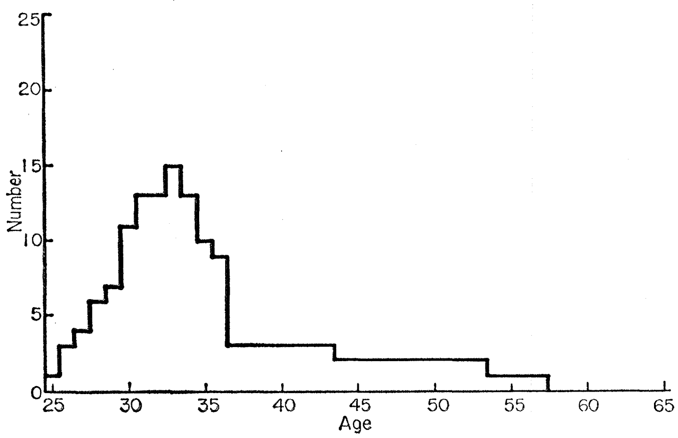
Scientific research as a full-time profession, instead of as merely part of an academic career, is a phenomenon largely of the last few decades. Since World War II the number of large industrial laboratories in this country has increased by 50 percent, and the total number of scientists in these laboratories has doubled (*1*).

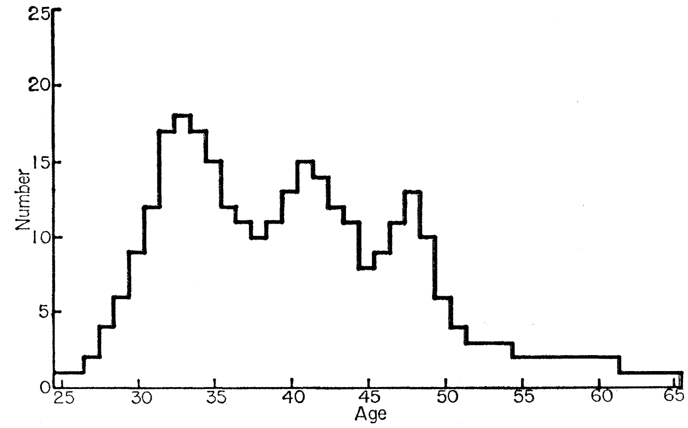
The number of males who graduate from college with degrees in science and engineering has been increasing at the rate of 12 percent per year, as compared with 5 percent for college graduates generally and only 2 percent for people of age 22 in the total U.S. population (*2*). All in all, there has been a remarkable and disproportionate increase in the flow of young people into the science professions, matching the equally remarkable flow of money into research and development activities.

As a consequence, most scientists in professional research laboratories have thought of themselves as young people, in young organizations and with unlimited growth opportunities. Yet now, looking around, they are intuitively aware that, on the whole, they are working with older people. What exactly has been happening in these laboratories?

Data were available to us on seven

Dr. Cook is manager of project analysis at the General Electric Research Laboratory, Schenectady, N.Y. Dr. Hazzard is associate provost of Washington University, St. Louis, Mo.





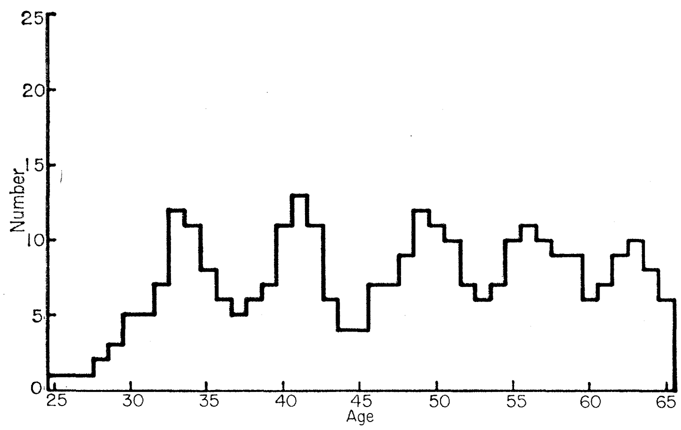


Fig. 1 (top left). Age histogram for a 10-year-old laboratory employing 150 Ph.D.'s.

Fig. 2 (top right). Age histogram for a 25-year-old laboratory employing 300 Ph.D.'s.

Fig. 3 (bottom). Age histogram for a 40-year-old laboratory employing 300 Ph.D.'s.

long-established laboratories, six industrial and one governmental. While there are some variations in detail, all seven show the same essential trends in ages of the Ph.D. research staff. The age distributions have been consolidated in Figs. 1, 2, and 3. These distributions are normalized to an initial laboratory size of 150 scientists, and to 300 scientists 15 years later.

A few years after its inauguration, the typical laboratory would have a Ph.D. staff of 150 with an age distribution as in Fig. 1. Usually, 20 percent or less of the staff is over age 38, with the majority of the members in the 27-to-35 age group.

During the next 15 years the laboratory typically doubles in size, and the age distribution becomes much like that in Fig. 2. Perhaps 50 percent of the staff is over age 38, with a fairly uniform distribution in the 27-to-50 age group. Such is the approximate age distribution in the early 1960's for all the laboratories studied.

Extrapolating this trend another 15 years, one gets the age distribution of Fig. 3. We have assumed that the laboratory has ceased to grow, having reached the maximum size its parent organization will support. Because of this, new employment has been confined to replacements. Partly because of restricted additions of young staff members, some 80 percent of the staff will be over age 38 and distributed fairly evenly over the 32-to-65 age group. This trend is more than hypothetical. The General Electric Research Laboratory, founded in 1900, had come to just this kind of age distribution by 1939 on about the time scale mentioned.

Two peripheral points are worth noting. Over a 15-year period, attrition of newly hired younger people may be close to 60 percent. However, there is usually sufficient hiring at distributed ages to reduce the net attrition in the young group to about 25 percent. Actually, the chances are about one in six that a man hired under age 33 will remain until retirement, whereas they are one in two for a man hired over age 38. There also appear to be regular periods of higher employment rates, and the age waves thus created appear to progress through the age histograms. They seem to be 6 to 7 years apart, with a 3- to 4-year half-width. Some relationship to a business cycle or to an assimilation period for new staff members may exist.

This growth in the proportion of older scientists is characteristic not only of these seven laboratories, but to some extent of the whole scientific community; it is, however, not indicative of what is happening in the U.S. population as a whole. Data (*3*) on the U.S. population from 1930 to 1980 (estimated) do not show an aging population. In fact, the ratio of U.S. population in the 50-to-60 age group to those in the 20-to-30 age group is predicted to decrease substantially.

Data on the scientific community are complicated by the problem of deciding whom to include. However, Fig. 4 summarizes one collection of data (*4*) on professionally active scientists generally, and on physicists in particular, including—in both instances—holders of B.A., B.S., and higher degrees.

Below age 32 there will be many potential scientists who are still students, but by age 32 this complication can certainly be neglected. These curves indicate that the rapid increase in the number of those who entered the science professions in the past, which shows up in the 37-to-50 age group, is tapering off. This, perhaps, was inevitable, and will tend to bring the science community more into age balance with the population as a whole as time goes on. It seems as if the whole science profession will more and more face the same preponderance of older

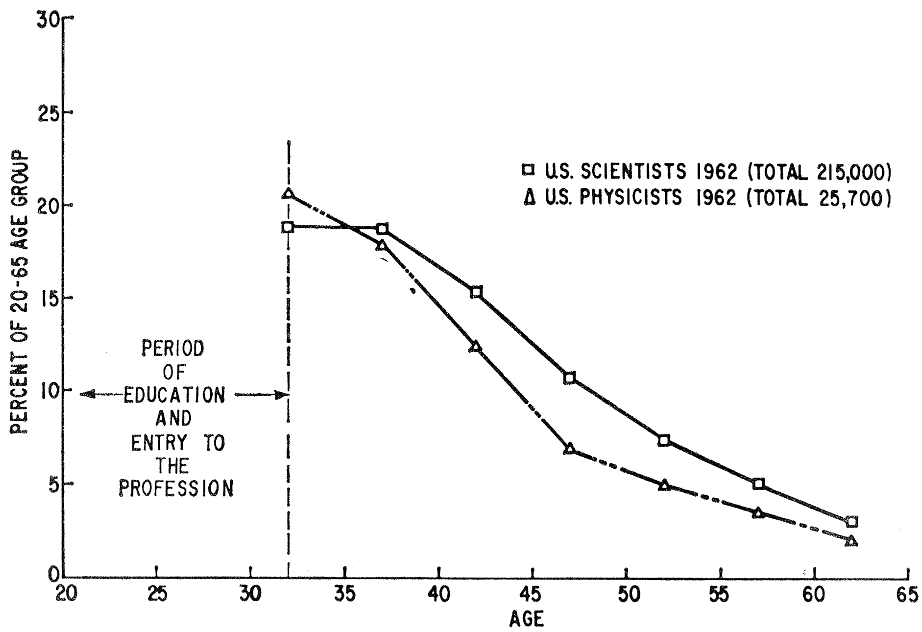


Fig. 4. Age distribution of U.S. scientists (1962).

scientists as is now developing in the research laboratories examined.

This increasing preponderance of older scientists in professional research laboratories will render some questions and problems of increasing significance, both for the individual scientist and for the research manager or director.

One of these problems is the mundane but essential one of cost. A laboratory of the sort considered, which has stabilized at about the maximum size that its parent organization will support, must expect its overall real personnel costs to increase by about 1 percent a year because of the increasing maturity of its staff. Although this easily gets lost in much larger increases brought about by present inflationary pressures, nevertheless, over a period of 10 to 20 years it makes its cumulative contribution to financial headaches.

This leads directly to the question of productivity, demonstration and measurement of which become more and more important to the laboratory and to the individual as costs increase. The maturing scientist wants to feel sure that his increasing cost is being justified by an increasing contribution to the parent organization. The research director wants to feel sure, too, to say nothing of the parent organization itself.

Despite many studies and hypotheses, simple and quantifiable indicators of research productivity are not reliable. Physical energy and published output seem to be fairly constant for those who remain practicing scientists for their whole working careers. Yet scientific insight and selectivity, or breadth of technical contact, can increase greatly with age. Perhaps the best measure for the research director is how well these abilities are utilized for the attainment of common goals. Thus, in a maturing research laboratory, the question of relations and shared responsibilities with its parent organization becomes of increasing importance.

There are other and more personal problems, too, which are scarcely apparent in a young laboratory, but which become increasingly pressing in the maturing laboratory. For example, the mobility of personnel drops substantially after age 40, which means that the individual implicitly makes a new type of long-term commitment to the laboratory, and the laboratory to him, at about this age. Both are naturally anxious to know exactly what this commitment is or what it is likely to become.

Such commitments in a maturing laboratory are different from those in a young laboratory. Whereas, for example, the successful research scientist in a young laboratory may be reasonably certain of an opportunity to assume substantial research-management responsibilities should he wish to develop his career in that direction, in the maturing laboratory he will be much less certain of such an opportunity. There will be an increasing number of qualified candidates for every opening in research management. In the maturing laboratory, the older scientist becomes more and more committed to a continuing career as an individual contributor to research.

This in turn raises other questions. The maturing scientist who is becoming committed to a life career as an individual contributor must pay special attention to the problem of his own technical obsolescence. Too much concentration on problems special to his parent organization may result, after a few years, in a scientist's finding himself hopelessly outside the mainstream of science. A compromise must be developed by each individual scientist, who consequently becomes anxious for reassurance that the compromise he is developing is appreciated by the laboratory and is contributing to his parent organization. This may create a need for some kind of organizational recognition of his special role, a need which as a young man he did not feel, and which the maturing laboratory may find it singularly difficult to fill.

From now on, the annual number of experienced and capable scientists crossing a decision threshold around age 40 will increase steadily. This growing number of individual decisions by scientists should be regarded as an opportunity for a research laboratory and its parent organization rather than as a problem. It would seem as if the scientist is to mid-20th-century society what the lawyer was to 19th-century society. The knowledge and skills of a scientist in a technically based society can well be used in decision-making by all kinds of modern organizations. Once a scientist sees a second career in administration, management, or public affairs as a logical extension of his previous experience, he becomes part of a valuable supply of talent for business, education, or government. The attraction and use of this increasing supply of talent is both a challenge and a responsibility for research management.

If management does not meet this challenge and responsibility—and perhaps even if it does—there is likely to be an increasing spillover of the talent of mature and successful scientists into administrative and management careers in business, government, and education.

We draw the following conclusions:

1) From now on research scientists reaching maturity and the age of 40 will be well advised to examine carefully their career plans for the next phase of their working life, for the competitive situation they will face will be quite different from that which their

predecessor faced during the last two decades.

2) Research-laboratory managements and their supporting organizations face a new challenge and opportunity, that of making full and proper use of the increasing flow of mature and capable scientists of age 40 and over.

3) Business, education, and government should be alerted that this flow of mature talent is at hand and that tremendous advantages could come from attracting some of it into their activities.

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Enzyme Nomenclature

Report on the Recommendations (1964) of the International Union of Biochemistry on Nomenclature and Classification of Enzymes.

Commission of Editors of Biochemical Journals

The Commission of Editors of Biochemical Journals, appointed by the International Union of Biochemistry (IUB), wishes to draw attention to the recently published *Enzyme Nomenclature* (*1*), which is the report of the IUB Standing Committee on Enzymes.

The draft of this report was considered by a joint meeting of the Standing Committee and the IUB Commission of Editors of Biochemical Journals in Rome in February 1964. The version agreed to by that joint meeting was adopted by the Council of the IUB at its meeting in New York on 27 July 1964, and designated *Recommendations (1964) of the IUB on the Nomenclature and Classification of Enzymes*.

The report of the Standing Committee of Enzymes is based on the report of the IUB Commission on Enzymes (*2*), adopted by the General Assembly of the IUB in Moscow on 16 August 1961. The changes made by the Standing Committee in the report of the Commission on Enzymes are of four types: (i) additions of new enzymes, and, where necessary, new subgroups to accommodate them; (ii) correction of definite errors in the first edition; (iii) changes in the nomenclature itself to meet criticisms which had been put forward; and (iv) addition of systematic names in some cases where the original Commission put forward only trivial names.

The chapter on the nomenclature of the cytochromes was revised by a special committee set up for this purpose. The chapter in the new report includes proposals for the nomenclature of heme compounds and hemoproteins in general.

Since the publication of the Report of the Commission on Enzymes in 1961, many of its recommendations have been widely used in scientific journals and textbooks. Most biochemical journals urge authors to follow most of the recommendations even if they do not insist on all. Some journals already require the procedure suggested in chapter 6, page 29, that, when an enzyme is the main subject of a paper or abstract, its code number (preceded by the letters EC), systematic name, and source should be given at its first mention; thereafter the trivial name may be used. Enzymes that are not the main subject of the paper or abstract should be identified at their first mention by their code numbers. When the paper deals with an enzyme that is not yet in the Enzyme Commission's list, the authors may introduce a new systematic name or a new trivial name, or both, each formed only according to the recommended rules, but a number should be assigned only by the IUB.

An addition to the new report that will be very welcome to editors and authors is the inclusion in the index of names which have been in frequent use but which are no longer recommended. It was often difficult to find in the old report the new name of an enzyme known to the reader only by its old name. Many enzymologists may note with regret that the name by which they have long known a favorite enzyme is printed in italics in the index, indicating that it is not recommended. For example, fumarase (EC 4.2.1.2) is replaced by fumarate hydratase as trivial name (systematic name, L-malate hydro-lyase). Those who are irritated by this change should perhaps pause to think how many students first coming across the name fumarase might legitimately think that it catalyzes the hydrolytic splitting of fumaric acid. Those who shed muramidase-containing tears on reading the first report may now rejoice that the old name lysozyme has been restored, whereas *muramidase* is now relegated to the list of disapproved names.

The chapter on enzyme units has received only one alteration. In the first report a standard temperature of 25°C was suggested, but this is now changed to 30°C because of the prevailing laboratory temperatures in many countries. No biochemical journal insists on the use of the Enzyme Commission's unit (U) of enzyme activity (the amount which will catalyze the transformation of 1 μmole of the substrate per minute under standard conditions). However, this unit is to be strongly recommended, and some journals suggest conversion of data in terms of the new unit when the paper has to be returned to the author for other revisions. The derived unit *specific activity* (U/mg) and *molecular activity* (U/μmole enzyme) are also recommended. Where inconvenient numbers would otherwise be involved, terms such as milliunit (mU), kilounit (kU), or, for those who specialize in small activities, nanounit (nU) or picounit (pU) may be used.

The members of the commission are J. T. Edsall (president), W. V. Thorpe (secretary), A. Dillmann, W. A. Engelhardt, Y. Raoul, and E. C. Slater.