welcomed in the past few years at AAAS meetings. The polemics and emotionalism generated over scientific involvement in the Vietnam war (napalm, antipersonnel bombs, human sensing devices, electronic warfare, defoliation) cannot be ignored. Concerted scientific protest, whether against Hitler's persecutions of Jews, Lysenko's destruction of formal genetics with Communist Party support, or the inhumanity of man to his fellowman during wartime, has always been accompanied by such powerful emotionalism that the scientific issues become overwhelmed in the conflict of values. This is perhaps the most important lesson revealed by Ludmerer's analysis of genetics and American society: If we fail to relate science to values and allow science to be used or abused by society we keep our scientific objectivity in the eyes of society but we may lose our humanity; if we act as a group or as individuals to advocate or protest the applications of science, we lose our objectivity in the eyes of society but we may well preserve our humanity.

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Human Sexual Development

Man and Woman, Boy and Girl. The Differentiation and Dimorphism of Gender Identity from Conception to Maturity. JOHN MONEY and ANKE A. EHRHARDT. Johns Hopkins University Press, Baltimore, 1973. xvi, 312 pp., illus. Cloth, $12.50; paper, $3.50.

Man and Woman, Boy and Girl presents a general and unified account of human sexual development and differentiation. By necessity the book ranges from biochemical to anthropological levels of analysis in an attempt to blend the several disciplinary perspectives into a single comprehensive and comprehensible picture. A unique feature of the effort is the clinical experience with hermaphrodites that the authors bring to bear. Over the last 20 years, more than 900 cases of hermaphroditism and related reproductive and psychosexual disorders have been seen in the psychohormonal research unit at Johns Hopkins Hospital. Money has been associated with this unit from its beginning, and Ehrhardt did her doctoral research there.

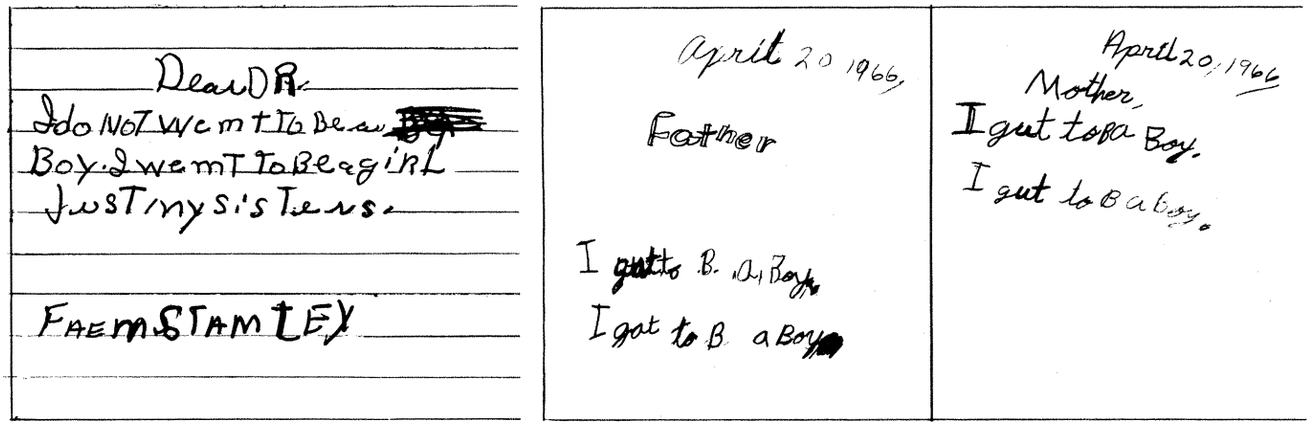
The major organizational principle of the book is ontogenetic: discussions of genetic dimorphism and fetal hormones are placed at the beginning, and pubertal hormones and adult behavior are reserved for the end. The middle chapters contain examples of unusual gender problems and their resolution (for example, raising as a girl a genetic male whose penis was completely lost to clumsy circumcision at age 7 months), brief ethnographies of gender role differentiation in six preliterate or transitional societies, and case material from "matched pairs" of hermaphrodites who had very similar clinical problems at birth (all were genetic females with adrenogenital syndrome) but who had been assigned different sexes by their parents. Several chapters contain photographs of patients or their genitalia which exemplify the problems under consideration. Should the text possibly fail to bring home, the human significance of this research, the photographs will allow no one to remain unaware of it.

The conceptual framework within which Money and Ehrhardt work is an evolutionary advance on the views presented by Money and by John and Joan Hampson in their chapters in the 1961 edition of *Sex and Internal Secretions*. There are more data now than then, but these have not necessitated major revisions of primary concepts. An extension of the earlier concept of "gender role" is the concept of "gender identity." Money and Ehrhardt use the term gender identity to distinguish a "private," experiential sense of gender from its "public," behavioral manifestations, to which they continue to apply the term gender role. The reviewer did not find this distinction very helpful. One problem is that gender role, as defined in the book (p. 4), includes "everything that a person says and does, to indicate to others *or to the self* the degree that one is either male, female, or ambivalent" (italics supplied). Thus "the self" becomes split off to observe and define "the person," who then experiences gender identity. Of course one can have a theory in which a distinction is made between the self and the person; several philosophers and psychologists have built such theories. But in the context of this book, if such a theory is intended it should be made explicit.

The concepts of "gender feedback" and "complementation" are emphasized as important determinants of normal gender differentiation. Regarding gender feedback, the authors cite the work of Lewis and his colleagues to show that parental expectations of infantile gender-related behaviors are partially self-fulfilling; biological potentials and culture-based parental expectations become completely enmeshed. Regarding complementation, Money and Ehrhardt use the analogy of bilingualism to account for normal gender role acquisition (p. 163):

> In the same way that the bilingual child encounters two sets of language stimuli requiring two sets of responses, so the ordinary child receives and responds to two sets of gender stimuli, one the behavior of females, the other the behavior of males. The child's response to one set is to imitate or identify with, and to the other, to reciprocate in a complementary manner.

In addition to its major organizational principle, the book has several underlying themes. One of these is the nature-nurture relation in the differentiation of human gender identity/role. In their preface the authors emphasize that the traditional "either-or" approach to the nature-nurture issue is outdated. Nevertheless their own data and their descriptions of the work of others respond to the question of how important are the relatively automatic consequences of particular genotypes in the eventual realization of behavioral gender dimorphisms. For example, the child whose penis was accidentally amputated in infancy and who has been reared as a girl has an identical twin, reared of course as a boy. Continued careful observation of this tragic natural experiment will give us valuable insight into the limits of behavioral gender plasticity. Of course the phenomenon of transsexualism has already shown that gender identity can be at variance with all biological sex criteria, but we typically take this to be pathologic rather than an example of a phenotypic extreme within the genetic norm of reaction.



Messages written by two children with congenital sexual anomalies that had been neglected or treated sporadically until they were 11 and 12 years old, respectively. Both children, genetic females with the adrenogenital syndrome, one reared as a boy, the other as a girl, were "afflicted with elective mutism specific to anything that had to do with sex differences." The message on the left, from the child reared as a boy, was written spontaneously and left "folded over and over into a square lump" on the arm of the chair in the doctor's office where the child had been coming for weekly counseling sessions. The two messages on the right, by the child reared as a girl, were written at the doctor's request, each in the presence of only the parent to whom it was addressed. The desired alterations were made subsequently by surgery and chemotherapy. [From *Man and Woman, Boy and Girl*]

On the other hand we must consider the authors' data on genetic females whose mothers were given large, pregnancy-saving doses of progestin. All these infant girls suffered from progestin-induced hermaphroditism (androgenization) of the external genitalia, which was surgically corrected. All are currently being raised as girls. Comparisons of their behavior, preferences, and so on with those of a control group of girls matched for age, IQ, and social circumstance suggest that at least in some aspects the androgenized girls are "masculinized." That is, they are significantly different from the controls in directions in which, presumably, an appropriate sample of boys would be. Unfortunately no matched group of boys has been used. A similar profile of masculinization was found in a group of girls with cortisone-arrested adrenogenital syndrome, a genetic defect that results in the secretion of excess androgen from the adrenal cortex. By contrast, girls with 45,X chromosome status (Turner's syndrome) tended to be significantly different from the controls *in the other direction*: they were less athletic, fought less, and were more interested in personal adornment.

These are interesting and important findings. The authors emphasize the difficulty of defining the dimensions within which masculinity and femininity are to be conceptually differentiated, for they have had to call the girls with Turner's syndrome "more extremely feminine" than the controls (p. 107). This implies that masculinity and femininity are on a unidimensional continuum and that a natural accident (45,X) leads to a purer sexual type than does the normal genetic complement. The reviewer doubts that the authors intend this implication, but those with sexist axes to grind may jump on it as an example of sexist biology. The authors remark on this general problem in their preface and have been very successful in avoiding the implicit sexism that, as Ruth Herschberger points out in *Adam's Rib*, can so easily creep into apparently neutral biological descriptions.

The authors' treatments of the relevant genetic and neuroendocrinologic fundamentals and details are admirably thorough yet succinct. The distinction between embryonic systems with a single undifferentiated anlage (such as the external genitalia) and those with parallel anlagen (the internal genitalia) is clearly delineated and related to the eventual action or absence of fetal androgen and, for the internal genitalia, of Müllerian inhibitory substance. No careful reader can finish the book without appreciating the critical significance of fetal androgen in the processes of sexual differentiation, including the pathological consequences of being exposed to too much or too little during the critical period of fetal development. Money and Ehrhardt present this relatively new and rapidly growing subject in developmental endocrinology with attention to the experimental procedures and animals that have been used. Similarities and differences among species are given enough emphasis to apprise the reader of the importance of comparative physiological considerations. Nevertheless the major emphasis is on the relation of animal experimental findings to human clinical considerations.

The first extended discussion of behavior occurs in chapter 5, in the context of the effects of fetal hormones on the brain. Here the animal sexologist may become somewhat concerned about a tone of offhand assertiveness, which fortunately is soon replaced by specific documentation of behavioral descriptions. It is somewhat disconcerting to be told (p. 66) that "only rarely does anal intromission occur," with no referenced species or other documentation, and then to be told (p. 228), immediately following a sentence about "intromission per rectum" in the ram, that "this kind of behavior is widespread in the animal kingdom," again without citation. (One's grumpiness at this unnecessary confusion is at least partly disarmed by the authors' assurances that evidence of this behavior is often transmitted by the oral tradition.)

Since 1970 there has been a reawakened interest in the search for hormonal determinants of human sexual preferences. By the end of 1972 a handful of papers had been published which show, with varying degrees of rigor, a correlation between homosexual preference and urinary or blood plasma steroid levels. Ehrhardt and Money give a comprehensive review of these data and conclude that great caution must be exercised in interpreting them.

It is the fate of all serious interdisciplinary efforts to get hung on the horns of the communication dilemma: you either explain too much and bore some people or you move too fast and snow them. The more disciplines covered, the more likely you are to accomplish both unfortunate ends at the same time with different groups of readers. Money and Ehrhardt have worked hard to find an appropriate middle ground. This has been accomplished in part by the presence of a glossary which contains almost all the technical words and phrases found in the text, from "Addison's disease" through "iatrogenic" and "pseudocyesis" to "zoophilia"; the Jacksonian law of release is one exception to complete coverage. Also, a bit of what one must assume is conscious humor creeps in from time to time to lighten the load, as for example when sexual intercourse more than three times daily is said to be "usually an imposition on one of the partners, just as a handwashing compulsion is an imposition on the hands" (p. 194). On the other hand, the light touch sometimes extends to making large-scale generalizations without appropriate documentation, an instance of which has already been cited. But it is evident that the book was carefully prepared, and it is both informative and provocative. It presents the most coherent treatment of the psychobiology of gender and its vicissitudes currently available in a single volume. It can be commended to all who will read thoughtfully.

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On the History of Computing

The Computer from Pascal to von Neumann. HERMAN H. GOLDSTINE. Princeton University Press, Princeton, N.J., 1972. xii, 378 pp. + plates. $12.50.

Few developments in man's scientific history have stirred the imagination like the advent of computers, as well as affected him so strongly in his daily life. That is partly why many persons compare the "Computer Revolution" with the Industrial Revolution. Herman H. Goldstine puts the case thus:

> [Charles Babbage], together with his predecessors, started a new trend—the Computer Revolution. It got off to a slow start, and it has only been in the last quarter century that this revolution has become of importance to society; and, in a relative sense, it is still in its earliest infancy, even though it has moved at a prodigious rate in the years since the end of World War II.

In Goldstine's opinion,

> The world-view of mankind has been irreversibly altered; man's way of life is changed and will continue to change in response to the challenges and problems raised by the computer in society.

The book is divided into three parts: Part 1, The Historical Background up to World War II; part 2, Wartime Developments: ENIAC and EDVAC; and part 3, Post-World War II: The von Neumann Machine and the Institute for Advanced Study. There is also an appendix on World-Wide Developments. Throughout the book Goldstine interweaves technical descriptions of the developments taking place. These descriptions may enhance the book for some readers, but many may wish to skip over them.

Goldstine was himself deeply involved in the events described in parts 2 and 3. He was associated with John von Neumann, more or less closely, from the time he introduced himself to von Neumann in a train station in Aberdeen, Maryland, "sometime in the summer of 1944" until von Neumann's death in 1957. His esteem for this internationally famed mathematician is very high. He relates that it used to be said about von Neumann in Princeton that while he was indeed a demigod he had made a detailed study of humans and could imitate them perfectly. He provides little intimate glimpses into von Neumann's life that make very interesting reading.

As a representative of the Ballistic Research Laboratory, who had the technical responsibility for the Army's ENIAC contract with the Moore School of Electrical Engineering at the University of Pennsylvania, Captain Goldstine, as he was then, had a responsible position and one that gave him access to, and eventual ownership of, the Army's files of information on the project. He is therefore in a unique position to write a history of this important period in the development of electronic computers.

His viewpoint on this history is sometimes at variance with that of other key participants. Naturally, every participant is entitled to his own viewpoint, but it is unfortunate when this viewpoint is simply presented as fact. Not all readers may be aware of the differences of opinion and deep cleavages that took place as early as 1945, and that continue to the present day, among various persons connected with this early period of computer history. Several lawsuits have brought out widely differing testimony from participants, as well as engendered much bitter feeling. For example, in his testimony during one of these trials in 1971 (*Honeywell vs. Sperry Rand*, U.S. District Court, District of Minneapolis, Fourth Division) John Mauchly in no way agrees with the statement in this book that his discussion with John V. Atanasoff in 1941 "greatly influenced Mauchly and through him the entire history of electronic computers."

Then there is the question of who was responsible for the important "stored-program concept," which grew out of discussions on how to build the computer that was to follow the ENIAC at the Moore School. This computer-to-be came to be known as the EDVAC, and in 1945 von Neumann wrote a report called "First Draft of a Report on the EDVAC" (Report on Contract No. W-670-ORD-4926, Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, 30 June 1945). This report gave no credit to anyone else, and was widely distributed, howbeit at the time without von Neumann's knowledge. Largely as a result of this report von Neumann has, by and large, been given the sole credit for the authorship of this important concept. Clearly, Goldstine thinks this credit is deserved. In referring to the design worked out for the EDVAC he writes,

> It is obvious that von Neumann, by writing his report, crystallized thinking in the field of computers as no other person ever did. He was, among all members of the group at the Moore School, *the* indispensable one. Everyone there was indispensable as regards some part of the project—Eckert, for example, was unique in his invention of the delay line as a memory device—but only von Neumann was essential to the entire task.