Vignettes: Inside Science

Conscious, unacknowledged, and unscrupulous borrowings are a fact of scientific life. So are situations in which the same idea occurs independently to several people. There are, moreover, a whole range of cases that lie between these two extremes. Ideas only take root in prepared minds, and it is not always easy either for the outsider or the inventor to separate the preparation from the new seed.

—*Joan Lisa Bromberg*, in *The Laser in America, 1950–1970* (MIT Press)

The "doing" of science is, at its best, a gripping and fully absorbing activity—so much so that it is difficult for anyone so engaged to step outside the demands of the particular problems under investigation to reflect on the assumptions underlying that investigation. . . . Keeping track of and following the arguments and data as they unfold, trying always to think ahead, demands total absorption; at the same time, the sense of discovering or even generating a new world yields an intoxication rarely paralleled in other academic fields. The net result is that scientists are probably less reflective of the "tacit assumptions" that guide their reasoning than any other intellectuals of the modern age.

—*Evelyn Fox Keller*, in *Secrets of Life, Secrets of Death: Essays on Language, Gender and Science* (Routledge)

remaining 60 percent may be related to public policy measures favoring equality. For example, some reduction in sex segregation occurred during this time, in part because of equal employment policies, with a proportion of women improving their pay by entering certain men's jobs (see B. F. Reskin and P. A. Roos, *Job Queues, Gender Queues*, Temple University Press, 1990).

Comparable worth itself may be a factor. Although statistical assessments are still under way, there is evidence that comparable worth resulted in pay raises for many women in the public sector. It may also have raised the consciousness of many others about systematic wage bias against women's jobs. Social psychologists have shown that "existing arrangements come to be expected and seen as fair" (p. 90). When existing arrangements begin to change, new standards of fairness become "part of the frame for wage setting." And new notions about what is fair may help to produce new wage outcomes.

But optimists should beware. Historically, the sex wage gap has fluctuated, and the 1980-to-1990 change may be part of such a pattern. In addition, comparable worth has been most successful in large public-sector organizations where employment was stable and protected and where union organization supported change. Now "good" jobs in both public- and private-sector large organizations are being drastically cut, while contingent jobs—part-time, temporary, and contract—are increasing rapidly (*New York Times*, 15 March 1993). These changes in the labor market undermine the possibility of unionization, individualize wage-setting, and erode the sort of stable, long-term jobs that can be evaluated and compared in a comparable-worth process.

If work organizations keep moving toward employing only a core of stable, skilled, and well-paid workers along with a much larger group of contingent employees, new approaches to wage equity may be necessary. Nevertheless, comparable worth has been an important reform movement, and England does an excellent job of presenting the theoretical and empirical arguments about it.

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Human Auxology

Growth, Maturation, and Body Composition. The Fels Longitudinal Study, 1929–1991. ALEX F. ROCHE. Cambridge University Press, New York, 1992. xiv, 282 pp., illus. $64.95. Cambridge Studies in Biological Anthropology.

The number of individuals who dedicate their careers to studying the physical growth and maturation of normal, healthy children and youth is relatively small. Measures of growth and maturation are often used in a clinical setting or to describe the status of a sample, but relatively few individuals study changes in size, body composition, maturation, and so on from infancy into adulthood with the intent to describe, understand, and track the processes as such. There are even fewer research centers that are devoted primarily to the study of growth and maturation of the healthy child. The Fels Research Institute, founded in 1929, is such a center, and this volume is an overview of the development and evolution of the Fels Longitudinal Study. It highlights major research directions since the inception of the study, with a focus on physical growth and maturation, including ongoing studies that continue into adulthood. Contributions of the Fels study regarding cognitive and behavioral development are not considered. Collection of psychological data stopped in 1974, and analysis of the available data has slowed.

The origins of the Fels Research Institute and the longitudinal study, the sample, and the types of measurements are described at the outset of the book. The sample was one of convenience, and participants were enrolled during the pregnancy of the mother. The sample also includes second and third generations, that is, offspring of participants and their offspring. Data were also collected from many other relatives of the participants.

The nature of the data, quality control, derived variables, and analytical strategies are then described. It is in the analysis of longitudinal data that the Fels group has made substantial and unique contributions.

The remainder of the volume focuses on specific analyses and some results, beginning with studies of prenatal growth and functional development in the 1930s and '40s. It is in the context of more or less traditional concerns—somatic growth, biological maturation, and skeletal and dental growth—that Fels studies have contributed significantly. Several examples suffice to illustrate the scope of contributions. The Fels study is unique in that data collection continues into adulthood, which has permitted analyses of late adolescent growth, for example growth in stature and weight after peak height velocity or menarche and the attainment of adult stature. Other contributions relate to secular changes within families and the total Fels sample, fatness as a determinant of growth, cranial growth, and growth of skeletal tissue from childhood into adulthood, and also include a method for the prediction of adult stature. Studies of maturation are likewise comprehensive, beginning with skeletal ossification and epiphyseal union, eruption and calcification of the dentition, development of secondary sex characteristics, and the timing of the adolescent growth spurt and culminating in refined methods for the assessment of skeletal maturation of the knee and the hand and wrist.

The Fels study has longevity, and its course has changed somewhat. The current emphasis is more on health-related factors, providing opportunities for relating indicators of growth and maturation to aging and health. Body composition and risk factors for cardiovascular disease are a primary focus, especially issues related to methodology, fatness, fat distribution, tracking of risk factors, and so on. New methodology complements traditional anthropometry, the multicomponent estimation of body composition through measurement of bone mineral, body water, body density, and bioelectric impedance. With the addition of these new dimensions to the longitudinal data set, contributions to our understanding of growth, maturation, aging, and health status should continue.

The discussion that the book offers of the many facets of the Fels Longitudinal Study is, of necessity, superficial. Details of methods and results have been published in numerous papers; indeed, the reference list includes over 600 entries. Overall, the Fels Longitudinal Study is a blend of traditional and more recent technology. Not only have the participants grown and matured and now age, the data, including those obtained with newer technology, and their analysis have also grown and matured.

I thoroughly enjoyed reading this volume. It is a rich source of information on a unique center and should be required reading for students of auxology.

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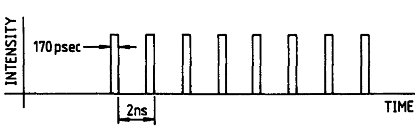
Looking at Crystals

Macromolecular Crystallography with Synchrotron Radiation. JOHN R. HELLIWELL. Cambridge University Press, New York, 1992. xix, 595 pp., illus. $165.

With ever-increasing frequency the three-dimensional crystal structures of biological macromolecules are being reported in the most widely read scientific journals. This explosion of information has been in part due to the availability of synchrotron radiation. In this timely and masterly work John Helliwell describes the uses of synchrotron radiation in macromolecular structure determination and puts its importance to the structural biologist in the context of modern-day scientific needs.

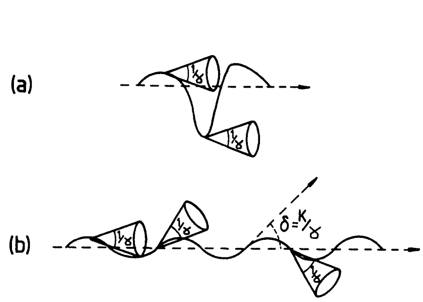


"The time structure of the X-ray beam derives from that of the electrons (or positrons) in the storage ring. The electrons travel in the ring in bunches and thus the radiation is emitted in pulses. The values shown are for the Daresbury [Synchrotron Radiation Source] in multibunch mode. In single bunch mode the light pulse occurs each orbital period of 0.321 μs." [From *Macromolecular Crystallography with Synchrotron Radiation*]

Used since the early 1970s to determine three-dimensional macromolecular structures, synchrotron radiation is ideal for the study of weakly diffracting crystals, those for which biochemists and biophysicists yearn to have structural data. Unexpectedly, the radiation damage to crystals is less with the use of synchrotron radiation than with conventional x-ray sources. Multiwavelength and very intense in character, synchrotron radiation is produced by high-energy electrons traveling at nearly the speed of light in an electron storage ring. Synchrotron radiation consists of pulses (on the nanosecond scale) and can be "tuned" to a specific required wavelength in the x-ray range by use of a monochromator crystal. It was originally considered a nuisance by-product in circular electron accelerators, which were not optimized for its use. Eventually, however, particle accelerators were designed with the necessary specifications for synchrotron radiation production, including continuous beams with long lifetimes, stable source positions, and magnetic insertion devices. Helliwell describes the appearance and operation of 32 storage-ring synchrotron x-ray sources, at 27 sites around the world, that are in use by scientists including x-ray crystallographers.

As Helliwell shows, crystallographers have discovered how to take advantage of the unique physical characteristics of synchrotron radiation to further the determination of macromolecular structures by crystal diffraction. For example, the multiwavelength nature of synchrotron radiation is useful in the phase determination of proteins or their derivatives that contain heavy atoms. Since synchrotron radiation can be tuned, it is possible to select a wavelength at which anomalous scattering by one component atom in the crystal occurs and then a wavelength at which this does not take place. The two sets of diffraction data are then compared and the results used as an aid in the solution of the phase problem. Furthermore, diffuse scattering, which gives information about the mobility and flexibility of molecules in the crystal, can be studied effectively at synchrotron radiation sources. This type of work will doubtless lead to greater knowledge of enzyme function, perhaps indicating which parts of the enzyme move during the catalytic reaction. Crystallographers are also succeeding at the formidable task of precisely interpreting the intensity data, and methods for circumventing attendant problems such as peak overlap that occur because of the multiwavelength character of the radiation are now being devised. The outcome is that tens of thousands of Bragg reflections can be measured in short periods of time and used with confidence in structure analyses.

Since von Laue performed his first experiment in 1912, x-ray diffraction studies have been conducted with monochromatic x-rays, because the analysis of the diffraction pattern is simpler. Now, as a result of new abilities to measure and interpret the diffraction intensity data, untuned synchrotron radiation is being used for Laue methods (multiwavelength radiation and a stationary crystal), because the time required for measurement of diffraction data for a protein crystal can be reduced to seconds. Crystal diffraction data can thus be monitored as a function of time so that reactions taking place in, for example, enzyme crystals—such as the phosphorylation of heptenitol to heptulose-2-phosphate by glycogen phosphorylase *b*, or GTP hydrolysis in the Ha-ras p21 protein—can be demonstrated in the equivalent of a motion picture of the action of an enzyme. Since there are probably several molecular conformers of substrate or product present in such crystals during the reaction, methods for analyzing the diffraction data with this in



"Schematic showing the electron motion and synchrotron cone emission for the three insertion devices: (*a*) wavelength shifter; (*b*) multipole wiggler; and (*c*) undulator." [From *Macromolecular Crystallography with Synchrotron Radiation*]