A New Look at Morton's Craniological Research[1]

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Samuel George Morton, M.D. (1799–1851), was one of the giants of the American scientific community of his time. In addition to being a practicing physician and a professor of anatomy, Morton was active in geology and ethnology. Because of his expertise in paleontology, he was regularly called on to examine and describe newly uncovered fossils. He was also lauded for his innovative approach to ethnological research, especially his use of illustrations and measurements (Gillispie 1974:540).[2] To provide specimens for his anatomy lectures, he collected skulls representing numerous populations (Stanton 1960:27–28). As the collection grew, Morton began to use it as the focus of his ethnological research. By 1849 the Morton Collection of Human Skulls contained over 800 human crania from throughout the world (Morton 1849*a*:vi).

With Blumenbach, Morton believed that there were five major races, each characterized in part by the shape of the head (Stanton 1960:4–11, 29). He considered cranial capacity an especially good indicator of race (Stanton 1960:31). To determine cranial capacity he filled crania with sifted mustard seed and then emptied the seed into a homemade volumetric cylinder (Stanton 1960:29–32). In 1839, he used 256 of these values to calculate a mean cranial capacity for each of the five races. The table listing these means, reproduced here as table 1, was published along with many of Morton's raw data in his *Crania Americana* (1839:260). The thesis of this work was that native Americans were one race distinct from Eskimos and Mongolians. *Crania Americana* implied, though it did not state, that each race had an independent origin,[3] and since Morton argued that the races were as immutable as species the reader was left to conclude that the racial differences in cranial capacity detailed in this table were as old as humanity.

As Morton continued his ethnological research and enlarged his collection, he improved the accuracy of his measuring technique by substituting lead shot for mustard seed and in 1849 used 623 of these "shot values" to construct an even more elaborate table of cranial capacities. This 1849 table, reproduced here as table 2, and all of the data used in its construction were published in Morton's (1849*a*) *Catalogue of Skulls* (pp. vii–viii). In this work, Morton proposed that the five established races would be more aptly described as "groups" and divided these "groups" into "families" in turn divided into "races." Late in his career, he began to apply the results of his research to enhancing the scientific understanding of species. From his 1849 table he concluded that each race was characterized by "a collective identity of physical traits" and said that he favored the independent origin of races (p. ix). By 1851 he was openly declaring that human races were in fact species; physical form was for him the ultimate criterion for determining species, and his ethnological research showed that each race had a distinct form (Stanton 1960:140–41). Morton's definition of species contradicted the widely accepted notion of specific infertility. Mixed-race humans, unlike hybrid animals, are indeed fertile, and many scholars used this to support the specific unity of

 This paper is based on research reported in "An Analysis of Samuel G. Morton's *Catalogue of the Skulls of Man and the Inferior Animals, Third Edition*, Based on a Remeasurement of a Random Sample of the Morton Collection of Human Crania," which was presented to the Macalester College Honors Program in the Department of Geology on May 1, 1986. I am grateful to Janet Monge, Gerald Webers, Joe V. Michael, and Tom and Bonnie Michael for support and encouragement.

2. Gillispie refers to Morton as "a founder of invertebrate paleontology in the United States" and describes his first ethnological publication as "a landmark in anthropology."

3. Stanton feels that Morton, a man of social standing, may have shied away from a direct discussion of racial origins in order to avoid any potential for scientific or religious controversy (pp. 32–33).

TABLE 1
Mean Cranial Capacities (in.^{3}) of Races according to Morton (1839)

Race	Sample Size	Mean	Largest	Smallest
Caucasian	52	87	109	75
Mongolian	10	83	93	69
Malay	18	81	89	64
American	147	82	100	60
Ethiopian	29	78	94	65

SOURCE: Morton (1839:260).

humankind. According to Morton, however, specific infertility was a myth and hybrids were actually as common among species of animals as they were among "species" of humans (Stanton 1960:140–41).

Gould (1978, 1981) has criticized Morton's ethnological resesarch, especially his 1839 and 1849 tables, for conforming to the conventional American racist tenet that the "Caucasian" race is superior in intelligence to "Negroes." Morton, he claims, "regarded cranial capacity as an overall indicator of intelligence" (1978:503). He shows that Morton's samples contain unequal numbers of male and female crania, an important factor because cranial capacity is generally less in women than in men. He also notes that Morton's samples are not uniform in size and should not have been compared and that this sample-size inequality is compounded in the 1849 table when Morton averages the means of "races" and presents the resulting values as the means of "families" or "groups." In addition, Gould finds the 1839 and 1849 tables inconsistent with their respective data because of miscalculations and omissions. Finally, he argues that Morton's 1839 "seed data" are inconsistent with his 1849 "shot data" (pp. 505–9). He goes on to suggest that these errors indicate that Morton unconsciously doctored his results in terms of his a priori conviction of Caucasian racial superiority. He traces this bias to Morton's cultural upbringing and claims that the errors serve to skew his results to conform to this bias. He even speculates that Morton may have systematically mismeasured crania recorded in his 1839 "seed data" in accordance with this bias. In the final analysis, Gould views this as a prime example of how a priori convictions can influence the outcome of ostensibly objective research (pp. 504–9).

To assess Gould's claims, I remeasured the cranial capacities of 201 specimens from the Morton Collection[4] and compared the values with Morton's. I also used the 1849 data to recalculate mean cranial capacities for populations similar to those presented in Morton's 1849 table. The goals of this work were to determine (1) whether Morton accurately measured cranial capacity using shot, (2) whether Morton's 1849 table is incompatible with his 1849 data, (3) whether there is evidence that Morton unconsciously doctored his 1849 table in terms of a racial bias, and (4) whether Morton's 1849 table is scientifically sound.

To avoid confusion, all of Morton's measurements of cranial capacity are called "measurements" and my measurements of identical crania "remeasurements." Likewise, Morton's data were "calculated" in 1849 and "recalculated" for this study. His terms for the populations in his 1849 table are enclosed in quotations (e.g.,

4. The Morton Collection of Human Crania is currently stored in the University Museum, the University of Pennsylvania, and was remeasured during January of 1986.

TABLE 2
Mean Cranial Capacities (in.^{3}) of Races according to Morton (1849a,b)

Race and Family	Sample Size	Largest	Smallest	Mean	
Modern Caucasian Group					
Teutonic Family					
Germans	18	114	70	90	92
English	5	105	91	96	
Anglo-Americans	7	97	82	90	
Pelasgic Family					
Persians, Armenians, Circassians	10	94	75	84	
Celtic Family					
Native Irish	6	97	78	87	
Indostanic Family					
Bengalees, &c.	32	91	67	80	
Semitic Family					
Arabs	3	98	84	89	
Nilotic Family					
Egyptians	17	96	66	80	
Ancient Caucasian Group					
Pelasgic Family					
Graeco-Egyptians	18	97	74	88	
Nilotic Family					
Egyptians	55	96	68	80	
Mongolian Group					
Chinese Family	6	91	70	82	
Malay Group					
Malayan Family	20	97	68	86	85
Polynesian Family	3	84	82	83	
American Group					
Toltecan Family					
Peruvians	155	101	58	75	79
Mexicans	22	92	67	79	
Barbarous Tribes					
Iroquois, Lenape, Cherokee, Shoshone, &c.	161	104	70	84	
Negro Group					
Native African Family	62	99	65	83	83
American-Born Negroes	12	89	73	82	
Hottentot Family	3	83	68	75	
Alforan Family					
Australians	8	83	63	75	

SOURCE: Morton (1849*a*:viii; 1849*b*:222).

TABLE 3
Mean Cranial Capacities (in.^{3}) from Morton's 1849 Measurements and 1986 Remeasurements

Group and Subgroup ("Race" or "Family")	Sample Size	Measurement Mean	Remeasurement Mean
American	91	78	76
Mexican	10	92	88
Peruvian	54	90	88
Various tribes ("Barbarous Tribes")	27	82	81
Caucasian	52[a]	84	84
Ancient Pelasgic ("Graeco-Egyptians")	3	95	91
Anglo-American	7	83	80
Celtic	1	78	73
Egyptian	4	86	84
English	3	98	96
Fellah	6	73	73
German	10	89	88
Indostanic	11	78	77
Pelasgic ("Persians, Armenians, Circassians")	3	88	84
Semitic	3	84	82
Malayan	11	85	83
Malayan	8	86	84
Polynesian	3	84	82
Mongolian	4	87	83
Mongolian ("Chinese")	4	87	83
Negro	40	82	79
African Negro ("Native African Family")	28	84	81
American Negro ("American-Born Negroes")	7	80	78
Australian	4	73	71
Hottentot	1	75	74
Mixed	3	80	77

[a]Includes one Caucasian group cranium of unknown subgroup.

"group," "Egyptian race"); my alternatives are not. All of the crania listed in Morton's 1849 catalog were assigned to rigorously defined groups and subgroups based, respectively, on Morton's "groups" and on his "families" and "races" (all loosely defined). Some of the crania measured by Morton do not fit clearly into any of the "races" in his 1849 table but were assigned to subgroups according to Meigs's (1857) catalog of the Morton Collection.[5]

Of the crania measured by Morton, 201 were randomly selected for remeasurement.[6] Cranial capacity was remeasured by a technique adapted from Olivier (1969) that uses molded acrylic balls in place of shot.[7] Remeasured capacities were then entered into a computer file along with the capacities recorded in Morton's 1849 catalog. Mean cranial capacities were determined for groups and subgroups and compared with those presented for "groups," "families," and "races." Each cranium was remeasured three times, the largest variation being only 1.8% by volume.[8] Individual cranial capacities thus determined were consistent with Morton's[9] but on the average 32.48 cm^3 (roughly 2 in.^{3}) lower. Means calculated for groups and subgroups from remeasured values were also consistent with but lower than means calculated from Morton's data (table 3). Because the 1849 table does not represent all the measured crania Morton listed, it is impossible to determine exactly which crania he used in his calculations. Nonetheless, mean cranial capacity was recalculated for groups and subgroups using all the crania listed, and 75% of the "family" or "race" means reported by Morton in 1849 were found to be within

5. This catalog, unlike Morton's, lists the crania according to "race." My group-subgroup classification was created solely for the analysis of the Morton Collection and has no biological or sociological significance. Although based on Morton's and Meigs's systems of classification, it is presented not as a correction of these systems but as a rigorously defined alternative.

6. I originally remeasured 12 randomly selected crania from each of three populations: (1) Black Africans and Americans, (2) Native Americans, and (3) Teutonic Europeans and Americans. I then chose to enlarge this study to include all populations listed as "races" in Morton's 1849 table and remeasured 165 crania from all "races" at random. The sample of 201 crania therefore contains a slightly larger subsample of the above three populations relative to most subsamples remeasured.

7. Molded acrylic "no-hole" balls are available from Greene Plastics Corp., Hope Valley, R.I.

8. Twenty-nine crania had a coefficient of variation over 0.99%, while five were under 0.10%.

9. Over 95% of Morton's measurements were within 4 in.^{3} of the measurements; fewer than 7% were smaller.

TABLE 4
Mean Cranial Capacities (in.^{3}) from Morton's 1849 Table and 1986 Recalculation

Group and Subgroup ("Race" or "Family")	Morton's 1849 Table		Recalculation	
	Sample Size	Mean	Sample Size	Mean
American	338	79	335	80
Mexican	22	79	27	82
Peruvian	155	75	152	75
Various tribes ("Barbarous Tribes")	161	84	157	84
Caucasian	171	—[a]	185	83
Ancient Pelasgic ("Graeco-Egyptians")	18	88	17	87
Anglo-American	7	90	10	85
Celtic	6	87	6	88
Egyptian	55	80	55	81
English	5	96	5	96
Fellah	17	80	18	79
German	18	90	20	87
Indostanic	32	80	33	80
Pelasgic ("Persians, Armenians, Circassians")	10	84	10	84
Semitic	3	89	8	85
Malayan	23	85	27	85
Malayan	20	86	23	85
Polynesian	3	83	4	83
Mongolian	6	82	8	85
Mongolian ("Chinese")	6	82	8	85
Negro	85	—[a]	93	82
African Negro ("Native African Family")	62	83	67	84
American Negro ("American-born Negroes")	12	82	10	81
Australian	8	75	10	75
Hottentot	3	75	3	75

[a]Not calculated by Morton.

2 in.^{3} of the subgroup means recalculated from the same data (table 4).

Many of the means presented in Morton's 1849 table are inconsistent with his data, probably because of miscalculations and omissions. As table 4 shows, for example, the Celtic and Egyptian means are rounded off incorrectly.[10] Again, he lists 670 crania measured for cranial capacity and his table (p. vii) shows only 623 measurements. While he intended to omit "idiots," "mixed races," and children from his table (p. ix), this does not account for all the omissions. According to his criteria, no Fellah, Indostanic, Malayan, or Polynesian subgroup crania should have been omitted from the table, and yet some are omitted from each of these samples. Table 4 appears to indicate further procedural errors, but these may be an artifact of the group-subgroup system. For example, Morton lists the capacities of five crania described as "Semitic" (Meigs 1857:34–35), two "Baramka, or Baramacide Arabs," and one "Bedouin," but of these eight crania he tabulates only three. Because it was impossible to determine which three, I included them all in the Semitic subgroup (Meigs 1857:50).[11]

There is no indication that Morton's miscalculations or omissions had any substantial effect on his overall results. When all of Morton's 1849 data are used to determine mean cranial capacities for subgroups, the resulting means are quite similar to those presented in his 1849 table.[12] The only error of Morton's 1849 table that may indicate bias is his unfair comparison of samples. His samples are unequal in size and sexual distribution, and Gould (1978:505–6) has convincingly argued that Morton had some knowledge that sample size could affect means. It is possible that Morton unconsciously adjusted his results by limiting the size of some samples, but because his other errors do not indicate bias it appears equally possible that the inequality of sample sizes was a result of his ignorance of statistics.

Unlike Morton's calculations, his specific cranial

10. Although subgroups do not always match Morton's "races" in sample size, the Celtic and Egyptian subgroups do. It is quite probable that the data used to recalculate these two means are identical to those used by Morton.

11. Likewise, the Mongolian subgroup contained a "Laplander" that may not have been used by Morton in the "Mongolian family" mean.

12. And this is so even though Morton incorrectly determined the means for "groups" and "families" by averaging the means of their constituent "races."

measurements contain few errors. To be sure, they are consistently larger than my remeasurements, but current anthropometric convention accepts that measurements of cranial capacity will vary with the technique (Olivier 1969:134). Gould's speculation that Morton systematically mismeasured crania using seed is based on his statistical analysis of Morton's 1839 and 1849 data and the assumption that Morton held "Caucasians" superior to "Americans" and these in turn superior to "Negroes."[13] He admits that his own results may have been due to the increase in sample size after 1839, but he presents other evidence suggesting that Morton adjusted his values to position "Negroes" below "Americans." Gould finds that Morton's 1839 data for "American" crania produce a mean capacity of 80 in.^{3} while the 1839 table gives an "American" mean of 82 in.,^{3} above the "Ethiopian" mean of 78 in.^{3} Because he finds no evidence that Morton knew of this error, Gould concludes that it was unconscious (pp. 505–6). I have, however, uncovered evidence suggesting that Morton was aware of it. The library of the Academy of Natural Sciences of Philadelphia holds a copy of *Crania Americana* that contains a dedication handwritten by Morton. In this copy there is also a zero penned in over the "2" of the "82 cubic inches" recorded as the "American" mean in question.[14] Gould considers this error a result of Morton's desire to adjust the "American" mean above the "Ethiopian" but below the "Caucasian." If there had been a similar error reducing the "American" mean, however, it could also have been interpreted to indicate bias toward "Caucasians." This hypothetical bias is subtly different from that spelled out by Gould but just as reasonable. If conflicting evidence can support two almost identical interpretations, it cannot be said *clearly* to indicate anything. Gould's statistical analysis would support his suspicion of systematic mismeasurement only if Morton had the bias he attributes to him. Since I have found no indication of that bias, and given the accuracy of Morton's shot data, it seems unlikely that Morton systematically mismeasured crania in 1839.

Gould makes no mention of any errors that do not appear to favor Morton's assumed racial bias. I have found such an error: the 1849 table and my recalculations give the "Malay group" and Malayan group mean as 85 in.^{3} even though the recalculated sample is larger than Morton's; simply averaging the recalculated means for the Malayan and Polynesian subgroups produces a value 1 in.^{3} lower than Morton's. This error cannot be attributed to Morton's bias, and it is all the more noteworthy because Gould misses it in determining a "Malay" mean of 85 in.^{3} using Morton's data (p. 508). This is, furthermore, not Gould's only error. He presents a recalculation of the 1849 table entitled "Corrected values for Morton's final tabulation" (p. 508) showing means of 86 in.^{3} for "Native American peoples," 85 in.^{3} for "Mongolian peoples," "Modern Caucasian peoples," and "Malay peoples," 84 in.^{3} for "Ancient Caucasian peoples," and 83 in.^{3} for "African peoples." In fact, this table is not a correction; it is based on data and terminology not used by Morton. Gould uses data from 1839 that Morton does not use in final tabulation, and his "peoples" do not contain all the samples in Morton's "groups." His "African peoples," for example, do not include Morton's "Australians" or "Hottentots." He justifies dropping the "Australians" from his "African peoples" by citing modern anthropological evidence showing no relationship between native Australians and black Africans (p. 508). Yet he does not combine "Modern Caucasian peoples" and "Ancient Caucasian peoples" as modern anthropologists usually do.[15] He omits the "Hottentot" subsample from his "African peoples" because Hottentots "are very small in stature, and all three crania are female."[16] Elsewhere, however, he includes a subsample of five "English" crania, all male, in his "Modern Caucasian peoples" mean (p. 508). Also, Crania 1191, "German of Frankfort," and 1248, "Laplander," are omitted from the "Corrected" table (p. 508).

Contrary to Gould's interpretation, I conclude that Morton's research was conducted with integrity. Morton was one of the first scholars to attempt the study of human diversity through objective measurements, and it is not surprising that he made mistakes. Although he cannot be excused for his errors or his unfair comparison of means, he should be given credit for having taken the risk of experimenting with a new and innovative technique. He was attempting to understand racial variation and not, as Gould claims, trying to prove Caucasian racial or intellectual superiority. The science historian William Stanton concludes that "Morton himself never equated cranial capacity with intelligence" (Stanton 1960:35).[17]

Although Gould is mistaken in many of his assumptions about Morton and his work, he is correct in asserting that these tables are scientifically unsound. He fails, however, to mention the overriding reason for rejecting them, namely, Morton's acceptance of the existence of race. Most anthropologists feel that there is too little evidence to conclude with certainty whether the concept of race is a biological reality or simply an artifact of classification (Weiss and Maruyama 1976:47). If race dose not really exist, then Morton's samples are meaningless, and this criticism overshadows Gould's

13. "I have reanalyzed Morton's data and I find that they are a patchwork of assumption and finagling, controlled, probably, by his conventional a priori ranking (his folks on top, slaves on the bottom)" (Gould 1978:504).

14. The dedication reads, "Presented to the Academy of Natural Sciences of Philadelphia by the Author. December 24, 1839." The ink used for the correction matches the ink used for the dedication, and the handwriting of the dedication matches that found in the library's collection of Morton's personal letters.

15. I have yet to find any anthropological work other than Morton's or Meigs's that separates Caucasians into ancient and modern populations.

16. Gould did this even after he criticized Morton for having dropped "Hindu" crania from the "Caucasian" sample because they were notably smaller than the rest of the sample.

17. I have chosen to follow Stanton's interpretation because it is directly supported by historical references.

criticisms of the size and sexual distributions in Morton's samples. Gould nowhere questions the scientific authenticity of racial classification and in fact, by presenting a "Corrected" table, lends support to the notion of racial classification as a biological reality.

Morton's tables contain miscalculations and omissions of data, but his 1849 data are reasonably accurate and there is no clear evidence that he doctored these tables for any reason. His tables are nevertheless scientifically unsound because his so-called samples were never adequately defined. His failure to define "race" makes his work statistically meaningless. I do not argue that ostensibly objective research may not sometimes be affected by the unconscious desires of the researcher; I simply suggest that the work of Morton is not a clear example of this phenomenon. His work is flawed, and the scientific community within which it took place was racially biased, but a connection between Morton's errors and this conventional racism is simply not supported by the evidence at hand.

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