Chapter **9**

Evaluating the Consistency of Age and Sex Assessments of Ohio Hopewell Human Remains by Previous Investigators

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The thick prehistory approach that we suggest for bringing past peoples and their cultures to life from their bioarchaeological remains requires, by definition, the identification of individuals and social groups. It also involves describing these individuals in action through their on-the-ground, sociocultural roles. An essential step in this reconstructive process is to determine the age and sex of each individual for which skeletal remains are extant. The age and sex of an individual at death will have played a part in determining the culture-specific age and gender categories of his or her social personae at the time of death, and the roles associated with those personae. An individual's age and sex may also have been among the culturally-defined criteria necessary for taking on certain other social roles, such as those of a leader of any number of kinds, or of a sodality or clan member. Thus, by identifying the ages and sexes of individuals in a past society, the past is begun to be personalized with active, motivated people.

This chapter presents the thinking and analyses that were done in the course of assigning ages and sexes of the individuals in the HOPEBIOARCH data base and in evaluating the reliability of those assignments. The chapter continues the process of defining variables in the HOPEBIOARCH data base that was begun in Chapter 8, and is followed by further presentation of how age and sex identifications were made for one particular site – the Hopewell site – in Chapter 10.

In Chapter 8, we defined a number of variables (columns) in the HOPEBIOARCH data base that report the probable sexes and estimated ages at death of Ohio Hopewell people. Estimates contributed by sometimes multiple researchers are listed under those variables, along with what were determined from this study to be the most reliable of these estimates. In this chapter, I extend this documentation in several ways. First, I describe the methods that many of the researchers used to make their age and sex estimates. For those researchers who did not report their

specific methodologies, I report the methods that were available at the time the assessments were made in order to better understand what range of methods might have been used by researchers who were not explicit about their methodologies. I then assess the consistency of the age and sex estimates made by different researchers with one other, to shed light on the comparability, precision, and likely accuracy of their estimates. The results of this analysis are reported in the HOPEBIOARCH data base as best estimates of the age ranges and sex categories of the individuals encompassed in the data base, coded to indicate their degree of reliability.

The primary goal of determining the methods that various researchers used or likely used and the reliability of their age and sex assessments, as presented here, was to maximize in the data base both the *number* of individuals with age or sex information that might reasonably be included in social analyses, and the *reliability* of these assessments for use in reconstructing individual social personae. For example, because early excavators of many Ohio Hopewell sites commented on the age or sex of some skeletons that were either not removed from the field, or were subsequently lost or mislabeled such that they can no longer be tied to a specific provenience, an important question is the probable reliability of field determinations made by particular excavators. If the field determinations made by an excavator prove to be reasonably reliable for skeletons that were collected and properly labeled, then it can be assumed that field determinations made for other skeletons from the same site that are no longer available for study are also reliable, improving the quantity of age-sex data for the site and the quality of mortuary analyses possible with the data. If, on the other hand, the error rate of field determinations among extant skeletons proves to be high, then the additional age-sex information for individuals not currently curated would have to be left out of mortuary analyses, reducing sample sizes. Subtler variations on this theme include the evaluation of previous laboratory assessments of age and sex for skeletons that are no longer curated or labeled to provenience and therefore cannot be studied by modern osteological and dental anthropological methods.

AGING AND SEXING HOPEWELL HUMAN REMAINS: A HISTORICAL PERSPECTIVE

For more than 100 years, researchers interested in Ohio Hopewell peoples have attempted to determine the ages and sexes of skeletons from Hopewell burial sites (e.g., Putnam 1886a; Moorehead 1891; Shetrone and Greenman 1931). The earliest assessments were made in the field by site excavators, perhaps using recognized indicators and techniques that were available between the 1880s and 1930 (e.g., Schmidt 1888; Pittard 1900; Derry 1909; Todd 1920, 1921; Todd and Lyon 1925a–c), but more likely relying on general observations, such as relative size and robusticity of the skull and postcrania to determine sex, and perhaps dental wear, tooth loss, and joint degeneration to categorize skeletal remains into broad age categories of young, middle, or old adult. Field assessments were typically made on only a few of the skeletons from a given site (e.g., Moorehead 1922; Shetrone 1926a). For some individuals, field determinations are the only ones available, because many skeletons and most cremations were either not collected, or were in such poor condition after removal or transport that they were not saved.

Some early studies of Ohio Hopewell skeletons were undertaken in a laboratory setting using primarily cranial indicators of age and sex (e.g. Snow 1943). More recent age and sex assessments date from the 1970s and after (e.g. Reichs 1975), and have been made using a wide array of indicators (Sciulli n.d.; Cadiente 1998; Johnston 1995, 2002). However, skeletal aging is still a problematic field of inquiry for physical anthropologists, and even today's standard techniques result in rather wide error ranges and a persistent tendency to underestimate ages among the oldest individuals (Jackes, 2000). Comparison of age and sex studies of Ohio Hopewell skeletons made by so

many different investigators over such a long period of time is challenging because of a lack of information about which specific techniques were used by a researcher to make age and sex assessments on particular skeletons. This leads to uncertainty about the level of accuracy and the comparability of specific determinations. However, an understanding of when certain techniques were available to researchers may provide some insight into patterned differences in the age and sex determinations of researchers working with the same skeletal materials at different times over the past century.

Sex Assessment in the Twentieth Century and Ohio Hopewell Skeletal Data

Current standards for sexing skeletons from archaeological contexts are based on morphological features of the pelvis and skull (Buikstra and Ubelaker 1994). The pelvis is generally preferred for sexing because accuracy is somewhat higher (see Krogman and Iscan 1986:189), and the relevant features used to sex the pelvis are less variable by population than are those of the skull. However, the most sexually dimorphic region of the pelvis – the pubis – is more easily damaged than are the sexually dimorphic parts of the skull, so both areas of the skeleton are routinely assessed in bioarchaeological studies.

The standard morphological features used to determine sex from the pelvis are the ventral arc, subpubic concavity, ischiopubic ramus ridge, preauricular sulcus, and the greater sciatic notch. The preauricular sulcus was one of the first sexually dimorphic features of the pelvis to be recognized (Derry 1909, 1911). In the 1920s, Straus (1927) mentioned both the preauricular sulcus and the relative size of the greater sciatic notch as useful qualitative traits for sexing from the pelvis. The remaining three standard traits were highlighted several decades later (Phenice 1969).

Standard features of the skull used for sexing are the rugosity of the nuchal crest, volume of the mastoid process relative to nearby structures, thickness of the supraorbital margin, prominence of glabella, and projection of the mental eminence (Buikstra and Ubelaker 1994). Most of these were already recognized by the late 1930s, as were additional features related to the contour of the forehead, the size of the occipital condyles, the size of the teeth, and the size of the zygomatic bones (Krogman 1939). In European literature, traits used in sexing the human skull were published even earlier, near the turn of the twentieth century (Mobius 1907; Pittard 1900).

The earliest sex assessments on Ohio Hopewell skeletons were reported by excavators working in the late nineteenth century, such as Warren Moorehead, who excavated the Hopewell site in the 1890s, and Frederic Putnam, who excavated at the Turner site in 1885 (Table 9.1). These assessments were probably made solely on the basis of relative size differences, as the excavators were not physical anthropologists, and sexually dimorphic traits of the skull and pelvis had not yet been published at the time of their excavations. Given the small proportion of individuals to whom sex was assigned by these excavators, it seems likely that only the very largest and very smallest skeletons were assigned to a particular sex in the field. These would have been the easiest skeletons to sex because they fall at the extremes of the size continuum. If such is indeed the case, one would expect these field assessments to have a fairly high rate of accuracy.

Some traits for sexing from the pelvis and cranium had been published by the time Henry Shetrone carried out his excavations at the Hopewell and Seip sites in the 1920s (Shetrone 1922–1926a). Earnest Hooton was clearly aware of some of these indicators when he made his laboratory assessments of skulls from the Turner site for Charles Willoughby's (1922) publication. Although Hooton's study was focused on measurements and qualitative features of the skull, he did not limit his analysis to that part of the skeleton; he used whatever skeletal material was present to make his sex determinations (Willoughby 1922). Unfortunately, Hooton does not list the traits he used for sexing, but from his recorded observations it is clear

Table 9.1. Age and Sex Information by Site[1]

Site	Researcher	Adult Sex	Adult Age	Subadult Age	Source or Dates
Ater	Johnston	X	X	X	Johnston (1995)
	Baby	X	X	X	Baby (1948–1954)
Esch	Snow	X	X		Snow (1943)
	Greenman	X	X	X	Greenman and Goslin (1930a, b)
Harness	Johnston			X	Johnston (1995)
	Baby	X	X		Baby (1948–1954)
	Mills	X			Mills (1907)
Hopewell	Johnston	X	X	X	Johnston (1995)
	Pickering	X	X		Pickering (1987)
	Reichs	X			Reichs (1975)
	Snow		X		Snow (1943)
	Shetrone	X	X	X	Shetrone (1922–1925, 1926a)
	Moorehead	X	X	X	Moorehead (1891)
Rockhold	Reichs	X			Reichs (1975)
	Johnston		X		Johnston (1995)
Seip	Johnston	X	X	X	Johnston (1995)
	Konigsberg	X		X	Konigsberg (1985)
	Reichs	X			Reichs (1975)
	Baby	X	X	X	Baby (1948–1954)
	Shetrone	X	X	X	Shetrone, Greenman (1931)
	Blosser	X		X	Shetrone (1926b)
	Krogman	X		X	Shetrone (1926b)
Turner	Cadiente	X	X		Cadiente (1998)
	Giesen	X	X		Giesen (1991–1992)
	Santa Luca	X	X	X	Greber (1976)
	Hooton		X		Willoughby (1922)
	Volk			X	Volk (1905)
	Putnam	X			Putnam (1885)
	Metz	X		X	Metz (1882)

[1]Marked boxes indicate that a determination for the listed researcher is used as primary age or sex information in the HOPEBIOARCH data base. Some researchers may have made age and sex determinations that are not marked because they were superceded by later determinations believed to be more reliable.

that he made note of traits such as the size of the mastoid process, supraorbital ridges, size of the mental eminence, and contour of the frontal. Therefore, based on the similarity between the traits he observed in the skull and the standard traits used today, coupled with the fact that he considered other parts of the skeleton as well in his assessments, it would not be surprising if Hooton's assessments were fairly accurate. Hooton's findings concerning sexual dimorphism in the skull (Willoughby 1922), in turn, may have been known to members of Shetrone's teams excavating the Hopewell and Seip sites (Shetrone 1926a; Shetrone and Greenman 1931). These team members included a young anthropologist by the name of Wilton Krogman, who joined the crew for part of the 1926 field season at Seip (Shetrone 1926b), and would later become known for his work on forensic analysis of the skeleton (e.g. Krogman 1939; Krogman and Iscan 1986).

Sex assessments after 1930 were made primarily in a laboratory setting by trained physical anthropologists. Cranial assessments from that point forward would likely rival in accuracy those made today because most of today's standard features were already well known then. Pelvic assessments prior to 1970 would have been fairly good as well, but probably improved with the publication of Phenice's (1969) technique involving the ventral arc, subpubic concavity, and ishiopubic ramus ridge. Of the sex assessments made during the period from 1930 to 1970, only two are of relevance to the study presented below. Charles Snow (1943) assigned sexes

to Ohio Hopewell skulls as part of a craniometric study. These data are known to us from data collection forms with no explanation, so the techniques used to determine sex are unclear. However, since the study was focused on skulls, it seems likely that these determinations were made, either primarily or exclusively, using cranial indicators. Raymond Baby also determined the sexes of a number of Ohio Hopewell skeletons sometime between 1948 and 1954 (Greber 1976). Based on the fact that he included cremations in his analysis, it seems likely that he would have used whatever traits were available, whether cranial, pelvic, or other, depending upon the preservation of each individual set of remains. Sex assessments made by researchers working after 1970 would likely have been based on the same general suite of traits used for sexing today, and it should be expected that the results are quite comparable among investigators working after this date.

Age Assessment in the Twentieth Century and Ohio Hopewell Skeletal Data

The expected comparability of age assessments on Ohio Hopewell remains is much more difficult to predict. Although some standard aging methods have been available since the early 1920s, the methods for aging adult skeletons have undergone significant revision since that time, and new methods that are now considered standard were introduced in the late 1980s. On the other hand, techniques for aging subadults have been recognized for a long time, and the landmark work on skeletal development and age dates back to the 1920s (Stevenson 1924). Thus, it can be expected that age estimates on subadults are very comparable among physical anthropologists working after 1930, while age estimates on adults likely vary to some extent over time.

Aging of adults is based on the slow, and highly variable, degeneration of skeletal elements. These may include cranial sutures, sternal rib ends, the pubic symphysis of the pelvis, or the auricular surface of the pelvis (Buikstra and Ubelaker 1994). Aging of subadults, on the other hand, is based on the more regular sequence of skeletal and dental development, measurements of bone size, or some combination of both. Because of the regularity in sequence and timing of skeletal development, accuracy is generally quite high for subadult determinations compared to adult determinations. Subadult assessments based on dental development and eruption are most accurate up to the age of 12 years, with errors ranging from approximately one year on either side of the estimate for young children, to perhaps three years for pre-teens (Buikstra and Ubelaker 1994). After the age of 12, development of skeletal elements becomes the primary means of age assessment (Buikstra and Ubelaker 1994).

Most of the limb bones begin as multi-element structures held together by plates of cartilage. There is typically a long shaft, and one or more growing ends called "epiphyses". These epiphyses are attached to the shaft through a plate of cartilage, and growth in bone length takes place at the junction between each epiphysis and the shaft. Skeletal epiphyses begin fusing to the shafts of long bones as early as nine years of age in females, and 11 years of age in males (Buikstra and Ubelaker 1994). Fusion of the various epiphyses follows a predictable sequence that spans the teenage years. The range of variation in the timing of these fusions is higher than that for dental eruption, however, and the problem is exacerbated by generally earlier fusion of epiphyses in females than in males. Still, the age ranges for epiphyseal fusions are relatively narrow compared to the age ranges of adult age categories. Age ranges produced by applying the epiphyseal fusion approach may span five years or more within each sex, and female epiphyses tend to fuse about two years earlier than the same epiphyses in males. Thus, because it is very difficult to accurately sex adolescents before their late teen years, an additional two years must be added to the age range for the fusion of most epiphyses. Once the limb epiphyses have all fused, usually by the end of the teen years, other developmental indicators continue to be useful into early adulthood. For

example, the spheno-occipital synchondrosis in males tends to fuse between the ages of 20 and 25, and the pseudoepiphysis of the medial clavicle at some point between the ages of 20 and 30 (Buikstra and Ubelaker 1994). Thus, age assignments are fairly easily made into 5–10 year categories during the first 30 years of life, if the appropriate parts of the skeleton are available for analysis.

Excavators of Ohio Hopewell sites began reporting the ages of subadults from at least the early 1880s (e.g. Metz 1882). Typical reporting included categories such as "infant", "child", or "adolescent". Such identifications would not have been terribly challenging for anyone with even a passing knowledge of skeletal development. The ability to recognize bones with unfused epiphyses, or dentitions that were not fully erupted, and then to roughly estimate body size from the skeletons uncovered, would have been all the information necessary to make such estimates. For those familiar with seeing adult skeletons at a site, the ability to recognize subadults and to sort them into broad categories would have been easy to acquire. Therefore, it is expected that the accuracy of these assessments by early excavators is quite good at the broad scale of distinguishing children, adolescents, and adults, but that divisions into finer subadult age categories, when attempted, may be somewhat less reliable.

The situation is quite a bit more complex when considering estimates of adult ages. Physical anthropologists have been recognizing over the last two decades that our methods for age estimation are not nearly as accurate as once thought (Jackes, 2000). When different methods are applied to similar samples, the results tend to be different. Accuracy rates may also vary depending on the age of the individual being examined. For example, various methods of assessing age from cranial suture closure have peak accuracy at different ages (Jackes, 2000). When tested on individuals of known age in the Terry Collection sample, Meindl and Lovejoy's (1985) aging method had an error rate of about five years for the 35–40 age range, but that rate increased to around 10 years at age 50, and around 20 years at age 60. Conversely, the method proposed by Masset (1989) has an error rate of about 5 years for individuals between the ages of 55 and 60, while being off by as much as 15 years between the ages of 35–40, and over 10 years at the age of 70. These error rates, while large, may not be so high as to render social analyses unreliable, because most social analyses based on mortuary data tend to use age categories that are quite wide. For example, in the HOPEBIOARCH data base, age categories span 15 year periods, and are divided into young adults (21–35), middle adults (36–49), and old adults (50+). However, there is also a recognized tendency with many age estimation techniques to underestimate ages of individuals over the age of 45 or 50 years (Jackes, 2000). This bias poses a more serious problem in social analyses, because it means that old adults are likely to be misidentified as middle adults, making certain social roles that might be reserved exclusively for old adults actually appear to have been held frequently, or even primarily, by middle adults. These problems with current adult aging methods must be kept in mind when considering the data available from the past century or so of research on Ohio Hopewell skeletons.

The earliest excavators of Ohio Hopewell sites did not have much to say about adult age, except to differentiate adults and subadults (e.g. Metz 1882; Putnam 1886b; Volk 1905). Field assessments of adult age that were made by the teams headed by Shetrone (1926a), Moorehead (1891), and Shetrone and Greenman (1931) were few in number and most likely based on observations of dental wear, antemortem tooth loss, or perhaps degree of osteoarthritis evident in the joints, despite the fact that at least one trait, closure of cranial sutures, had already been recognized as a potential indicator of age (Dwight 1890). Dwight's observations were not standardized, however, until Todd and Lyon (1924, 1925a–c) published a series of articles on the subject in the 1920s. Methods for aging skeletons from the pubic symphysis were also published in the 1920s (Todd 1920, 1921). These methods were available early enough that they could have been used by Shetrone's team prior to publication of his work

at the Hopewell site (Shetrone 1926a), and Shetrone and Greenman's team prior to publication of their work on the Seip site (Shetrone and Greenman 1931). However, the relatively small percentage of skeletons that were actually assigned to an age category for these two sites, and the fact that the categories were recorded in the more general format of young, middle, or old adult rather than as an age range, suggests that the methods used by Shetrone's teams were not those presented by Todd and associates.

The only specific information available on methods of age determination used for Hopewell skeletons prior to 1930 is the study of the Turner skeletons published by Hooton (Willoughby 1922). Hooton was able to sort 55 out of 72 adult skeletons into age categories of 21–35 years, 36–50 years, and 51+ years. He does not list the methods used, although he does report dental wear by age category for 29 of these skeletons, as well as cranial suture closure by age category for 33 skeletons. These reports suggest that he recognized that these traits could vary with age; however, they were perhaps not the exclusive indicators he used in making his age assessments.

Since the 1920s, the cranial suture method of age assessment has been updated and expanded by Meindl and Lovejoy (1985) and Mann et al. (1987). These updates would not have been available to Snow in the 1940s, Baby in the early 1950s, Reichs and Santa Luca in the mid-1970s, or Sciulli in the early 1980s, but would likely have been known by all later investigators. A similar situation holds for sexing from the pubic symphysis. Todd's (1921) original method was updated over time by several investigators, beginning with Brooks (1955) and McKern and Stewart (1957) in the 1950s, and continuing through the late 1980s with modifications by Gilbert and McKern (1973) and Meindl and Lovejoy (1985). A new approach called the Suchey-Brooks method was ultimately developed in the late 1980s (Katz and Suchey 1986; Brooks and Suchey 1990), and appears to have become the method of choice for many physical anthropologists.

Yet another method for aging from the pelvis was developed around the same time as the Suchey-Brooks method. This new method used degeneration of the auricular surface of the pelvis to estimate age (Lovejoy et al. 1985b). Thus, researchers working with Ohio Hopewell material after 1990 had new methodologies available for the pubic symphysis and the auricular surface that were not available to researchers previously. The presence of so many different methods, and modifications to earlier methods, right up to the recent past makes it possible that age estimates could differ significantly among investigators working during different decades, or among those working at the same time but employing different methods among several considered to be standard. Current standards favor the original method of Todd, the newer Suchey-Brooks method, and the auricular surface method for age estimation of skeletal remains (Buikstra and Ubelaker 1994), although there is still much concern about the real accuracy of these methods (e.g. Jackes, 2000). Revisions to the auricular surface method are still being suggested (Buckberry and Chamberlain, 2002; Igarashi et al., 2005).

THE COMPARATIVE STUDY

In order to better understand the quality of the age and sex information available for Ohio Hopewell human remains, a compilation was made of the estimated ages and sexes of as many Ohio Hopewell individuals as possible at the time of the study. Skeletons from some sites, such as Esch, Marietta, Rockhold, and Wright-Holder, were excluded from the comparative study because they were only examined by a single researcher. Table 9.1 summarizes the sites from which the individuals came and the researchers who made the assessments. The age-sex data, themselves, are presented in Appendices 9.1–9.11. Only skeletons with a provenience designation or a unique accession number that allowed comparison among the determinations made by different researchers were included in the study.

The data in the eleven appendices were obtained from published site reports, articles, and dissertations, as well as from unpublished field notes and museum inventories.

In addition, fairly recent assessments made by Cheryl Johnston in the 1990s (Western Carolina State University) and Paul Sciulli in the early 1980s (Ohio State University) were also gathered. Together, these sources provided a considerable quantity of information on the estimated ages and/or sexes of individuals (n = 347) buried at the larger sites of Hopewell, Seip,

Table 9.2. Comparison of Johnston's (1995, 2002) Age and Sex Assessments for the Hopewell Site

ID Number	Mound	Burial	2002 Sex	2002 Age (Years)	1995 Sex	1995 Age (Years)	Age Change
150108	2	1	M	30–40	M	40–50	–10
150168	2	2	M	14–19	M	14–19	0
150109	2	3	F	20–25	F	30–40	–12
150112	2	4	F	20–25	F	25–35	–7
150215	2	5	M	35–45	–	35–45	0
150135	4	2 (Skull 1)	F	Adult[1]	–	–	–
150134	4	2 (Mandible)		50+	–	–	–
150133	4	2		20–35	–	–	–
150129	4	3	M	25–35	M	30–45	–8
150143	4	4		40–45	M	35–45	+3
150127	4	9	M	45–55	–	37–47	+8
150137	7	1	F	25–35	F	32–42	–7
150138	7	3	M	20–30	–	–	–
41618	18	181	M	40–50	–	–	–
41617	20	177		30–40	–	–	–
41613	23	205		20–30	–	–	–
41606	23	228	F	20–30	–	–	–
41608	23	234	F	40–50	–	–	–
41607	23	236	F	30–60	–	–	–
150165	25	6	M	20–30	M	34–44	–14
150166	25	7	F	20–30	F	35–45	–15
150123	25	10		36–40	–	–	–
150213	25	11	M	20–30	M	–	–
150124	25	12	F	25–35	–	30–40	–5
150119	25	13	F	–	–	–	–
150132	25	15	F	20–30	F	30–40	–10
150131	25	15	F	20–30	F	30–40	–10
150122	25	16	F	20–30	F	–	–
150061	25	22A	M	35–45	M	40–50	–5
150062	25	22B	F	25–35	F	25–35	0
150210	25	23N	F	40–50	–	40–50	0
150209	25	23S	M	45–55	M	40–50	+5
150128	25	24	M	40–50	–	MAD	+3
150121	25	25	M	30–35	M	30–40	–2
150117	25	34	M	45–55	–	45–55	0
150212	25	35	M	35–45	M	45–55	–10
150058	25	41–1	F	41–45	–	–	–
150057	25	41–3	F	40–50	F	MAD[2]	+3
150053	25	41–2	F	30–40	F	MAD-OAD[3]	–15
150116	25	42	F	25–35	F	35–45	–10
150115	25	45	M	35–45	M	35–45	0
150170	26	5	M	–	M	40–60	–
150164	26	6	M	35–45	M	35–45	0
150107	27	1	F	30–35	M	22–32	+5
Average:				36		40	–4

[1] The "Adult" category indicates a skeleton older than approximately 20 years.
[2] MAD stands for "Middle Adult", which includes the age range of approximately 35–49 years.
[3] OAD stands for "Old Adult", which includes the age range of approximately 50 years and older.

Ater, and parts of Turner, as well as data on a few individuals (n = 7) buried at the smaller sites of Esch, Marietta, Rockhold, and Wright-Holder. Limited data are also available from the relatively large but less well reported Edwin Harness Mound at Liberty Earthwork.

Most of the analyses to follow include only those data on ages and sexes of Hopewell skeletons that were available before 1998. These were the data included in the HOPEBIOARCH data base prior to conducting the mortuary analyses in the *Gathering Hopewell* book (Carr and Case, 2005c). Since the initial study into the reliability of age and sex information from the Hopewell site, additional work by Johnston (2002) has produced new data that were not available at the time the data base was first created. The particulars of Johnston's study are described in Chapter 10 of this volume. These new data are not part of the analyses for the Hopewell site in this chapter. However, Table 9.2 is included to show how these determinations have impacted the original determinations from the study reported here.

METHODS

The various age and sex assessments tabulated for each of the larger sites of Hopewell, Turner, and Seip (Appendices 9.1–9.10) were compared to determine the degree of consistency among all researchers on a site-by-site basis. Comparisons were generally made between pairs of investigators to maximize the number of skeletons included in each component of the study. The same approach was used to compare the smaller data sets from Ater, Esch, Edwin Harness, Marietta, Rockhold, and Wright-Holder, in cases where comparative data were available (see "Other Sites", below).s

Inter-investigator comparisons were occasionally hampered by difficulties in identifying which skeletons had been studied by each researcher. Particularly in cases of double burial, there was often confusion about which skeleton(s) had actually been analyzed and which estimate(s) went with which skeleton(s).[1] In order to indicate that determinations were made by multiple researchers for the skeletons in a double burial, but that the determinations cannot be assigned to a specific skeleton, such sex assessments in the appendices are followed by the entry "which?" for both skeletons. In these cases, the information is not used in comparing the degree of correspondence among researcher's assessments.

Comparison of sex determinations among the various researchers is a fairly straightforward process. The only adjustments made to the reported data involve disagreements about the certainty with which a particular sex was assigned. Many researchers reported the relative certainty of their sex assessments by designating skeletons as male or female when certainty was high, and "M?" (probable male) or "F?" (probable female) when there was some degree of uncertainty. For the analyses that follow, both male categories (male, probable male) and both female categories (female, probable female) were collapsed into "male" and "female" respectively. Thus, in each analysis, the sex determinations for each pair of researchers are reported as either matches or mismatches.

Age determinations for each site were compared in at least one of the following two ways, depending on the amount of data available. Method 1 is an integer-scale approach. When a pair of researchers tended to place skeletons into individual age ranges (e.g., 25–35 years), the midpoint of each age range was selected as the most probable age, and the numeric difference between the estimates of the two researchers was determined. A mean difference in years between the ages estimated by each investigator was then calculated. In cases where the data were primarily categorical (e.g., young adult, middle adult, etc.), assumed age ranges were assigned to the categories, and the midpoints of those age ranges were used in the numeric comparisons. These assumed age ranges are very similar to those reported by Hooton for skeletons from the Turner site, and probably represent categories that were commonly recognized from at least the early 1920s onward (Willoughby 1922). These categories are: infant (0–2), child (3–12), teen (13–20), young adult (21–35), middle adult (36–49) or old adult (50+).

Method 2 for comparing age estimates is a categorical-scale approach. The method determines whether individuals studied by two different investigators were assigned to essentially the same broad age categories of young adult, middle adult, old adult, and etc. Numeric data were converted to categorical data for these comparisons by identifying the midpoint of each numeric age range, and then assigning the individual to one of the following categories: infant (0–2), child (3–12), teen (13–20), young adult (21–34), middle adult (35–49) or old adult (50+). Because these categories are more relevant to social analyses than quantitative ages, it is important to know how consistently different researchers tended to assign skeletons to the same category. Categorical determinations were used for the analyses in *Gathering Hopewell*.

ANALYSES

The Hopewell Site

The greatest amount of information on age and sex is available for human remains from the Hopewell site. The earliest assessments were done in the field by members of Warren Moorehead's excavation team in the early 1890s (Moorehead 1891; Moorehead 1922), and 30 years later by Henry Shetrone's excavation team (Shetrone 1922–1925; Shetrone 1926a). In the 1940s, Charles Snow collected metric data on Ohio Hopewell crania and recorded his assessments of age and sex on unpublished data collection forms (Snow 1943). More recently, Kathleen Reichs (1975) reported sex information for individuals from several sites including Hopewell, and Robert Pickering (1987) conducted an inventory of the Moorehead skeletons housed at the Field Museum in Chicago. Pickering assessed age and sex where possible, and tried to sort out some of the confusion caused by multiple individuals being assigned the same burial number. In the early 1980s and mid 1990s, respectively, Paul Sciulli (n.d.) and Cheryl Johnston (1995) each reassessed age and sex for many of the skeletons from the Shetrone excavations, which are currently housed at the Ohio Historical Center in Columbus. A more comprehensive study of the ages and sexes of Hopewell site individuals curated at the Ohio Historical Society and the Field Museum of Natural History has since been reported by Johnston (Chapter 10; 2002). The study includes estimates made by seriations and multivariate statistical approaches. As noted above, these latter determinations were not included in the pairwise analyses between researchers presented here.

Appendices 9.2A and 9.2B contain all of the 1995 and earlier data on age and sex available from the various researchers for the Hopewell site. Comparisons of the age and sex assessments made by various researchers are reported in Tables 9.3A and 9.3B. For the Hopewell site, the assessments by Johnston (1995) are used as the baseline for comparison,

Table 9.3A. Sex Correspondence for Ohio Hopewell Sites: Number of Individuals Placed in the Same Sex Categories

	Comparisons				
Reasearcher and Site	**1**	**2**	**3**	**4**	**5**
Johnston	**Sciulli**	**Reichs**	**Snow**	**Shetrone**	**Baby**
Ater	–	3/4	0/1	–	5/6
Hopewell	14/16	16/18	16/18	11/12	–
Harness	–	1/1	1/1	–	–
Konigsberg	**Johnston**	**Reichs**	**Baby**	**Snow**	**Shetrone**
Seip-Pricer	1/1	2/2	7/7	2/2	6/7
Cadiente[1]	**Giesen**	**Santa Luca**	**Hooton**		
Turner	8/11	6/6	9/10		

[1]Comparisons are between Cadiente's pelvic and cranial assessments and all assessments by other researchers.

Table 9.3B. Age Correspondence for Ohio Hopewell Sites: Number of Adults Placed in the Same Age Categories

	Comparisons				
Reasearcher and Site	**1**	**2**	**3**	**4**	**5**
Johnston	**Scuilli**	**Snow**	**Shetrone**	**Baby**	
Ater	–	1/1	–	2/2	
Hopewell	8/20	5/23	9/25	–	
Harness	–	0/1	–	–	
Cadiente	**Giesen**	**Santa Luca**	**Hooton**		
Turner	5/7	–	10/12		

because they are the most recent and probably used the most standard techniques.

Comparison of C. Johnston and P. Sciulli

Johnston's (1995) data on age and sex were used to find all skeletons that had an associated provenience or a catalog number and that had age or sex information recorded. Johnston's assessments were the most recent available in 1998, at the time this study was made, and use many of the newest techniques (e.g., the Suchey-Brooks pubic symphysis method and the auricular surface method for aging), which had not yet been developed when many of the earlier assessments were done, including those by Sciulli (n.d.). Table 9.3A contains a summary of the results of these comparisons.

Sixteen skeletons sexed by both Johnston and Sciulli could be directly compared (Appendix 9.3). It is not certain that the sex designations assigned by Johnston and Sciulli for skeleton M25 B23 were made on the same individual because this provenience contained two skeletons. If these two researchers both looked at the "South" skeleton, then their assessments are a match. However, because of the uncertainty, this skeleton was not included in the comparison. Fourteen out of sixteen (14/16) assigned sexes matched (88%). One of the two skeletons disagreed upon by Johnston and Sciulli (M25 B42: 283/400) was also evaluated by K. Reichs and C. Snow. Snow agreed with Sciulli that it was a male and Reichs agreed with Johnston that it was a female. It appears that this particular skeleton shows some characteristics of both sexes.

Twenty skeletons aged by both Johnston and Sciulli were compared using Methods 1 and 2 (Table 9.3B). Johnston (1995) recorded quantitative ages for 19 of the skeletons and a categorical age for only one. This individual was called a "middle adult". Johnston's age assessments proved to be older than Sciulli's, and averaged eight years older for all 20 skeletons. Exclusion of the one child and the "middle adult" individual did not change the average difference in estimates. For Method 2, Johnston and Sciulli agreed on age category for 8/20 (40%) individuals. In all cases of mismatch, Sciulli's assessment fell into a younger age range category.

Comparison of C. Johnston Lab Assessments and H. Shetrone Field Assessments

Age and sex data from Shetrone's (1926a) published report and field notes (Shetrone 1922–1925) on the Hopewell site were compared with Johnston's (1995) data (Appendix 9.4). Twelve skeletons sexed both by Johnston and by Shetrone's team could be compared directly. Eleven of twelve sexes (92%) were found to match in this comparison. The only mismatch is the skeleton from M2 B2, which Johnston determined to be "probable male" and Shetrone determined to be "probable female". Looking to other researchers for confirmation of one sex or the other, one finds that Snow agreed with Johnston, while Reichs agreed with Shetrone. No sex was recorded for this individual by Sciulli. Thus, the case appears to have been ambiguous.

All of these results suggest that there is very little difference in sex determination between Johnston and Shetrone's team for skeletons from the Hopewell site.

Nearly all of Shetrone's age data from the site report and field notes are categorical. Applying Method 2 to the data, Shetrone's age categories exceeded Johnston's in only one case, and the two researchers assigned skeletons to the same category 9/25 times (36%). Using Method 1 for individuals over 20 years of age, Shetrone's estimates average 33 years whereas Johnston's average for the same set of skeletons is 41. Thus, results of the age comparison show nearly the same degree of difference between the estimates as was found between Johnston and Sciulli.

Comparison of C. Johnston and C. Snow

Age and sex data from Snow's (1943) raw data sheets were compared with Johnston's (1995) data (Appendix 9.5). Snow and Johnston agreed on the sex of 16/18 (89%) individuals. The two skeletons on which Snow and Johnston disagreed were each studied by four researchers. In both cases, two researchers said they were males and two said they were females, suggesting that both skeletons were difficult to evaluate. It would appear that Snow and Johnston are quite consistent in their sex assessments – somewhat surprisingly so when one considers that Snow was likely using the skull, alone.

Snow's age assessments were also apparently made from the skull. Since aging from the cranial sutures has proven to have a very high error component (Krogman and Iscan 1986), Snow's assessments would be expected to differ markedly from Johnston's. It is not surprising, then, that the average age difference between Johnston's and Snow's assessments is 12 years, with Johnston's determinations being older in most cases. The greatest difference is 20 years, and the smallest is zero years. In only one case did Snow suggest an age greater than Johnston, and most of Snow's assessments appear to be substantially younger, again reiterating the comparisons of Johnston's age estimates with those of Sciulli and Shetrone. Only 5/23 (22%) ages were in the same category, and three of the similar assessments were for individuals under age 25, when indicators of skeletal development can still be used for more accurate aging.

Comparison of C. Johnston and K. Reichs

Eighteen skeletons sexed by both Johnston (1995) and Reichs (1975) could be compared (Appendix 9.6). Johnston and Reichs agreed on 16/18 (89%) individuals. The two cases of disagreement were problematic for other researchers as well, suggesting that these two skeletons were difficult to assess for sex.

Comparison of W. Moorehead Field Assessments and R. Pickering Lab Assessments

The skeletal material currently extant from Moorehead's excavations is curated at the Field Museum of Natural History in Chicago. There are several problems with the sample. First, many of the proveniences that were purported to contain a single skeleton have elements of two or more individuals assigned to them. In some cases, this problem makes it difficult to determine with certainty which of the two or more skeletons is actually the one referred to in Moorehead's notes and site report. In several of these instances, the bulk of the skeletal material belongs to a single skeleton (Pickering 1987), and only a few elements belong to one or more others. When such was the case, the primary skeleton was assumed to be the one referred to in the field notes or site report. In addition, Moorehead did not save all of the skeletal material he excavated. Rather, he apparently chose skeletons that were better preserved or individual elements that exhibit interesting pathologies or anomalies, such as humeri with septal apertures (Pickering 1987).[2]

No comparison is possible between Moorehead's field assessments and Pickering's lab assessments, because none of the skeletons aged or sexed by Moorehead in the field were the same as those aged and sexed by Pickering at the Field Museum (Appendix 9.7). It should be noted that Moorehead assigned only one

skeleton to any age category other than "adult" or "child". Furthermore, Moorehead seems to have noted only that a skeleton was an adult when the skeleton was so badly decayed that its status as an adult versus juvenile was not readily visible. When a skeleton was obviously an adult, nothing was said about it. When a skeleton was obviously a child, it was noted as such. Appendix 9.7 contains information only about ages that were explicitly stated in Moorehead's site report or field notes, whereas the HOPEBIOARCH data base has an "assumed adult" category to account for individuals not explicitly described as adults by Moorehead.

Comparison of C. Snow to C. Johnston, P. Sciulli, and R. Pickering Combined

A combined dataset was created from the age and sex assessments by Johnston (1995), Sciulli (n.d.), and Pickering (1987) for comparison with the determinations by Snow (1943). Such combination seems reasonable since the sex determination methods used by all of these investigators were likely very similar, and all of the investigators except for Snow would likely have used age assessment techniques that included the pelvis where available. These age data will provide an interesting contrast to those from Snow based on the skull. In all cases, Johnston's determinations were used when present, and those of other investigators when not, to compare to Snow's estimates.

Twenty-two sexed skeletons could be compared, versus 18 in the comparison with Johnston's estimates alone. There was agreement between Snow and the other three researchers on 20/22 (91%) skeletons. This suggests a very good match between the sex assessments of Snow using only skulls, and those by later researchers who may have relied more heavily on the pelvis.

Twenty-six aged skeletons could be compared. The age results are very similar to those found when only Johnston and Snow are compared, which isn't surprising since the bulk of the data used for comparison with Snow are from Johnston's determinations (Appendix 9.8). Applying Method 1, Snow's assessments were 11 years younger than those of the other three researchers. When Method 2 was applied, only 7/26 (27%) assessments matched the same age category.

The Turner Site

Comparison of T. Cadiente with M. Giesen, E. Hooton, and Santa Luca

Data on age and sex from the Turner site are available from seven different sources. The primary source is a Master's thesis by Teresa Cadiente (1998). Other data collected after 1970 are available from Myra Giesen (1991–1992), who made her unpublished assessments in the early 1990s, and Santa Luca, a physical anthropologist hired to provide age and sex assessments for Greber's (1976) dissertation. Earnest Hooton (Willoughby 1922) supplied age and sex information in the 1920s for a number of Turner skeletons, and more limited information is available from excavators of the Turner site, including Metz (1882), Putnam (1885) and Volk (1905).

Data on sex and age for all provenienced skeletons used by Cadiente (1998) from the Turner and associated Marriot sites were entered into tables (Appendices 9.9A and 9.9B). These data are derived from Appendix 3 of a draft of Cadiente's thesis. Appendices were ultimately not included in the thesis. Provenience information for each catalog number is given in Cadiente's Appendix 2. Hooton has additional data for skeletons from the Turner site, but these data are reported by catalog number, and there is no readily available list at the Peabody Museum that cross-references the catalog numbers with the burial numbers. The only way to determine which burial number goes with which catalog number would be to go through the accession ledger and record the association by hand. Therefore, 11 individuals with age and/or sex information reported by Hooton could not be included in the data base. This problem did not affect the comparative study, however, because these were individuals that were not examined by Cadiente or Giesen. The catalog numbers of burials without associated

provenience designations are reported in the last part of Appendices 9.9A and 9.9B.

Due to the often fragmentary nature of the Turner skeletons, Cadiente's sex assessments were made using pelvic indicators in some cases, cranial and mandibular indicators in others, and occasionally by measuring the femoral, humeral, or radial head and comparing with metric values from other populations. These different methods are reported in separate columns of the appendix tables to indicate the different levels of confidence in each technique (eg. TC Pelvic Sex, TC Cranial Sex, TC Other Sex). Data from Giesen were also reported in two columns, one listing designations based on pelvic indicators, and the other listing designations based on the rest of the skeleton. Giesen sometimes reported a sex with a question mark following (eg., F?). The question mark indicates that sex was determined based on size and shape extremes. Data from Hooton and Santa Luca are recorded in single columns simply for comparison. The specific methods they used are unknown.

The data on skeletal age are handled in a similar way. For Cadiente's information, pelvic techniques such as pubic symphysis degeneration and auricular surface remodeling are recorded in one column (TC Pelvic Age), cranial suture closure results in a second column (TC Cranial Age), and techniques based on dental wear, osteoarthritic stage, and so on are found in a third column (TC Other Age). Ages were reported by Giesen only when they were determined using either the pubic symphysis or the auricular surface, and should therefore be quite comparable to Cadiente's "Pelvic Age" determinations. Data from the other physical anthropologists were recorded in single columns (Hooton Age, and Santa Luca Age) simply for comparison.

Further information about the sex of several skeletons could be determined through the use of osteometric techniques. Cadiente actually studied two different prehistoric Native American samples for her thesis: Ohio Hopewell skeletons from the Turner site, and a portion of the skeletons from the nearby Fort Ancient period site of Madisonville, which had been mislabeled as belonging to the Turner site. Fifteen of the skeletons from these two sites could be sexed using pelvic indicators, and also had femora that were present and well enough preserved to allow the femoral head diameter to be measured (10 individuals from Madisonville, 5 from Turner). The Turner individuals had femoral head diameters within the range of those of the Madisonville individuals, suggesting that combining the samples from two sites for this study is reasonable. The female femoral head diameters (N=10) have a mean of 41.9 mm, a median of 41.2 mm, and a standard deviation of 1.4 mm. The range is 40.6–44.3 mm. At three standard deviations above the mean, the femoral head diameter would be 46.0 mm. The male femoral head diameters (N=5) have a mean of 49.4 mm, a median of 48.9, and a standard deviation of 1.5 mm. The range is 47.6–51.2 mm. At three standard deviations below the mean, the femoral head diameter would be 45.1 mm. Using three standard deviations above the female mean as a minimal size for all male femoral heads, and three standard deviations below the male mean as a maximal size for all female femoral heads, these data suggest that any femoral head diameter greater than 46 mm can be considered that of a male and any diameter less than 45 mm can be considered that of a female. Those falling in the region of overlap between 45 and 46 mm are considered indeterminate.

Using these criteria, it was possible to determine sex with what should be a reasonable degree of confidence for several individuals who could not be sexed using pelvic or cranial traits. These skeletons are: Enclosure B1a-A (#A-534), Enclosure B3a (#A-541), M1 B1-A (#A-612), M1 B9 (#A-622), and M12 Bc-A (#30119). Femoral head measurements for all of the Turner skeletons that could be measured are reported in the column titled Femur Sex (Appendix 9.9A). Those that could be sexed based on their femoral head diameters (excluding those used to develop the distribution) have a sex designation in the Femur Sex column, followed by the femoral head diameter measurement in parentheses.

All of the physical anthropologists seem to agree on the sex of individuals who had pelves available for study. Cadiente assigned sex based on pelvic characteristics to ten individuals.

None of the other physical anthropologists disagreed except in the case of catalog number A-4, where Hooton and Giesen disagreed with Cadiente and Santa Luca, who thought A-4 was a female. In this case, the femoral head diameter (41.3 mm) is slightly below the female mean and well below the boundary point of 45 mm, suggesting that the individual was most likely a female.

Cadiente also sexed four individuals using cranial and mandibular indicators. All four were sexed by at least one of the other physical anthropologists. Cadiente agreed with Hooton on the three skeletons that they both observed, but disagreed with Giesen on two of the three individuals (catalog numbers A-560 and A-612). Hooton supported Cadiente's assessment that skeleton A-612 was a female. Femoral head measurements also suggest that A-612 is female, although at 44.4 mm, the diameter is near the upper end of the female range.

For six individuals, Cadiente relied on criteria such as femoral, radial, and humeral head measurements, using cut-off points determined from other populations for the radial and humeral head measurements, and in one case, using overall robusticity as a sex indicator. Four of these six individuals were also sexed by others, and in each case, Cadiente disagreed with the other investigator. In two of these cases Cadiente disagreed with both Hooton and Giesen. It is difficult to know which assessments are most reliable in such cases, since all of the assessments were probably based on criteria other than the standard traits of the pelvis and skull. Furthermore, metric techniques often perform poorly when applied to populations other than those on which the technique was developed. However, in each case of disagreement between Cadiente and others, the femoral head analysis that was developed for use with this particular population confirmed Cadiente's designation of female. Furthermore, the stature of one of these individuals (M12 Bc-A), as measured during excavation, proved to be only 5 feet 0 inches, further supporting Cadiente's contention that this individual was female.

Overall, it would appear that sex assessments on the Turner series using pelvic characteristics are quite reliable. Sexing by cranial traits appears to have led to some disagreement among the three physical anthropologists, suggesting that these traits are less reliable indicators of sex in this skeletal series. It is interesting to note that at the Hopewell site, Johnston (Chapter 10) found only three cranial traits to be good sex indicators. These were supraorbital tori, nuchal crest, and mastoid process. Assuming that the femoral head diameters of the Madisonville people are similar to those of the Turner skeletons, sexes based on femoral head diameters appear to be fairly robust as well. Thus, sex determinations based on pelvic characters can probably be considered most reliable, those based on femoral head diameter perhaps second most reliable, and those based on cranial/mandibular traits and other techniques least reliable in this skeletal series.

Age designations are remarkably consistent across researchers at the Turner site. Applying Method 2, Cadiente agreed with Giesen on age categories in five of seven cases (71%). In one of the cases of disagreement, Cadiente and Hooton were in agreement that the individual was middle aged (36–49), whereas Giesen reported an age of 30–34. Cadiente and Hooton agreed more often, having 10/12 (83%) assessments in common. In one of these two disagreements, Giesen agreed with Cadiente that the individual was a young adult rather than a middle adult as assessed by Hooton. The other individual (A-16) was disagreed on by all three investigators, with Giesen assigning an age in the late teens, Cadiente an age in the young adult range, and Hooton an age in the middle adult range. However, Cadiente notes in her appendices that there were two skeletons with the label A-16, suggesting the possibility that either Hooton or Giesen might have assessed a different skeleton from that studied by Cadiente.

Comparison of M. Giesen and E. Hooton

Fourteen skeletons were sexed by both Giesen and Hooton. They agreed on 10 of 14 (71%) skeletons. There were no disagreements in the five cases where Giesen used pelvic indicators to determine sex. Once again, the evidence suggests that sex assessments based upon

the pelvis have provided the greatest consistency among physical anthropologists for the Turner site.

The Seip-Pricer Mound

C. Johnston, L. Konigsberg, K. Reichs, C. Snow, R. Baby, and Blosser/Krogman's Data

Johnston's (1997c) data base on age and sex was used to find all skeletons with an associated provenience or a unique catalog number that had age or sex information recorded (Appendices 9.10A and 9.10B). Lyle Konigsberg's data on these same skeletons as well as a number of others were then added to the tables (Konigsberg 1985).

The fact that most of the Seip burials were cremations poses technical problems for assessing age and sex. Konigsberg's sex designations were determined primarily by presence or absence of a preauricular sulcus, suggesting a possible bias toward designations of female, since a small proportion of males will also exhibit a preauricular sulcus (Buikstra and Ubelaker 1994). Konigsberg also used Phenice's (1969) technique and cranial features when possible, but does not report which features were used on which skeletons. Because Konigsberg also did not report catalog numbers, skeletons were matched by burial number to the extent possible. There were often multiple individuals from the same provenience, causing occasional problems matching up the skeletons analyzed by Johnston and Konigsberg. Ages were used to solve some of these problems, since it is unlikely that an adult, for example, would be mistaken for a young child due to the ease of recognizing unfused epiphyses in children, even in cremated material. The catalog numbers in Appendices 9.10A and 9.10B come primarily from Johnston's data base, as do most of the notes. Provenience numbers come primarily from Shetrone and Greenman's (1931) site report. When an adult and a subadult skeleton are reported from the same provenience, the adult is given the designation "A" and the subadult "B". In other multiple burials involving only adults, the same burial number is given to all individuals with an available age or sex assessment.

Age comparisons between Konigsberg and Johnston were restricted to the subadults, because Konigsberg did not report any specific ages for individuals over 20 years old, given the cremated nature of most of the sample. Individuals over 20 years old were identified simply as "adult" by Konigsberg. Johnston and Konigsberg agreed on the adult category in six of eight cases. The only disagreements were over Burial 77, which Johnston called an adult while Konigsberg gave an age range of 15–19 years, and Burial 76, where Konigsberg gave an age of 20+ whereas Johnston gave an age range of 13–19 years. The fact that these two burials are numerically adjacent to each other, and that the directions of the difference in age assessment between the investigators are opposite in the two cases, suggests the possibility that one or the other of the two investigators made an error when reporting the ages and skeleton numbers, and that in reality there was full agreement on all adult skeletons. Among the subadults, Johnston and Konigsberg had overlapping age-ranges for two out of three individuals. They disagreed only on the postcrania from Burial 48, which Johnston thought was 5.5–7.5 years and Konigsberg thought was 2.5–3 years.

As noted earlier, Reichs' (1975) dissertation included data on sex alone. She reported on only two skeletons (41A and 41B) not reported by Konigsberg. Her numbering system was a mixture of burial proveniences and catalog numbers, and the two additional skeletons were reported as 0041A and 0041B. The Seip site report lists Burial 41 as being a single, cremated skeleton. Thus, it is likely that these numbers are actually an abbreviation of the catalog number 957/041 (the 957 represents the Seip site), and that there were two individuals with this same number, which Reichs labeled A and B. Four of Reichs' five sexes can be compared to those from Baby. They disagree on 2/4 comparisons (50%). Shetrone and Greenman agree with Reichs on one of the disputed individuals (Appendix 9.10A).

Snow's limited data on Seip were also added to Appendices 9.10A and 9.10B. One

burial, number 48, was said by Snow to be a cut trophy. Konigsberg also calls one of his Burial 48 individuals an "unburned trophy skull". The site report notes a skull lying atop a cremation pile that showed evidence of having been painted but not having been drilled – probably the same skull. Johnston doesn't mention a trophy among the Burial 48 skeletons, but since she has only one individual who is an adult labeled Burial 48, it is assumed that the same skeleton was observed by all three researchers. Only two sexes determined by Snow could be compared to other determinations. In both cases, Snow agreed with all other investigators who attempted to sex the same individuals.

Baby's data for skeletons from the Seip site are the most extensive (Appendices 9.10A and 9.10B). These assessments were taken from a data table in Greber's (1976) dissertation, which does not report the techniques used to age and sex the skeletons. These determinations were apparently made between 1948 and 1954. For those assessments that could be compared to one or more other investigators, Baby agreed with the others 8/10 times (80%). However, without knowing what features were observed by Baby on the rest of the skeletons from Seip, and given the fact that most of the sample was cremated, it is difficult to assess how accurate his other determinations might be.

There are quite a few assessments noted in Shetrone and Greenman's (1931) site report. These are also reported in Appendices 9.10A and 9.10B. It is not clear what techniques were used to determine sex or age, although they would have had the advantage of observing any cremations before they were disturbed by collection and transport. Shetrone and Greenman agree with the sex assessments of other investigators in 7/9 cases (78%). They disagree with Konigsberg on Burial 31, and with Baby on Burial 4. On Burial 2, Shetrone and Greenman agree with Reichs but disagree with Baby. Shetrone and Greenman's age data for adults are the most extensive next to the data from Baby. Seven ages could be compared to determine whether they fell in to the same range. The two data sets only agreed for 2/7 individuals (29%)

Blosser's and Krogman's data come from Greber's (1976) dissertation, and were apparently drawn originally from the excavation field notes. The data are quite limited, with only three skeletons having been assessed for sex, and only five for age (Appendices 9.10A and 9.10B). Sex could only be compared among Johnston, Reichs, Konigsberg, and Snow in two cases (Burial 48 "trophy skull", and Burial 52). There was no disagreement in either case, the first being assigned female, the second male.

Because so many of the Seip skeletons are cremations, and since the techniques used are not clearly outlined for several of the investigators, it would seem prudent to give precedence to assessments made on the inhumations first, followed by assessments on cremations that are agreed upon by more than one investigator. For those skeletons assessed by only one investigator, Konigsberg's assessments should be given greatest weight, because the technique he used is explicit, and included standard traits such as the preauricular sulcus, ventral arc, subpubic concavity, and ischiopubic ramus ridge.

Other Sites

Sex and/or age information from these same researchers is also available for the sites of Ater, Esch, Edwin Harness, Marietta, Rockhold, and Wright-Holder. Sources of this information are Johnston (1995), Reichs (1975), Snow (1943), and Baby (Greber 1976). All skeletons that have an associated provenience or a unique catalog number and that have age or sex information recorded were entered into Appendix 9.11. Most of the notes in the appendix come from Johnston's data base, and most of the catalog numbers come from Johnston or Snow. As mentioned earlier, the skeleton numbers recorded in Reichs' dissertation were based on a numbering system that used either the burial number or the catalog number, whichever best described the number on the skeleton or the box containing it. Because Reichs' results were recorded in a table with no indication of whether the number was a catalog or a burial number, large numbers on skeletons from small sites are assumed to indicate a catalog rather than a burial number, and small numbers are assumed to represent a burial number.

Five skeletons were sexed by both Johnston and Reichs. There is agreement on four (80%) of these. The only disagreement is over Ater Burial 50, which Johnston designated a "probable female" and Reichs called a male. Reichs did not report the certainty of her sex assessments in her dissertation tables through the use of question marks. Johnston and Snow only sexed two of the same skeletons. They agreed on one and disagreed on the other, with Snow calling Burial 51 a female, and both Johnston and Reichs calling it male. Burial 51 was the only skeleton assessed by both Reichs and Snow, and they also disagreed on the sex.

CONCLUSIONS

The age and sex comparisons presented above provide insight into both the relative usefulness of various age and sex assessment methods generally, and the degree to which specific researchers tended to agree on age and sex determinations. Both kinds of information are helpful in determining which age and sex determinations, of the many that have been made on Ohio Hopewell human remains and that are recorded in the HOPEBIOARCH data base, are useful for biological and sociological analysis.

As was expected, sex assessments on noncremated skeletons are quite consistent among the various researchers, regardless of the traits used to make the determinations. For skeletons from the Hopewell site, agreement was on the order of 90%, whether the researcher relied heavily on pelvic traits or used only cranial indicators. What is particularly surprising is the consistency between very old data from Snow and Shetrone's excavation team and recent data from Johnston and Sciulli.

In sharp contrast to these encouraging results, there was considerable inconsistency in age assessments for the Hopewell site skeletal series, particularly between Johnston, who relied heavily on the Suchey-Brooks system for determining age from the pelvis, and the other researchers who did not use this system. Johnston's assessments tend to be older than those of the other researchers, averaging approximately eight years older than Sciulli's lab assessments (n = 16) and the field assessments of Shetrone's team (n = 23), and 12 years older than Snow's assessments (n = 18). Using the information from Appendix 9.3, Johnston's assessments suggest an average age at death of 39 years (excluding children) for individuals at the Hopewell site, whereas Shetrone's, Sciulli's and Snow's assessments for essentially the same set of skeletons suggest ages of 33 years, 31 years, and 27 years respectively. It would seem improbable that a local population with an average adult age at death of 27–33 years would be able to sustain itself through time. Thus, despite being substantially older, Johnston's assessments are by no means surprisingly old, and were selected as probably representing the best estimates for the Hopewell site. The difference between her assessments and those of the other researchers are likely due in great part to her having used the Suchey-Brooks and auricular surface systems of age determination. Caution is necessary, here, however. It may be significant that when Johnston revised her ages using additional information from seriating the dentition, the auricular surface, and the pubic symphysis, and in some cases using these data in a multivariate principal components approach, the new age estimates for the same sample averaged four years younger than previously calculated (Table 9.2).

Age differences seem to be less pronounced among researchers who studied the skeletons from the Turner site. However, the size of the sample that could be compared among researchers is somewhat smaller. Significantly, the assessments of Cadiente, Giesen, and Hooton all suggest an average age at death in the middle adult category (35–49 years), which is similar to Johnston's results for the Hopewell site. It is also interesting that Hooton's age assessments from the early 1920s tend to be slightly older than those made by Cadiente and Giesen, who used primarily pelvic indicators. As noted above, it is unclear what indicators Hooton used to make his age assessments, although it does appear that he did not rely exclusively on either cranial sutures or dental wear. It may be that Hooton used a suite of different

indicators to determine age, a practice that is more recently being recommended as optimal for age assessment (Ubelaker 1989; Schwartz 1995).

Practical Results for the Use of Age and Sex Determinations in Analyses

The final question that must be addressed is which data can be used with confidence in biological and social analyses of Ohio Hopewell sites, and which must be used with caution. For the Hopewell site, the assessments of Johnston, Sciulli, Reichs, Snow, and Shetrone all show good concordance for sex. Pickering's assessments could not be tested for concordance with other researchers, but because they are based on similar standard techniques, they are probably as reliable as those of Johnston, Sciulli, and Reichs. Skeletons that were sexed by several researchers who disagreed in their assessements, however, should probably be considered ambiguous and excluded from all analyses.

Among the sex assessments from the Turner site, the most reliable appear to be those made from the pelves by Cadiente and Giesen**.** As with the sex assessments for the Hopewell site, those on which researchers disagreed should be used with caution. The assessments of Santa Luca, despite the lack of explicit statement of the techniques used, show good concordance with the others and therefore can probably also be considered reliable. Sex assessments made by Cadiente, Giesen, and Hooton for the Turner individuals using cranial and other indicators should be considered less reliable. However, femoral head diameter data provided in Appendix 9.9A, in addition to cranial or other indicators, appear useful for bolstering an assessment's reliability for some of the Turner skeletons.

Sex assessments made on cremated remains from Seip and Ater should probably be used with caution. Konigsberg's estimates are the only ones for which the techniques used are explicit, and therefore should be given the greatest confidence**.** The assessments made by Baby and Shetrone have an unknown degree of reliability because it is not clear what techniques were used to make the determinations. Caution is particularly warranted in the case of Baby's assessments, because he seems to have assigned both age and sex to a surprisingly large number of skeletons from both the Ater and Seip sites, considering that they were mostly cremated.

The question of which age estimates can be used with confidence in biological and social analyses can be approached similarly. Age assessments on subadults probably have fairly equal reliability regardless of the researcher, since the order of epiphyseal union and the pattern of dental eruption have been well understood for a long time. The only caveat is that assessments made on inhumations, on the average, will be more accurate than those made on cremations because of loss of information during the cremation process. For adults, age estimates for inhumations based on pelvic indicators should be considered more reliable than those made from the skull. Those that include the Suchey-Brooks system should be considered most reliable, because they appear to produce a more reasonable average age at death. Thus, the assessments of Johnston and Giesen, as well as those of Cadiente made from the pelvis, can be used with the greatest confidence. The other assessments made by Sciulli, Pickering, Snow, Shetrone, Moorehead, Hooton, Santa Luca, Baby, and Shetrone and Greenman also supply information, but might better be viewed as marking a lower boundary for the age of the individual, because many of these assessments are quite a bit younger than those made using the Suchey-Brooks system, and only rarely are they equal to or older than assessments made using this system. Specific age assessments made on adult cremations from Ater and Seip are probably not very reliable, when one considers the variability in age estimates encountered even when skeletons are fairly well preserved. Perhaps the best approach for the cremated individuals from these two sites is to simply note that any skeleton determined by Baby or Shetrone and Greenman to be over age 20 is an adult.

All of the above rules of thumb and particular conclusions are used in the HOPEBIOARCH data base to record, for each assessed individual, the reliability of the estimates made by researchers and a summary

of the most likely best age and best sex estimate. Within the data base, age and sex information are coded under a number of variables to indicate the relative reliability of the estimates. For a given individual, only the most reliable estimates of age and sex are recorded. High reliability estimates are reported under the "SEX1" and "AGE1" variables. When a high reliability estimate is not available and an estimate thought to be moderate in reliability is, it is reported under the "SEX2" and "AGE2" variables. When neither a highly nor moderately reliable estimate is available, but a poor or uncertain one is, it is given under the "SEX3" and "AGE3" variables. The physical anthropologist responsible for the reported estimate is indicated by last name under the "PHYSANTHAGE" and "PHYSANTHSEX" variables. A summary estimate that is based on the best available data and that is sensitive to the level of precision reasonable in stating an age or sex is then recorded under the "AGECODE" and "SEXCODE" variables. For sex information, mild uncertainty about the estimate is indicated by following the "M" for male, or the "F" for female with a question mark (e.g. F?). Slightly greater uncertainty is indicated by an additional question mark (e.g. F??). For age information, all assessments concluded to be highly reliable are reported into the age categories of child (0–12), adolescent (13–20), young adult (21–34), middle adult (35–49), or old adult (50+). A less reliable age results in a simple indication that the individual is an adult (AD), or has been assumed to be an adult (AA) based on our understanding of the way an early excavator reported information about the skeletons they encountered.

NOTES

1. For example, Mound 25 Burial 23 from the Hopewell site was a double burial, and both skeletons were given the same accession number. Johnston noted in her data base that one of the two skeletons was the "north" skeleton described in Shetrone's (1926a) site report, and that the other was the "south" skeleton. See Appendix 10.4 for an explanation of her rationale. Sciulli (n.d.), Reichs (1975), and Snow (1943–1944) do not report this information in their data tables, although since the "south" skeleton had a more complete cranium and skeleton, it seems likely that all would have sexed this skeleton.
2. Burial 248 poses a different kind of problem. This is Moorehead's burial of the "King", but the currently curated remains contain most of two skeletons plus a skull and hand of what appears to be a third individual. The "King" is readily identifiable among these three skeletons because the pattern of copper staining on one individual is extensive and matches fairly closely the locations of copper artifacts described in the field notes. Associated skeleton S249 is also problematic. Moorehead's field notes mention that a skeleton "lay to the west of [S248], being a small one with head in the same direction". Plate XLIX of the site report shows a photo of Burial 248, just to the west of which appears to be the cranial fragments of another skeleton. Moorehead's excavation team tended to number skeletons as they came to them, and since another skeleton was already visible when 248 was being excavated, it is reasonable to assume that it would have been given the number S249. Pickering describes the second skeleton labeled S248 as exhibiting copper staining of the cranial vault and left hand, suggesting that it was associated with copper artifacts. Greber and Ruhl (1989) note in *The Hopewell Site* that an artifact label found with a set of copper panpipes stated that the panpipes were found with Burial S249. The copper staining of the left hand of the second skeleton labeled S248 might suggest that the panpipes were in this individual's hand, as has been seen at other Ohio Hopewell sites (e.g. North Benton, Burial 4). Finally, the field notes also mention (after describing Burial 248) that ten more skeletons were found in cut #2 without objects or ornaments. However, 11 more numbers are given after 248, suggesting that perhaps one of the last 11 skeletons excavated from cut #2 was found with artifacts. This single skeleton with artifacts present may have been S249. Taken together, all of this information seems to suggest that the individual immediately adjacent to S248 was S249, and that this individual is the same individual labeled 248b by Pickering. Therefore, in Appendix 9.7, the sex of S249 is assigned as female, following Pickering's identification of the second skeleton with S248, but with a double asterisk after it to denote the uncertainty about the provenience.