the publication of a 1986 seminar. It is true that, with the exceptions of the two references contained in an addendum to Chapter 2, the most recently published cited work is a single 1987 reference. Nonetheless, this volume is the reference source for prehistoric bone chemistry.

KEVIN M. KELLY
Department of Otolaryngology
University of Iowa
Iowa City, Iowa

A CLINICAL ATLAS OF ROENTGENOGRAPHIC MEASUREMENTS IN *Norma Frontalis.* By Sudha Srikrishen Saksena. New York: Alan R. Liss, Inc. 1990. xvi + 252 pp., figures, tables, references. $65.00 (cloth).

It is not so difficult to imagine a useful reference source for normative craniofacial growth data. One would begin by carefully specifying a biological population and operational procedures for gathering morphometric data for an appropriate sample from this population. One would then carefully specify a space of descriptive features in which to carry out carefully specified biometrical analyses. These might include the computation and display of the central tendencies in the data, as they vary in accordance with systematic factors such as age or sex; the analysis of patterns of correlation among scalar measures; or the construction of decision rules for diagnosis of various abnormalities. The overpriced little volume under review aims at hardly any of these themes and mishandles even those. I organize my critique under three rubrics: sample design, data collection, and biometric analyses.

1. SAMPLE DESIGN

Any volume of "growth standards" (p. xv) needs to specify the population to which the standards ostensibly apply. The present volume is unacceptable in that it refers to a haphazard mixture of four different populations born in years that range over most of the twentieth century. Eighty percent of the cases are from "a twin study conducted at the I.U. Medical Center between 1974 and 1976." But surely it is inappropriate to found a normative study on so non-normative a prenatal environment as that. (Nor are we told to what extent this subsample size is inflated by inclusion of identical twins twice.) Another 5% of the sample are normal sibs of Down syndrome cases, "gathered between 1965 to [sic] 1968"; a further 7% "were elementary school children with 'excellent' dental occlusion, who participated in the 'Annual Smile Contest'... in the years 1953, 1956, and 1959"; and a final 8% are " 'untreated' normal children with Class I dental occlusion" from the files of "the Department of Orthodontics" (years unspecified).

Now of course no sample "from Indianapolis and its surrounding counties" in the 1950's through 1970's is of any use today absent strenuous justification. We are told nothing of the racial backgrounds of these persons, about the differential recruitment of adults and children, about repeated measurements, about systematic differences among the four wholly disparate data sources; nor about the effects of year of birth, nutrition, or dental care upon members of age classes; nor about the effect of the passage of time on the raw radiographic emulsions. We are not told the magnification of these images; we are not even told whether measurements were corrected for beam-spreading.

2. DATA COLLECTION

The information suplied in this volume is quite insufficient to judge the quality and the generalizability of the quantifications that follow. Locations of 34 landmarks (including 12 bilateral pairs) were "digitized directly from the radiographs" (p. 10) by persons unknown. The samples of landmark location in Figures 1 and 2 are shown on tracings, not on radiographs, and hence do not represent what was actually done. Verbal characterizations of landmark locations lead different technicians to different data; yet we are given no information about operator biases or differential reliabilities landmark by landmark. Radiographs were scanned for left-right positioning errors but not, apparently, for errors of rotation around the ear-

rods. Indeed, neither Porion nor Orbitale appears to have been digitized.

3. BIOMETRIC ANALYSES

A roentgenographic Atlas should be a collection of typical forms at each of a series of levels of explanatory factors. Then the core of this publication ought to have been a series of landmark configurations graphically averaged by age, sex, and provenance of data. (The landmark locations might have been averaged in any convenient coordinate system, as all such superpositions are biostatistically equivalent when reported properly.) This volume omits all display of averaged forms, supplying instead a series of tabulations and models each of which is too flawed to be of any anthropological or clinical use.

Consider, for instance, the "percentiles" of the various measures as listed in Tables 1 through 95. (The provenance of this "total of 95 measurements" goes unjustified.) It is nowhere explained how "5th, 50th, and 95th" are computed for small samples, as for the 4 four-year-old males of this study. These are not plotted, only the inappropriately pooled regression-based predictive confidence intervals. If these pages mainly express means and standard deviations across age, the information would have been much better presented in graphics that look like faces, not like tables. In any case, the regressions associated with the tables are meaningless; neither straight lines nor parabolas are ever correct for "age effects" even were the present data longitudinal, which of course they are not. The introduction advises using these regressions for "growth estimates" in an unprofessional manner that ignores the realities of the study design.

Other aspects of the biometric analyses here are equally problematic. The ten 3-dimensional charts of "indexes," while free of regressions, are nevertheless totally illegible. The tables in Section IV calibrate asymmetry quite uselessly, in the form of left-right correlations rather than left-right discrepancies; the correlations of "widths" against "heights" pool over ages, and thus are nearly equivalent to the tables of means alone; the last table, on "significantly high negative correlations," is likewise inappropriately pooled over age, and in any case is surely no substitute for a decent factor analysis, as was demonstrated by Solow many years ago.

In summary, the book seems to me to be of negligible value for any of its stated purposes. Some very unfortunate decisions were made early on in respect of sample aggregation, data collection and screening, presentation of central tendencies, and biometric analyses. In any event, modern techniques for the detection of significant anomalies of form have left far behind the simplistic referral of arbitrarily selected distances and "indices" to the means and variances of a haphazard sample. The volume under review is unsuitable either as a reference source or as a guide to the biometrics of craniofacial dysmorphology.

FRED L. BOOKSTEIN
Center for Human Growth and Development
University of Michigan
Ann Arbor, Michigan

DIE MIKROSKOPISCHE UNTERSUCHUNG PRÄHIS-TORISCHER SKELETFUNDE (THE MICROSCOPIC EXAMINATION OF PREHISTORIC SKELETAL MATE-RIAL). By Michael Schultz. Liestal, Switzerland: Amt für Museen und Archäologie. 1986. 140 pp, figures, summary, references. 35 Swiss francs; $25.00 (paper).

Issued as the first of three volumes proceeding from a palaeopathology symposium held in Liestal, Switzerland, in June, 1984, *Die mikroskopische Untersuchung prähistorischer Skeletfunde* is a boon to physical anthropologists and archaeologists interested in the examination and analysis of postmortem alteration and pathological conditions in archaeological bone. Through the use of lucid text and numerous photographs, Schultz, an anatomist at the Georg-August-Universität in Göttingen, West Germany, with a special interest in bone histology, attempts to show the value of observation beyond the gross level. The work is directed to the advanced researcher in bone biology and biochemistry, for a good knowledge of normal bone histology and composition is assumed. Even individuals without any