

W. M. Bass,¹ Ph.D. and P. A. Driscoll,² M.A.

Summary of Skeletal Identification in Tennessee: 1971-1981

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ABSTRACT: Records of 111 forensic anthropology cases from Tennessee received from September 1971 through September 1981 are analyzed. Thirty percent of the cases in which no identification existed when the skeleton arrived were positively identified and an additional "probable" identification was made in 11%. The skull or skull bones were the most common element recovered followed by femora, mandibles, and innominates, in that order. The sternum was the single major postcranial bone least likely to be recovered. January has been the single busiest month for the discovery of skeletal remains in Tennessee, and there are almost twice as many fire-related discoveries between September and February. In the first half of the decade, from 1971 through 1978, there were 39 cases with 72 cases occurring from 1977 through 1981. This increase is probably because of efforts to educate students at the University of Tennessee as well as lectures to law enforcement and citizens' groups.

KEYWORDS: physical anthropology, human identification

Demography of a Decade of Forensic Cases

Physical anthropologists with training and an interest in forensic science analysis have aided law enforcement agencies since the early part of this century. Stewart [1] discusses the early development of forensic anthropology. The research and a few cases of such early leaders as W. M. Krogman at Chicago and later Pennsylvania, T. D. Stewart at the Smithsonian Institution, C. E. Snow at Kentucky, and T. McCown at Berkeley have been reported in the literature. The Physical Anthropology Section of the American Academy of Forensic Sciences was founded on the leadership of Ellis R. Kerley at Maryland and the section today has approximately 45 members. Each of these members are, in various formal or informal ways, associated with the law enforcement agencies in their geographic area. This leads to a variety of responsibilities for the forensic anthropologist including aiding law enforcement, medical, or legal authorities by answering questions or assuming complete responsibility for analysis or both and identification of cases involving skeletal material. In Tennessee, the state forensic anthropologist is an official consultant to the state medical examiner's system. Dr. Jerry Francisco, the State Medical Examiner, has encouraged the county medical examiners to consult with and, in most cases, transfer to the state forensic

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¹Professor and head, Department of Anthropology, University of Tennessee, Knoxville, TN and Tennessee state forensic anthropologist.

²Graduate student in physical anthropology, University of Tennessee, Knoxville, TN.

anthropologist cases containing human or animal bones. The state forensic anthropologist analyzes the material and in cases in which positive identifications are made, the county medical examiners sign a death certificate based on the official report filed by the state forensic anthropologist.

Cases are referred to the state forensic anthropologist through either local or state law enforcement agencies (Tennessee Bureau of Investigation, [TBI]), county medical examiners, or district attorney generals. Copies of all forensic anthropology case reports are sent to the medical examiner in the county in which the case originated and to the state medical examiner. Payment for time and expenses are paid through the state medical examiner's system. This procedure allows for a great variety of cases to be seen by the Tennessee state forensic anthropologist and thus provides a large data base.

William M. Bass, a Diplomate of the American Board of Forensic Anthropology and professor and head of the Department of Anthropology at the University of Tennessee, Knoxville, has kept records of the forensic science cases on which he has worked. In 1971 he was appointed state forensic anthropologist upon coming to the University of Tennessee, Knoxville and in this capacity has served as a consultant on the Medical Examiner's staff in Tennessee. In 1981, Bass recorded his 100th case in Tennessee. September 1981 seemed an appropriate time, then, to examine his records to see what, if any, patterns might be noted in the cases on which he has worked.

Method

Records of 111 forensic science cases received from September 1971 through September 1981 were studied by Patricia Driscoll, a graduate student in physical anthropology at the University of Tennessee. Each report was examined to determine the age, race, and sex of each individual involved; the location and month of the skeletal recovery; the bones that were recovered; and whether or not a positive identification was made.

Results

Bass's forensic science caseload has increased over the ten years he has been in Tennessee (Table 1). In the first half of the decade, from 1971 through 1976, there were 39 cases with

TABLE 1—Number of forensic science cases per year and minimum number of human individuals for Bass's forensic science cases from 1971 through 1981.

Year	All Cases	Animal Cases		Human Cases		Minimum Number of Individuals
		Total	Fire Related	Total	Fire Related	
1971	5	1	0	4	1	4
1972	4	0	0	4	0	4
1973	7	1	0	6	0	8
1974	11	2	2	9	1	10
1975	7	2	0	5	0	5
1976	5	1	1	4	1	4
1977	10	1	1	9	1	10
1978	17	5	2	12	1	15
1979	12	0	0	12	3	12
1980	13	2	0	11	1	16
1981	20	7	0	13	3	21
Total fire-related cases	6	...	12	...
Total cases	111	22	...	89	...	109

72 cases occurring from 1977 through 1981. The minimum number of individuals examined over the same time period doubled from 35 individuals in the first five years to 74 in the second five years.

Of the 111 cases reported, 22, or 20% involved only animal bones and 89, or 80% were human remains (Table 1).

While the number of cases each year containing only animal bones varied from zero to seven, overall the rate remained fairly constant (Table 1). In the first five years of Bass's cases in Tennessee, 18% of the cases involved nonhuman bones and in the second five years, 20% were only animal remains. These figures are slightly higher than the "about 10 percent" range Angle [2] gives for nonhuman bones brought to him as being possibly human.

Identification

Of the 106 cases in which no identification existed when the skeleton arrived, a positive identification was made in 30% of the cases. A "probable" identification was made in an additional 11%. In these "probable" identifications, individuals were identified and often buried by their families but there were no X-rays or dental charts available to confirm the finding.

As was to be expected, the rate of positive identification was more favorable in instances in which a complete or nearly complete skeleton was involved (Table 2). Relatively complete skeletons were found in about one third of the cases. A complete or relatively complete skeleton was positively identified 62% of the time. These cases ranged from one in which the identification was made within minutes of being presented with the skeleton to much more difficult cases. I have entitled the first case mentioned, "Look Before You Drive 600 Miles."

One Friday night, the 6th of July, a few years ago I received a call from the police chief of a town about 480 km (300 miles) from my laboratory asking if I could identify a recently discovered skeleton. I suggested that the chief mail the skeleton to me to save him a 960-km (600-mile) round trip. His response was, "Oh Doc it smells too bad to be mailed." I asked how much tissue remained on the bone and he replied none. Apparently the skeleton had been found that afternoon by a telephone repairman. The repairman was up on a pole along the main street of the town which has a population of about 50 000. When he looked down in the undergrowth along a creek he saw the fully clothed skeleton of a male. The police were called, and the skeleton was taken to the local medical examiner. Since there was no tissue,

TABLE 2—Rate of positive identification for Bass's forensic science cases from 1971 through 1981.

Type of Case	No.	Positive Identification		Probable Identification		Not Identified	
		Number	Percent	Number	Percent	Number	Percent
All cases	106 ^a	32	30	12	11	62	59
Any human bone	84	32	38	12	14	40	48
Historic human bones	71	32	45	12	17	27	38
Historic human bones							
"complete" skeleton ^b	27	17	62	5	19	5	19
fragmented skeleton	35	12	34	7	20	16	46
condition of skeleton							
not listed	10	3	30	0	0	7	70

^aDoes not include five cases in which identification was made by other authorities.

^bIncludes cases in which remains were reported as complete, nearly complete, or which met a specific criteria.

the local medical examiner contacted the state medical examiner who suggested that the skeleton be brought to me.

An appointment for 11:30 Saturday morning was arranged. The police chief was to bring the skeleton to the parking lot adjacent to my laboratory. A few minutes before the appointed meeting, the police chief and the chief of detectives drove up in a pickup truck with a covered plastic garbage can tied down in the back. After introductions, I opened the garbage can while the others stood at a safe distance. Indeed, there was no tissue on the bones; but it had only recently decayed, and the smell was strong. The garbage can contained the skeleton and all of the clothing—everything just as it had been picked up the day before.

I began to sort the bones out and place them in anatomical order. It was the first case that I have had that I had to reach into the pants legs and pull out the femur, tibia, and fibula! After accounting for all of the bones, it was evident that we had the remains of a young adult (early twenties) white male. Since there were no broken bones, cut marks, or bullet holes to suggest cause of death, I began a careful search of the clothing. The clothing was soiled but in good condition, and the belt was still buckled. The shirt revealed no cuts or tears. When I picked up the pants, I immediately noticed a blue-green stain on the inside of the right front pocket, suggestive of copper staining. As I placed my hand in the pocket I found a quarter and two pennies. I asked if the pockets had been checked and I was assured that the clothing had been checked by both the medical examiner and someone from the police department. The copper staining had come from the two pennies in the right front pocket.

However, I proceeded to check the left rear pocket, the pocket in which most men carry their billfold. As I picked up the pants, we were immediately aware of a bulge in the left rear pocket. I reached in and pulled out a billfold. I opened the billfold and read a name off of the Kentucky driver's license and asked the chief of police if he was looking for C. T. The chief reached in his pocket, pulled out a list of missing persons, and the most recent name on the list was that of C. T. It was an embarrassing moment when the two policemen realized that they had driven 480 km (300 miles) because someone had not performed his job in initially examining the remains.

An interesting point about this case is that the man was last seen alive on 20 June. He had changed from a living human to a complete skeleton in 15 days. The area where the body was found is often hot and humid in late June and early July, and the conditions were good for rapid decay. I was, however, astonished that decay had been so rapid and commented on this fact to Dr. T. D. Stewart who has identified many skeletons for the Smithsonian Institution. He was not as surprised and told me of a case from Jackson, MS that he had worked on the year before in which a teenage girl had been killed and placed in the city dump and had completely decayed in twelve days. The climatic conditions of Jackson, MS are similar to the area where this body was located.

Incomplete Skeletons

In cases in which the skeletal remains submitted were incomplete, the skull or skull bones were the most common elements recovered followed by femora, mandibles, and innominates, in that order. The sternum was the single major postcranial bone least likely to be recovered (Table 3).

The fact that the skull bones, femora, mandibles, and innominates are the most frequently retrieved bones suggests that these bones may be either the largest, most durable, or the most recognizable ones. Increased knowledge of human osteology by the general public might result in recovery of more human skeletal remains.

Age, Sex, and Race

Over half of the positively identified females, whose age at death was recorded, were under the age of 30 (Table 4). Most of the positively identified men fell into the 30- to 44-year-old

TABLE 3—*Skeletal elements present in 58 fragmented skeletons from Bass's forensic science cases from 1971 through 1981.*

Bone	Number	Percent
Skull or skull bones	38	66
Femora	28	48
Mandibles	24	41
Innominates	23	40
Tibias	22	38
Ulnae	19	33
Humeri	17	29
Fibulas	16	28
Scapulae	16	28
Clavicles	13	22
Radius	13	22
Sacrum	10	17
Patellae	8	13
Sternum	7	12

TABLE 4—*Age at death, race, and sex of positively identified individuals from Bass's forensic science cases from 1971 through 1981.*

Age Range	No. ^a	Women		Men	
		Black	White	Black	White
0-14	0	0	0	0	0
15-29	10	2	4	0	4
30-44	11	1	1	0	9
45-59	5	0	1	0	4
60-74	4	0	1	0	3
Total	30	3	7	0	20

^aDoes not include two individuals for whom the exact age at death is not known.

age range. Note that there were no cases of children under the age of 15. Although the sample is small, a large majority of the positively identified remains were of white males (Table 4). Forty-five percent of the white men studied died between the ages of 30 and 44. This figure does not embrace the median age of white men in Tennessee which is 27.8 years [3].

Blacks accounted for 10% and whites 90% of the positively identified individuals (Table 4). As of 1970, blacks made up 15% and whites 84% of Tennessee's population [3]. Of the 111 cases studied, 13 or 12% are believed to be remains of native Americans from prehistoric archaeological sites.

Although women make up 51% of the population in Tennessee [3], they were only represented in 33% of the cases which were positively identified (Table 4).

Location of Cases

Most of the cases involving human skeletal remains were found outside in woods, fields, orchards, and parks. An equally large number were found in and along rivers and lakes (Table 5). Hunters, fishermen, hikers, cavers, and other sports enthusiasts located most of the cases involving human skeletal remains. Other sources leading to the discovery of human bones included fires, construction projects, tip-offs to the police, and bones carried in by dogs.

TABLE 5—Month of discovery of skeletal remains in Tennessee from Bass's forensic science cases from 1971 through 1981.

Location or Type of Discovery	Cases Involving Human Skeletal Remains	No. ^a	Month													
			Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.		
Fire related	12	17	3	2	1	1	1	1	0	2	0	1	1	2	3	0
In and along rivers and lakes	14	15	5	1	0	2	2	2	2	1	1	1	1	0	0	0
Woods, fields, and caves	14	14	0	1	2	0	1	1	1	1	0	1	1	2	3	2
Construction sites, dumps, and buildings	9	11	3	1	0	0	1	1	2	2	1	1	0	1	0	1
Police tips	4	5	0	2	1	0	1	1	0	0	0	1	0	0	0	0
Near streets and highways	5	5	0	0	1	0	0	0	0	2	0	0	1	0	0	1
Brought in by dogs	2	4	1	0	0	1	0	0	1	0	0	1	0	0	0	0
Grave disturbances	1	3	0	0	0	0	0	0	0	0	1	0	1	0	0	1
Miscellaneous	10	10	3	0	1	1	1	0	1	0	0	0	2	0	0	2
Total		84	15	7	6	5	6	6	9	5	5	6	7	5	6	7

^aDoes not include 27 cases for which the location, type, or month of discovery is unclear.

The fact that most of the cases were discovered by hunters, fishermen, and other nature enthusiasts suggests that a program to better acquaint these individuals with human skeletal remains might be worthwhile. Articles could be submitted to sports periodicals and lectures might be presented to groups such as the Sierra Club.

The material has been recovered in 52 of Tennessee's 95 counties from the largest county of Shelby to the smallest one, in regards to population, of Moore. Not surprisingly, more cases were concentrated in the larger counties. Shelby, the state's largest, had five cases, Davidson, the next largest, had seven cases, Knox, where the forensic science laboratory is located and the third largest county, had eight, the most any county had. Blount, a county that borders Knox county, had six cases.

Although most cases were found outside in the woods and fields and near water, some cases have come from unusual locations. Twice, cases were discovered in dumpsites, at least five times near streets or highways, once during a drug raid, twice on the steps of a courthouse, and once hanging from a tree near a well-traveled river! A case that will illustrate that people can die very close to main streets is one I call "The Skeleton That Will Continue to Appear."

In the summer of 1976, the owner of a vacant lot that bordered a major thoroughfare in Knoxville, TN, began to clean the lot of bushes and debris with a bulldozer. After a few scrapes across the lot, the bulldozer operator noticed a broken skull and some scattered bones on the ground where the blade had deposited them. The operator collected what bones he could find or what appeared to him to be bones and placed them in a pile next to the area being cleared. The bushes and debris were loaded with a front end loader into a dump truck and hauled to a dump in another part of town.

Some hours later the landowner arrived to check on the clearing procedure and found the pile of human bones left by the operator. She took them home and reported the find to the police. The police took custody of the skeletal material and contacted the senior author for aid in identification. The material submitted for identification consisted of a skull with the face missing, a mandible, a pair of eyeglasses with very thick lenses, a right ulna with an old, unset, or poorly set healed fracture, and a few miscellaneous, broken, postcranial bones. No dirt was found in the external auditory meatus or in other foramen in the skull to suggest that the skeleton had been buried. The other bones contained attached debris suggesting that the skeleton had lain on the ground surface and had never been entirely covered by dirt. We determined that the skeletal material was from a white male of advanced age. We had taken the glasses to an ophthalmologist who had given us considerable information about the person for whom the glasses were made. The detective who accompanied us to the scene of the original discovery supplied us with the name of a suspect. In checking the list of missing persons, the detective had discovered that a 74-year-old white male, who lived in a foster home only a block away, had been reported missing about 26 months before the discovery of the skeleton. This suspect (O. K.) had been an outpatient at the regional psychiatric hospital and during the later years of his life had been placed in a foster home.

Because of the way in which the material had been found, I thought that it might be profitable to visit the scene and with the help of other trained osteologists look for additional bones not recovered by the bulldozer operator. Two days after the bones were brought in, an appointment with the police was set to meet the detective at the location of the original discovery. We made a thorough search of the area previously cleared by the bulldozer as well as the surrounding undisturbed area. We discovered a number of additional bones as well as a broken but complete upper denture. The name of the suspect had been manufactured into the acrylic of the upper plate.

Immediately upon our return to the laboratory, we contacted the medical records department of the psychiatric hospital explaining the situation surrounding the skeleton thought to be that of O. K. The medical records confirmed that O. K. had a healed fracture of the lower right arm which had been improperly set originally resulting in a shortened right arm

and had had both upper dentures and glasses made while a patient at the hospital. They also confirmed that it was standard hospital procedure to have the dentist put the name of the patient in dental plates to retard theft of such appliances. In addition, O. K. suffered from arthritis which was plainly evident on the joint surfaces of the postcranial bones. The medical records confirmed and supported our initial analysis of the bones submitted for identification. Only one item remained to be checked out and that was to have the optometrist who made the glasses identify these as belonging to O. K. The optometrist's name was obtained from medical records and an appointment for her to view the glasses was set. When the optometrist investigated the glasses, she was convinced that these were not those she had made for O. K. The frames, as well as the corrective values of the lenses, were different. Further investigation revealed that O. K. had been referred to the optometrist with the complaint that people were stealing his glasses and he could not see with the pair he had. Although we were disturbed by the fact that the glasses recovered in association with the skeletal remains were not those made for O. K., a further check with the psychiatric hospital revealed that they have a major problem with patients stealing items from each other. Since all of the other information, even to the healed fracture of the lower right arm, fit with that of O. K., we believe that when someone "borrowed" O. K.'s glasses he in turn was forced to "borrow" someone else's even though neither "borrower" could see nearly as well through another's prescription.

O. K. was known to visit the local ice cream store everyday, and it was on a trip to this store that he disappeared. Although it was impossible to determine exactly where O. K.'s skeleton had lain before being disturbed by the bulldozer, we were relatively certain that it came from a 9- to 18-m (10- to 20-yd) area in the vacant lot. Apparently O. K. had wandered off the sidewalk and had died some 36 to 55 m (40 to 60 yd) from the main street in what had been heavy underbrush. It is surprising that no one smelled the decaying flesh and investigated. The body laid on the surface within 55 m (60 yd) of the main street and within 90 m (100 yd) of at least three houses.

Only about 20% of the bones of O. K. were recovered from the initial and subsequent investigations of the location where O. K. died. Repeated attempts to contact the bulldozer operator and locate the dump where the remaining 80% of O. K.'s skeleton was taken have been fruitless. As children and adults look through this second fill, isolated bones of O. K. may find their way to the local police departments for many years, thus the title of this case.

Seasonal Patterns

There are seasonal patterns for particular types of forensic science discoveries. From September through February there are almost twice as many fire-related discoveries as there are during the rest of the year. During the same time over half of the finds made in wooded areas, fields, caves, and orchards occur. Discoveries made in and around lakes and rivers are four times as frequent in the months between January and June as those made between July and December. Skeletal material discovered as a result of construction projects or tip-offs to the police are spread fairly evenly throughout the year. January has been the single busiest month for the discovery of skeletal material in Tennessee (Table 5).

Tennessee's recreational areas are visited most frequently from May to October [4,5]. Except for September, these months do not produce more cases than the other six months of the year. One explanation might be that the heavy ground cover during the summer months prevents the remains being found. Another explanation might be that the hunting season, generally running from September through February, inspires individuals to go off the beaten path to where many of the skeletons are found. The holiday season in December may also lend itself to sportsmen going off the beaten path and might be, in part, responsible for large numbers of skeletons brought in during January.

Fire-Related Cases

While the number of fire-related cases has doubled along with the total caseload over the decade, the number of human remains found in these investigations has tripled from three from 1971 to 1976 to nine from 1977 to 1981 (Table 1).

With the recent nationwide rise in arson it will be interesting to observe if the increasing trend in fire-related human identification cases continues and to what degree (Table 1).

In some instances, we have been contacted by law enforcement officers to assist in the location of bodies. We have found skeletons and in some cases have determined that the body was not present. A case to illustrate some of these points is one I call the "Lady Who Wasn't There."

Imagine this scene at 3:30 a.m., 31 Jan. 1976. The stillness of the rural night is broken by the sight and sounds of a house fire; a neighbor from a trailer some 183 m (200 yd) from the two story log and frame structure arrives to find the house entirely in flame. Frantically, he makes an attempt to rescue the small dog tied to the porch. The attempt is futile as the dog, in panic runs back into the flames. Nothing can be removed from the house. There is no water to fight the fire, and the house and all of its contents fall inside of the fieldstone foundation to rest on the original surface of the ground. The following day the twisted sheets of metal roofing are removed and the rescue squad and investigator from the Fire Marshall's Office attempt to locate the body of the 76-year-old white female who lived in the house. Repeated poking into the ashes does not reveal a burned body. Investigations continue and three months later, the local Tennessee Bureau of Investigation's agent brings to my laboratory a few bones that are supposed to have been excavated from inside the house by the neighbor and thought to be those of the missing woman. An immediate visual examination revealed that they were not human, but were the bones of a domestic pig (*Sus scrofa*). The agent asks if it is possible for a body to be completely consumed in such a fire, and the answer is definitely *no*.

Since I am familiar with fragmentary, burned, and cremated bones, I offered to visit the site and conduct additional investigations. One April afternoon a few days later, Mr. Pat Willey, the osteology laboratory supervisor, the TBI agent, and I visited the burned house. Two hours of careful excavation in the area where the woman slept were fruitless. Since it is well known that individuals behave differently in fires (sometimes because of confusion they go away from the exits), we suggest that we return to the house with a crew of students trained in osteology and that the entire house be carefully excavated to determine if the body was in some other part of the 6.1- by 12.2-m (20- by 40-ft) structure. The house did not have a basement, and from 51 to 203 mm (2 to 8 in.) of ashes and debris lay within the flat fieldstone foundation and on the original ground surface. Approximately a week later, we returned with twelve advanced undergraduate or graduate students all of whom had had a course in human osteology. Beginning at each end of the 12.2-m (40-ft) house, we excavated the entire structure by trowel and paint brush. Although we knew nothing about the house, we were able to locate almost every piece of furniture and could place it in its approximate original position. The nonperishable contents of chest of drawers (needles, pins, buttons, glass bottles, and so forth) were located and many were identifiable. The extensively burned skeleton of the dog under the porch next to the outside wall of the house was found as well as the chain to which he had been attached. The coins in the woman's purse, some warped from the heat, were found in the area of the bed. Storage areas for dishes, pots, and pans in the kitchen and jars and other items in the pantry were easily recognizable. If called upon, we could have easily reconstructed the layout and contents of the house.

The extensive excavation did not, however, reveal the burned skeleton of the owner. Our conclusion was that the 76-year-old woman was not in the house at the time it burned. I doubt that the pig bones which are supposed to have come from within the foundation of the house actually came from there because the pig bones show no evidence of burning. The hole

from which they are supposed to have come is too shallow to have contained these bones without their having been extensively burned during the fire.

Conclusion

The increase in Bass's caseload over the decade might be a direct result of his effort to educate the Tennessee public to the skills of a forensic anthropologist. Since 1971, he has consistently taught large introductory and smaller graduate level anthropology courses at the University of Tennessee, traveled across the state presenting osteology and forensic anthropology lectures to law enforcement and citizen's groups, and has attracted considerable media attention with the unusual nature of his work.

It appears that the increase in the number of cases cannot be tied to an increase in the number of murders and nonnegligent manslaughters in Tennessee. Crime statistics [4] through 1978 show that there were a total of 2050 murders known to law enforcement officials between 1971 and 1974 compared with 1784 between 1975 and 1978 or a decrease from 12.58 to 10.48% per a population of 100 000 during the same time.

The number of positive identifications indicate that when human skeletal remains are found, a qualified forensic anthropologist can be of service. Of the cases involving only historic human skeletal material, 46% of the remains were positively identified and a "probable" identification was made in another 13% of the cases.

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Address requests for reprints or additional information to
Professor William M. Bass
Head of Department of Anthropology
University of Tennessee
Knoxville, TN 37996