



## Physical Anthropology Section - 2014

### H73 Stature Estimation in the CIL: Is There Significant Noise in the Trotter and Gleser Data?

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The goal of this presentation is to educate the attendees on special issues concerning the most important stature estimation formula in forensic anthropology.

This presentation will impact the forensic science community by improving awareness of problems that will affect stature estimation with the popular Trotter and Gleser models.

Stature estimation is one of the basic components of the biological profile of skeletal remains. The stature estimate is used as part of a general description of the physical characteristics of the deceased or, when the antemortem stature of a missing person is available, it can be formally compared by means of a statistical test. Either approach contributes to the goal of identification of the deceased.

Stature estimation has arguably seen the most aggressive utilization in the various Central Identification Laboratories (CIL) operated by the United States military since the Second World War. It was in the immediate post-war era that the Army began to utilize professional anthropologists for the purposes of identifying skeletonized remains of U.S. service personnel who died in combat but whose bodies were not recovered until months or even years later. Since actual measured statures had been recorded at induction for every missing soldier, the anthropologist who developed the identification procedures made systematic use of stature when comparing skeletal characteristics to the profiles of the missing. It was in this context in 1948 that Mildred Trotter recognized the need for new models based on reference data from the very population to which the models were to be applied. This data was to come largely from the CIL cases being identified in Hawaii, but augmented with data from the Terry Collection. Trotter collected data from the CIL cases, took measurements from the Terry Collection, and partnered with Goldine Gleser to calculate the regression models that are well-known to forensic anthropologists around the world.

The standard operating procedures in use in the Hawaii CIL in 1947-48 directed that measurements and observations were made by soldiers who were supervised by an anthropologist. The laboratory operation was large and there was only a single anthropologist employed. One consequence of this situation was that Trotter did not measure the military cases included in her reference data. She was responsible for ensuring that the soldiers knew how to take the measurements and she signed off on each skeletal analysis form that was completed.

Approximately ten years ago, anthropologists at the Joint POW/MIA Accounting Command (JPAC) CIL began to systematically examine old records from its precursor laboratory in the 1940s and from the Kokura Central Identification Unit (CIU) that operated in Japan during the Korean War. The opportunity to measure anew skeletal remains measured in the 1940s presented itself for several cases that had been disinterred for further testing. It became apparent that "standard" measurements of the femur and tibia were not being taken in a consistent manner. There appeared to be some differences among the anthropologists who signed the skeletal forms. Further, examination of the Standard Operating Procedures manuals from Hawaii (1948) and Kokura (ca. 1950-55) revealed that the intent was to take the physiological lengths of the femur and tibia for use with Rollet's (1888) stature tables (or formulae based on them) as opposed to the total lengths indicated for use in the Trotter and Gleser 1952 paper. The forms used in the 1940s simply labeled the measurements as "Femora" for the length of the femur and "Tibiae" for the length of the tibia.

Bivariate plots of data taken from forms signed by Charles Snow, Alexander Tardy, and Mildred Trotter were examined to determine which measurements were actually being recorded on the forms. Specifically, the raw data for the femur and tibia, respectively, were plotted against the fibula length since the length of the fibula had been measured in a single manner throughout the 20<sup>th</sup> century. This raw data was compared to a regression model line (with fibula as dependent variable) based on reference data measured in recent years in the CIL or from the Forensic Databank from the University of Tennessee, Knoxville. The data in the plots revealed that the femur and tibia measurements are too short relative to the fibula to have been consistently taken as total lengths (e.g. the residuals are biased). The spread of the raw data also *suggests* that the femur and tibia were measured inconsistently, as in sometimes total length and sometimes the physiological length. After the data had been plotted, the historian Heather Harris shared a letter from Goldine Gleser to Mildred Trotter dated April 7, 1957, in which Gleser suggests to Trotter that the femur had not been consistently measured as total length in the various laboratories that had contributed to their reference data. She alluded to a larger problem with the tibia. Of course, Gleser the statistician was noting a problematic pattern in the data.



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What difference does noisy data make? This study calculated new regression models for the femur and tibia based on modern CIL data combined with the Forensic<sup>®</sup> Data Bank. Statures were estimated for three resolved CIL cases with the new models and compared with the stature estimates using the Trotter data in FORDISC<sup>®</sup> 3.0. Differences in the point estimate on the order of 0.5 inches can be expected when using the femur and on the order of 1.0 inch when using the tibia. These differences can have forensic significance. Consequently, it is proposed that the old CIL data be scrubbed and re-formed with modern CIL data so that only reliable measurement data are included. New models will be developed from the clean reference data.

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### **Stature, Measurements, Trotter**