

of the curves which maximizes the projected loss of life.

Today, the relationship between economic level and mortality has largely disappeared. Countries at vastly different levels of development, such as the United States and Taiwan, have similar levels of life expectancy at birth. The impact of an economic collapse in terms of human life cannot easily be assessed, but it is certainly a mistake to believe that processes and relationships are reversible. Despite attempts to introduce lags and impact delays in World3, the model remains essentially ahistorical, and assumes the reversibility of its functions. In the model it makes no difference whether a dependent variable is affected by an independent variable on its way up while the system is growing or on its way down while it is collapsing. But the process of building up is conceptually very different from that of deteriorating. Whereas there is a historical correlation between industrialization and other processes such as the demographic transition, a decline of industrial output per capita would not bring fertility and mortality all the way back to where it had been brought from by the equivalent rise of that output. Many things that took time in the learning cannot be unlearned: the germ theory of disease, vaccination, and the technology of contraception, for example, could continue to be used by a population with a much reduced access to resources and to capital. A throwback to the per capita food production and industrial output of the 18th century would probably not bring pre-industrial demography back to England. With its knowledge of nutrition and the organizational ability to ensure equitable distribution through rationing, an industrial economy could probably withstand severe reduction of food supply without suffering major loss of life.

On the whole, then, a great reduction of world population is not an ineluctable part of the World3 model. The rise of fertility that appears in the decline phase of the simulations, as a mechanical result of the rise of family size norm when industrial output declines, also seems to be based on an unwarranted belief in the reversibility of historical experience. As far as the population sector of World3 is concerned, the overshoot and decline mode is not the only conceivable one, nor, perhaps, the most likely. It is likely that other sectors of the model would similarly be able to incorporate other functions that would significantly alter its conclusions.

But the value of this contribution, fortunately, does not hinge on the guidelines it gives for the future or on the accuracy of its insights about the world as a system. A model is a tool for investigating relation-

ships and deriving unknown values. Much can be learned from its failure and its failings; and it points to areas of ignorance and research needs. When a model has reached the formal perfection of World3, and when so much effort and talent have gone into presenting its methodology in intelligible detail, its conclusions cannot be dismissed without resorting to similar methods and raising new questions to be answered by new models. In the authors' words (p. 25):

World3 was developed through an exercise in assembling information from many sources, summarizing it explicitly, exploring its implications, and generalizing from the process a little understanding about the future of the complex human socio-economic system. This type of exercise can be valuable, even though the information it yields is incomplete. For example, it may bring about a critical reexamination of the underlying assumptions of current mental models and a more open discussion of the bases of social decision making. It may stimulate further attempts to improve the process of model making and the theories of social systems upon which all models depend It is both a demonstration of what can be done and a challenge to do better.

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Intelligence and Ideology

The Science and Politics of I.Q. LEON J. KAMIN. Erlbaum, Potomac, Md., 1974 (distributor, Halsted [Wiley], New York). viii, 184 pp. \$10.95. Complex Human Behavior.

The author of this book steps squarely into the controversy over the heritability of IQ, motivated at least as much by the political implications of the question as by its scientific interest. His position is that those who interpret the evidence as indicating that individual differences in IQ are largely inherited are "fundamentally incorrect." Secondly, he wishes to counteract the effects of hereditarians upon policy makers, largely by impugning the evidence upon which their case rests.

But before launching his attack upon the evidence, Kamin seeks to document his view that the science and the politics of IQ testing are inseparable. He contends that the IQ test has been fostered by those committed to the view that genetic inferiority is the cause of poverty, that the trappings of science have been used politically to oppress the poor by carrying tidings that they are not only stupid but immutably and ineducably so. He supports this contention by tracing the role of certain of the early leaders in intelligence testing who expressed worries about the supposed degen-

eration of the American population as a result of multiplication of the feeble-minded and insisted on the importance of "curtailing the increasing spawn of degeneracy." He documents the use of World War I U.S. Army intelligence test data by psychologists testifying before the Congress for restriction of the immigration of those European "races" that were thought to have lower heritable IQ scores. While recognizing that there is probably no living psychologist who views the World War I data as relevant to resolving this issue, he draws a parallel between the historical misuse of inadequate data and present-day attempts to draw social and political implications from data bearing on the heritability of IQ. He does this with a certain degree of affect. Although otherwise showing restraint in avoiding explicit ad hominem characterizations in an area where they are not unknown, he does remark, "Patriotism, we have been told, is the last refuge for scoundrels. Psychologists and biologists might consider the possibility that heritability is the first" (p. 3).

How well does the author document his assertion that the IQ test has been fostered by men with a particular social view? How valid is his at least implicit suggestion that all those who interpret the evidence as favoring the heritability of intelligence are cut from the same political cloth? It should be recognized that the author's collection of historical quotations by no means represents a random sample of the views of psychologists of the past or of today. In every decade since the introduction of intelligence testing there has been vigorous debate regarding the relative influence of nurture and nature. Granted that some unwarranted conclusions have been drawn from inadequate data in an effort to support social action consistent with a large role of genetic factors in IQ. An equally strong and equally misleading case could be made by assembling from the historical literature the intemperate interpretations and conclusions of extreme environmentalists. Neither side has been notable for restraint in drawing social implications from insufficient data.

It does not follow that because some historical advocates of the heritability of IQ have espoused illiberal views and policies all have such views. Traditionally, advocates of standardized testing have argued that its application permits the identification of meritorious individuals regardless of background. Even psychologists and human geneticists who specifically disavow any interest in comparing races or nationalities have nevertheless learned to expect to be harassed and called "racists" and "fascists" by the radical left. Kamin does not use these terms, but the impression he

apparently seeks to create is no less vivid, namely that those who study biological differences in human intellectual endowment may be "scoundrels" for their political views. In doing this he seeks to demonstrate the potential relation between politics and studies of human genetics. He could have chosen another example, creating a very different impression, by chronicling the repression of human geneticists and of the study of modern genetics during the quarter century when the doctrines of T. D. Lysenko reigned supreme in the Soviet Union. As Richard Herrnstein and others have suggested, those who are ideologically committed to a struggle for a classless society find even the possibility that human differences might find explanation in other than environmental or economic terms anathema. Work tending to undermine the factual basis for such ideological commitment, be the ideology Marxist dogma or American liberal egalitarianism, if not rejected out of hand will inevitably be subjected to close critical scrutiny and attack. It is to such a critique of the evidence to support the heritability of the IQ that the author turns.

The author's stated aim is to demonstrate that there "exist no data which should lead a prudent man to accept the hypothesis that IQ test scores are in any degree heritable" (p. 3). He takes up in turn studies of separated identical twins, kinship correlations, and studies of adopted children, as well as a few matters of more peripheral interest, such as intra-uterine experience and IQ. In this venture he spares no effort to identify weaknesses in the existing literature. His attack is aggressive and multifaceted. He searches for anomalies in the data, he performs post hoc analyses on subsets of data, he offers alternative interpretations, he invokes the possibility of experimenter bias and of improperly standardized intelligence tests. There is no question that here, as in many areas that depend on field studies, precise control of extraneous variables is less than perfect. For example, in studies of separated twins, the investigator must concede that the ideal of random assignment of twin pairs to separated foster homes is not likely to be fully achieved, that it will be difficult to find comparison or control groups perfectly matched on all variables, and so on. Short of abandoning field data in social science entirely, there is no alternative but to employ a variational approach, seeking to weigh admittedly fallible data to identify support for hypotheses by the preponderance of evidence. Most who have done this find support for the heritability of IQ. Kamin instead sees only flaws in the evidence. Certain of Kamin's criticisms appear warranted, as in

his demonstration of the cavalier manner in which the late Cyril Burt treated and reported his data on separated twins. But while sensitive to the biases of hereditarians Kamin is himself guilty of biased treatment of the data. In commenting on Kamin's Eastern Psychological Association address, on which the book is based, Loehlin, Lindzey, and Spuhler (*Race Differences in Intelligence*, Freeman, 1975) have documented several curious anomalies. Kamin reports a number of correlations based on subsets of twins in an effort to establish that there are artifacts. He chooses an incorrect and inflated value for his degrees of freedom, based on individual twins rather than twin pairs, that yields spurious estimates of statistical significance. Worse, he selectively reports correlations chosen post hoc in very small samples. To demonstrate that there is a correlation between IQ and age which might inflate the correlation between twin pairs, Kamin found four high values, but these were based on subsamples selected by him of 7, 3, 9, and 3. He failed to report near-zero age-IQ correlations based on larger samples. He invents a statistic called the "pseudo-paired" correlation to estimate the degree of confounding of age and IQ but for one study selectively reports only high values, and not those near zero or negative. He makes much of the fact that separated twins are often reared in similar environments, sometimes by relatives, but offers no explanation for the fact that separated identical twins are consistently more alike in IQ than are fraternal twins raised together. Certain of his interpretations of data usually considered as supportive of a genetic interpretation are a bit implausible or even contradictory. Conceding that parent-child correlations are much higher in biological than in adoptive families, he invokes the interpretation that adoptive families differ environmentally in ways that encourage diversity. He interprets a finding that adoptive children's IQ's are correlated with their biological mothers' education but not with that of their adoptive mothers by proposing that adoptive parents' education does not affect children's IQ in the restricted range under investigation. The correlation with biological mother's education is attributed to selective placement of children of "better" biological parents into "better" homes. But adoptive parents' education is not supposed to affect IQ. Here, as elsewhere, an attempt has been made to make a case for the absence of genetic effects by a somewhat convoluted argument. Some readers will find these arguments persuasive. Others will find it easier to invoke a genetic interpretation.

Throughout his discussion of the evi-

dence, the author displays a kind of two-valued logic by pitting evidence for environmental effects against evidence for heredity. When he encounters evidence for some degree of environmental influence, as, for example, in a higher correlation between IQ's of separated twins reared in similar homes than between IQ's of twins reared in unrelated homes, the data are interpreted as embarrassing for a hereditarian position. Few, if any, proponents of genetic influences on intelligence take a position that is the opposite extreme of the author's, that there are no environmental influences. Rather, discussion has centered on the proportion of the variance traceable to each source.

Whatever one's inclination regarding the heritability of the IQ, one is impressed with the thoroughness and tenacity of the author's criticisms of existing studies. He has hardly left a stone unturned in his efforts to impeach the evidence for heritability. Some of his arguments are to this reviewer a bit strained, and some of his statistical comparisons selectively presented, but there is no question that he has at least raised some serious doubts about widely quoted studies. Future researchers of whatever theoretical stripe will be indebted to him for identifying almost every conceivable methodological pitfall. To be sure, there are some studies that have escaped his review—he does not, for example, consider recent evidence of a sex-linked hereditary basis for the family of spatial abilities described by Witkin and his associates, nor does he review relevant animal research—but of the studies bearing more directly on the question his review is systematic.

Even if one accedes to all the author's interpretations of the evidence, the question remains whether or not he has succeeded in his purpose of removing any foundation for a prudent man's accepting the hypothesis that IQ test scores are in any degree heritable. His reasoning is that "the burden of proof falls upon those who wish to assert the implausible proposition that the way in which a child answers questions devised by a mental tester is determined by an unseen genotype" (p. 176). Although he disavows seeking to prove the null hypothesis that genes play no role in intelligence, the effect of his reasoning seems to place him in that untenable position. Someone else might argue that the burden of proof rests with those who deny a biological basis for differences in human behavior. In the reviewer's opinion, the prudent man will seek more and better evidence for resolving the question of the relative weights to assign heredity and environment in intelligence. But in this venture prudence would dictate asking even more probing questions of the data. Is IQ a rea-

sonable phenotype to be studied in searching for genetic influence? The facets of intelligent human behavior extend considerably beyond what is measured in IQ tests, however important the predominantly verbal abilities measured by many IQ tests may be. Some test specialists, such as Guilford, have defined well over 200 separate, albeit correlated, factors making up intelligence. Would it not be appropriate to treat many of these abilities separately? As for the social and political implications of this controversy, it would be a better strategy to focus on the efficacy of alternative environmental treatments in effecting changes in measured intellectual abilities. As the data stand, had the author been equally zealous in evaluating the null hypothesis that such treatments make no difference he would have been hard pressed to fail to reject it.

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The Fate of Toxic Chemicals

Environmental Dynamics of Pesticides. Proceedings of a symposium, Los Angeles, April 1974. RIZWANUL HAQUE and V. H. FREED, Eds. Plenum, New York, 1975. viii, 388 pp., illus. \$29.50. *Environmental Science Research*, vol. 6.

This group of papers is an admirable attempt to draw into perspective recent advances in relating the chemical and physical properties of pesticides to their movement and persistence within the numerous compartments within the environment. While the contributors consistently express the belief that useful predictive tools can be based upon chemical and physical data obtained from laboratory studies, it is apparent that the development of such tools lies in the future. For those who maintain that only field studies provide a sound basis for assessment of the environmental risks associated with the use of pesticides, this group of reviews should be required reading.

Perhaps the major weakness of several of the articles stems from the tendency of their authors simply to review the correlations reported in the literature. Often the reviews do not set forth the known or theoretical limits of these correlations. For instance, the use of the *n*-octanol-water partition coefficient of a pesticide as an indicator of its tendency to preferentially accumulate in living organisms breaks down theoretically where stereoisomers of a pesticide are metabolized or excreted at different rates. A critical account of the deg-

radative pathways operative specifically within aquatic ecosystems would have been a valuable addition to the book.

Overall, the book is a valuable reference not only for scientists interested in pesticides but also for those studying the environmental dynamics of organic chemicals in general.

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Organelles

The Mitochondria of Microorganisms. DAVID LLOYD. Academic Press, New York, 1975. xii, 554 pp., illus. \$36.

Because of their peculiar morphological features, cytochrome content, and pathways of electron transport, the mitochondria of simple eukaryotic cells were for some time looked upon as anomalies and considered quite apart from the mainstream of research in bioenergetics. However, owing in part to the increased concern since the early 1960's with the molecular and genetic aspects of organelle biogenesis, the mitochondria of microorganisms have become of more general interest, even a fashionable subject of investigation. In fact, it has been possible to conveniently study many aspects of the organization, assembly, and continuity of mitochondria, such as the rules governing mitochondrial inheritance, only in simple eukaryotes.

In this volume, Lloyd has attempted to provide a comprehensive and critical review of the isolation, properties, and biogenesis of mitochondria in a wide variety of microorganisms, and for the most part he has succeeded admirably. His approach is thorough. For example, his treatment of cell breakage and mitochondrial isolation procedures for different organisms, each of which presents its own unique problems, is summarized in a comprehensive, well-referenced table. Such compilations are found throughout the book and enhance its utility by making specific methodologies, compositional analyses, and other such information readily accessible.

Lloyd presents the material in two main sections. The first deals with the isolation, purification, and properties of mitochondria from a variety of microorganisms. A smooth transition into the second major topic, the biochemistry, molecular biology, and genetics of mitochondrial biogenesis, is accomplished by a revealing section on the manifold effects of environmental factors on mitochondrial structure and func-

tion. One of the advantages of studying mitochondria in microorganisms is the relative ease with which dramatic phenotypic changes in mitochondria can be elicited by controlled environmental perturbations, and Lloyd emphasizes the potential wealth of information that can be obtained from such studies.

The topic of mitochondrial biogenesis is developed from a roughly historical point of view; that is, the treatment begins with the discovery of mitochondrial DNA and the integration of the rudiments of mitochondrial molecular biology with the phenomenon of cytoplasmic or extrachromosomal inheritance. Much of this information can be found in recent reviews, but Lloyd again shows his penchant for organization by providing extensive, well-referenced tabulations. These include extensive listings of chromosomal and extrachromosomal mutations affecting mitochondrial function, particularly in yeast.

Those entering the field should find of considerable value the attention given to major unsolved problems, particularly with regard to biogenesis. Although by design the book is restricted to the mitochondria of microorganisms, Lloyd has not hesitated to make use of pertinent information obtained in work on higher eukaryotic cells.

Lloyd concludes the volume with a brief but provocative discussion of the evolution of mitochondria. Although some may consider this topic, for the time being at least, to be peripheral, the chapter will appeal to aficionados of molecular evolution.

In sum, the book is a comprehensive and readable reference work that ties together major concepts of the functional organization and assembly of mitochondria in a diversity of organisms. My most serious objection is to the absence of an author index.

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Catalytic Processes

Homogeneous Catalysis by Metal Complexes. M. M. TAQUI KHAN and ARTHUR E. MARTELL. Academic Press, New York, 1974. Vol. 1, Activation of Small Inorganic Molecules. xiv, 422 pp., illus. \$42. Vol. 2, Activation of Alkenes and Alkynes. xii, 196 pp., illus. \$23.

Compounds of the transition metals form complexes with a variety of types of small molecules: molecular hydrogen, dinitrogen, dioxygen, carbon monoxide, nitric oxide, olefins, acetylene derivatives,