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THREE

Measuring Heads

Paul Broca and the Heyday of Craniology

No rational man, cognisant of the facts, believes that the average negro is the equal, still less the superior, of the average white man. And, if this be true, it is simply incredible that, when all his disabilities are removed, and our prognathous relative has a fair field and no favor, as well as no oppressor, he will be able to compete successfully with his bigger-brained and smaller-jawed rival, in a contest which is to be carried on by thoughts and not by bites. —T. H. HUXLEY

The allure of numbers

Introduction

Evolutionary theory swept away the creationist rug that had supported the intense debate between monogenists and polygenists, but it satisfied both sides by presenting an even better rationale for their shared racism. The monogenists continued to construct linear hierarchies of races according to mental and moral worth; the polygenists now admitted a common ancestry in the prehistoric mists, but affirmed that races had been separate long enough to evolve major inherited differences in talent and intelligence. As historian of anthropology George Stocking writes (1973, p. lxx): “The resulting intellectual tensions were resolved after 1859 by a comprehensive evolutionism which was at once monogenist and racist, which affirmed human unity even as it relegated the dark-skinned savage to a status very near the ape.”

The second half of the nineteenth century was not only the era of evolution in anthropology. Another trend, equally irresistible,

swept through the human sciences—the allure of numbers, the faith that rigorous measurement could guarantee irrefutable precision, and might mark the transition between subjective speculation and a true science as worthy as Newtonian physics. Evolution and quantification formed an unholy alliance; in a sense, their union forged the first powerful theory of “scientific” racism—if we define “science” as many do who misunderstand it most profoundly: as any claim apparently backed by copious numbers. Anthropologists had presented numbers before Darwin, but the crudity of Morton’s analysis (Chapter 2) belies any claim to rigor. By the end of Darwin’s century, standardized procedures and a developing body of statistical knowledge had generated a deluge of more trustworthy numerical data.

This chapter is the story of numbers once regarded as surpassing all others in importance—the data of craniometry, or measurement of the skull and its contents. The leaders of craniometry were not conscious political ideologues. They regarded themselves as servants of their numbers, apostles of objectivity. And they confirmed all the common prejudices of comfortable white males—that blacks, women, and poor people occupy their subordinate roles by the harsh dictates of nature.

Science is rooted in creative interpretation. Numbers suggest, constrain, and refute; they do not, by themselves, specify the content of scientific theories. Theories are built upon the interpretation of numbers, and interpreters are often trapped by their own rhetoric. They believe in their own objectivity, and fail to discern the prejudice that leads them to one interpretation among many consistent with their numbers. Paul Broca is now distant enough. We can stand back and show that he used numbers not to generate new theories but to illustrate a priori conclusions. Shall we believe that science is different today simply because we share the cultural context of most practicing scientists and mistake its influence for objective truth? Broca was an exemplary scientist; no one has ever surpassed him in meticulous care and accuracy of measurement. By what right, other than our own biases, can we identify his prejudice and hold that science now operates independently of culture and class?

Francis Galton—apostle of quantification

No man expressed his era’s fascination with numbers so well as Darwin’s celebrated cousin, Francis Galton (1822–1911). Independently wealthy, Galton had the rare freedom to devote his considerable energy and intelligence to his favorite subject of measurement. Galton, a pioneer of modern statistics, believed that, with sufficient labor and ingenuity, anything might be measured, and that measurement is the primary criterion of a scientific study. He even proposed and began to carry out a statistical inquiry into the efficacy of prayer! Galton coined the term “eugenics” in 1883 and advocated the regulation of marriage and family size according to hereditary endowment of parents.

Galton backed his faith in measurement with all the ingenuity of his idiosyncratic methods. He sought, for example, to construct a “beauty map” of the British Isles in the following manner (1909, pp. 315–316):

Whenever I have occasion to classify the persons I meet into three classes, “good, medium, bad,” I use a needle mounted as a pricker, wherewith to prick holes, unseen, in a piece of paper, torn rudely into a cross with a long leg. I use its upper end for “good,” the cross arm for “medium,” the lower end for “bad.” The prick holes keep distinct, and are easily read off at leisure. The object, place, and date are written on the paper. I used this plan for my beauty data, classifying the girls I passed in streets or elsewhere as attractive, indifferent, or repellent. Of course this was a purely individual estimate, but it was consistent, judging from the conformity of different attempts in the same population. I found London to rank highest for beauty; Aberdeen lowest.

With good humor, he suggested the following method for quantifying boredom (1909, p. 278):

Many mental processes admit of being roughly measured. For instance, the degree to which people are bored, by counting the number of their fidgets. I not infrequently tried this method at the meetings of the Royal Geographical Society, for even there dull memoirs are occasionally read. . . . The use of a watch attracts attention, so I reckon time by the number of my breathings, of which there are 15 in a minute. They are not counted mentally, but are punctuated by pressing with 15 fingers successively. The counting is reserved for the fidgets. These observations should be confined to persons of middle age. Children are rarely still, while elderly philosophers will sometimes remain rigid for minutes altogether.

Quantification was Galton's god, and a strong belief in the inheritance of nearly everything he could measure stood at the right hand. Galton believed that even the most socially embedded behaviors had strong innate components: "As many members of our House of Lords marry the daughters of millionaires," he wrote (1909, pp. 314-315), "it is quite conceivable that our Senate may in time become characterized by a more than common share of shrewd business capacity, possibly also by a lower standard of commercial probity than at present." Constantly seeking new and ingenious ways to measure the relative worth of peoples, he proposed to rate blacks and whites by studying the history of encounters between black chiefs and white travelers (1884, pp. 338-339):

The latter, no doubt, bring with them the knowledge current in civilized lands, but that is an advantage of less importance than we are apt to suppose. A native chief has as good an education in the art of ruling men, as can be desired; he is continually exercised in personal government, and usually maintains his place by the ascendancy of his character shown every day over his subjects and rivals. A traveller in wild countries also fills, to a certain degree, the position of a commander, and has to confront native chiefs at every inhabited place. The result is familiar enough—the white traveller almost invariably holds his own in their presence. It is seldom that we hear of a white traveller meeting with a black chief whom he feels to be the better man.

Galton's major work on the inheritance of intelligence (*Hereditary Genius*, 1869) included anthropometry among its criteria, but his interest in measuring skulls and bodies peaked later when he established a laboratory at the International Exposition of 1884. There, for threepence, people moved through his assembly line of tests and measures, and received his assessment at the end. After the Exposition, he maintained the lab for six years at a London museum. The laboratory became famous and attracted many notables, including Gladstone:

Mr. Gladstone was amusingly insistent about the size of his head, saying that hatters often told him that he had an Aberdeenshire head—"a fact which you may be sure I do not forget to tell my Scotch constituents." It was a beautifully shaped head, though rather low, but after all it was not so very large in circumference (1909, pp. 249-250).

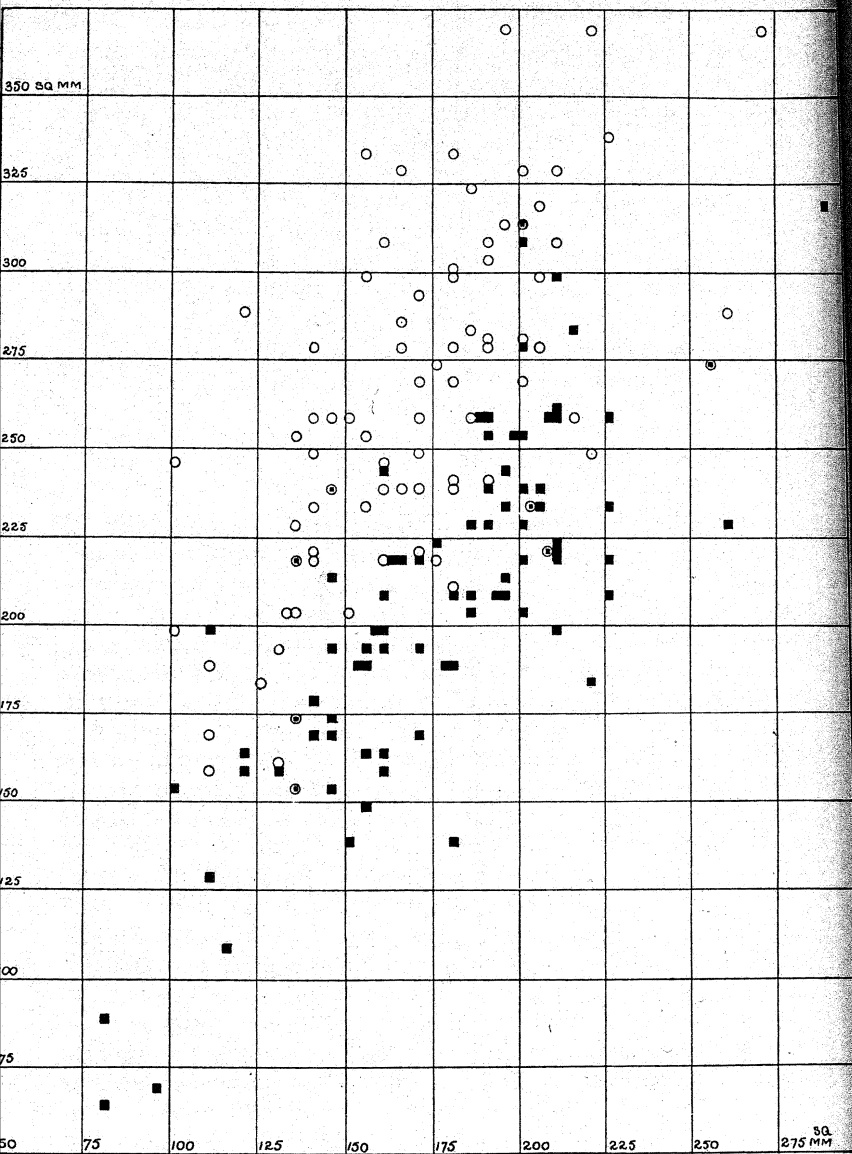
Lest this be mistaken for the harmless musings of some dotty Victorian eccentric, I point out that Sir Francis was taken quite

seriously as a leading intellect of his time. The American hereditarian Lewis Terman, the man most responsible for instituting IQ tests in America, retrospectively calculated Galton's IQ at above 200, but accorded only 135 to Darwin and a mere 100-110 to Copernicus (see pp. 183-188 on this ludicrous incident in the history of mental testing). Darwin, who approached hereditarian arguments with strong suspicion, wrote after reading *Hereditary Genius*: "You have made a convert of an opponent in one sense, for I have always maintained that, excepting fools, men did not differ much in intellect, only in zeal and hard work" (in Galton, 1909, p. 290). Galton responded: "The rejoinder that might be made to his remark about hard work, is that character, including the aptitude for work, is heritable like every other faculty."

A curtain-raiser with a moral: Numbers do not guarantee truth

In 1906, a Virginia physician, Robert Bennett Bean, published a long, technical article comparing the brains of American blacks and whites. With a kind of neurological green thumb, he found meaningful differences wherever he looked—meaningful, that is, in his favored sense of expressing black inferiority in hard numbers.

Bean took special pride in his data on the corpus callosum, a structure within the brain that contains fibers connecting the right and left hemispheres. Following a cardinal tenet of craniometry, that higher mental functions reside in the front of the brain and sensorimotor capacities toward the rear, Bean reasoned that he might rank races by the relative sizes of parts within the corpus callosum. So he measured the length of the genu, the front part of the corpus callosum, and compared it with the length of the splenium, the back part. He plotted genu vs. splenium (Fig. 3.1) and obtained, for a respectably large sample, virtually complete separation between black and white brains. Whites have a relatively large genu, hence more brain up front in the seat of intelligence. All the more remarkable, Bean exclaimed (1906, p. 390) because the genu contains fibers both for olfaction and for intelligence! Bean continued: We all know that blacks have a keener sense of smell than whites; hence we might have expected larger genu in blacks if intelligence did not differ substantially between races. Yet black genu are smaller despite their olfactory predominance; hence, blacks must really suffer from a paucity of intelligence.



3•1 Bean's plot of the genu on the y-axis vs. the splenium on the x-axis. White circles are, unsurprisingly, for white brains; black squares for black brains. Whites seem to have a larger genu, hence more up front, and presumably more intelligence.

Moreover, Bean did not neglect to push the corresponding conclusion for sexes. Within each race, women have relatively smaller genus than men.

Bean then continued his discourse on the relatively greater size of frontal vs. parietal and occipital (side and back) parts of the brain in whites. In the relative size of their frontal areas, he proclaimed, blacks are intermediate between "man [*sic*] and the orang-outang" (1906, p. 380).

Throughout this long monograph, one common measure is conspicuous by its absence: Bean says nothing about the size of the brain itself, the favored criterion of classical craniometry. The reason for this neglect lies buried in an addendum: black and white brains did not differ in overall size. Bean temporized: "So many factors enter into brain weight that it is questionable whether discussion of the subject is profitable here." Still, he found a way out. His brains came from unclaimed bodies given to medical schools. We all know that blacks have less respect for their dead than whites. Only the lowest classes of whites—prostitutes and the deprived—would be found among abandoned bodies, "while among Negroes it is known that even the better classes neglect their dead." Thus, even an absence of measured difference might indicate white superiority, for the data "do perhaps show that the low class Caucasian has a larger brain than a better class Negro" (1906, p. 409).

Bean's general conclusion, expressed in a summary paragraph before the troublesome addendum, proclaimed a common prejudice as the conclusion of science:

The Negro is primarily affectionate, immensely emotional, then sensual and under stimulation passionate. There is love of ostentation, and capacity for melodious articulation; there is undeveloped artistic power and taste—Negroes make good artisans, handicraftsmen—and there is instability of character incident to lack of self-control, especially in connection with the sexual relation; and there is lack of orientation, or recognition of position and condition of self and environment, evidenced by a peculiar bumptiousness, so called, that is particularly noticeable. One would naturally expect some such character for the Negro, because the whole posterior part of the brain is large, and the whole anterior portion is small.

Bean did not confine his opinions to technical journals. He published two articles in popular magazines during 1906, and attracted

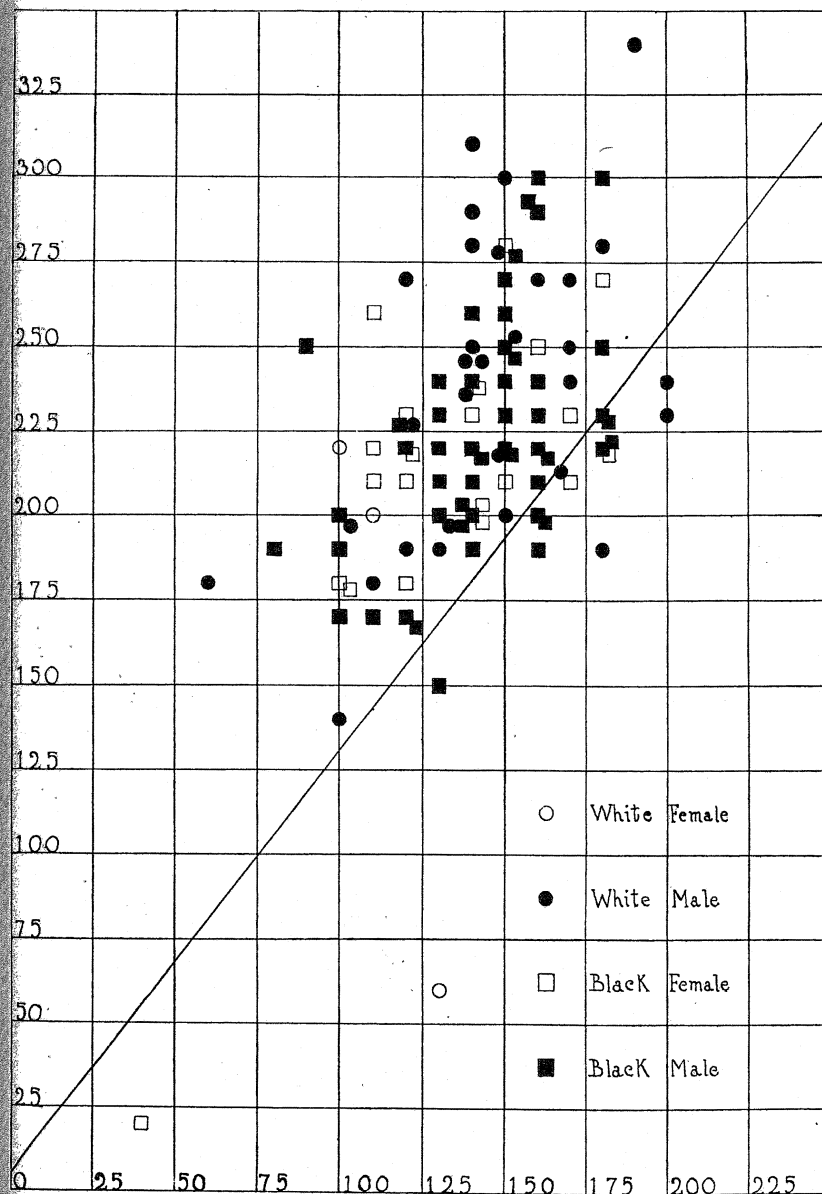
sufficient attention to become the subject of an editorial in *American Medicine* for April 1907 (cited in Chase, 1977, p. 179). Bean had provided, the editorial proclaimed, "the anatomical basis for the complete failure of the negro schools to impart the higher studies—the brain cannot comprehend them any more than a horse can understand the rule of three. . . . Leaders in all political parties now acknowledge the error of human equality. . . . It may be practicable to rectify the error and remove a menace to our prosperity—a large electorate without brains."

But Franklin P. Mall, Bean's mentor at Johns Hopkins, became suspicious: Bean's data were too good. He repeated Bean's work, but with an important difference in procedure—he made sure that he did not know which brains were from blacks and which from whites until *after* he had measured them (Mall, 1909). For a sample of 106 brains, using Bean's method of measurement, he found no difference between whites and blacks in the relative sizes of genu and splenium (Fig. 3.2). This sample included 18 brains from Bean's original sample, 10 from whites, 8 from blacks. Bean's measure of the genu was larger than Mall's for 7 whites, but for only a single black. Bean's measure of the splenium was larger than Mall's for 7 of the 8 blacks.

I use this small tale of zealotry as a curtain-raiser because it illustrates so well the major contentions of this chapter and book:

1. Scientific racists and sexists often confine their label of inferiority to a single disadvantaged group; but race, sex, and class go together, and each acts as a surrogate for the others. Individual studies may be limited in scope, but the general philosophy of biological determinism pervades—hierarchies of advantage and disadvantage follow the dictates of nature; stratification reflects biology. Bean studied races, but he extended his most important conclusion to women, and also invoked differences of social class to argue that equality of size between black and white brains really reflects the inferiority of blacks.

2. Prior prejudice, not copious numerical documentation, dictates conclusions. We can scarcely doubt that Bean's statement about black bumptiousness reflected a prior belief that he set out to objectify, not an induction from data about fronts and backs of brains. And the special pleading that yielded black inferiority from equality of brain size is ludicrous outside a shared context of a priori belief in the inferiority of blacks.



3•2 Mall's plot of genu vs. splenium. Mall measured the brains without knowing whether they came from whites or blacks. He found no difference between the races. The line represents Bean's separation between whites and blacks.

3. Numbers and graphs do not gain authority from increasing precision of measurement, sample size, or complexity in manipulation. Basic experimental designs may be flawed and not subject to correction by extended repetition. Prior commitment to one among many potential conclusions often guarantees a serious flaw in design.

4. Craniometry was not just a plaything of academicians, a subject confined to technical journals. Conclusions flooded the popular press. Once entrenched, they often embarked on a life of their own, endlessly copied from secondary source to secondary source, refractory to disproof because no one examined the fragility of primary documentation. In this case, Mall nipped a dogma in the bud, but not before a leading journal had recommended that blacks be barred from voting as a consequence of their innate stupidity.

But I also note an important difference between Bean and the great European craniometricians. Bean committed either conscious fraud or extraordinary self-delusion. He was a poor scientist following an absurd experimental design. The great craniometricians, on the other hand, were fine scientists by the criteria of their time. Their numbers, unlike Bean's, were generally sound. Their prejudices played a more subtle role in specifying interpretations and in suggesting what numbers might be gathered in the first place. Their work was more refractory to exposure, but equally invalid for the same reason: prejudices led through data in a circle back to the same prejudices—an unbeatable system that gained authority because it seemed to arise from meticulous measurement.

Bean's story has been told several times (Myrdal, 1944; Haller, 1971; Chase, 1977), if not with all its details. But Bean was a marginal figure on a temporary and provincial stage. I have found no modern analysis of the main drama, the data of Paul Broca and his school.

Masters of craniometry: Paul Broca and his school

The great circle route

In 1861 a fierce debate extended over several meetings of a young association still experiencing its birth pangs. Paul Broca

(1824–1880), professor of clinical surgery in the faculty of medicine, had founded the Anthropological Society of Paris in 1859. At a meeting of the society two years later, Louis Pierre Gratiolet read a paper that challenged Broca's most precious belief: Gratiolet dared to argue that the size of a brain bore no relationship to its degree of intelligence.

Broca rose in his own defense, arguing that "the study of the brains of human races would lose most of its interest and utility" if variation in size counted for nothing (1861, p. 141). Why had anthropologists spent so much time measuring skulls, unless their results could delineate human groups and assess their relative worth?

Among the questions heretofore discussed within the Anthropological Society, none is equal in interest and importance to the question before us now. . . . The great importance of craniology has struck anthropologists with such force that many among us have neglected the other parts of our science in order to devote ourselves almost exclusively to the study of skulls. . . . In such data, we hoped to find some information relevant to the intellectual value of the various human races (1861, p. 139).

Broca then unleashed his data and poor Gratiolet was routed. His final contribution to the debate must rank among the most oblique, yet abject concession speeches ever offered by a scientist. He did not abjure his errors; he argued instead that no one had appreciated the subtlety of his position. (Gratiolet, by the way, was a royalist, not an egalitarian. He merely sought other measures to affirm the inferiority of blacks and women—earlier closure of the skull sutures, for example.)

Broca concluded triumphantly:

In general, the brain is larger in mature adults than in the elderly, in men than in women, in eminent men than in men of mediocre talent, in superior races than in inferior races (1861, p. 304). . . . Other things equal, there is a remarkable relationship between the development of intelligence and the volume of the brain (p. 188).

Five years later, in an encyclopedia article on anthropology, Broca expressed himself more forcefully:

A prognathous [forward-jutting] face, more or less black color of the skin, woolly hair and intellectual and social inferiority are often associated,

while more or less white skin, straight hair and an orthognathous [straight] face are the ordinary equipment of the highest groups in the human series (1866, p. 280). . . . A group with black skin, woolly hair and a prognathous face has never been able to raise itself spontaneously to civilization (pp. 295-296).

These are harsh words, and Broca himself regretted that nature had fashioned such a system (1866, p. 296). But what could he do? Facts are facts. "There is no faith, however respectable, no interest, however legitimate, which must not accommodate itself to the progress of human knowledge and bend before truth" (in Count, 1950, p. 72). Paul Topinard, Broca's leading disciple and successor, took as his motto (1882, p. 748): "*J'ai horreur des systèmes et surtout des systèmes a priori*" (I abhor systems, especially a priori systems).

Broca singled out the few egalitarian scientists of his century for particularly harsh treatment because they had debased their calling by allowing an ethical hope or political dream to cloud their judgment and distort objective truth. "The intervention of political and social considerations has not been less injurious to anthropology than the religious element" (1855, in Count, 1950, p. 73). The great German anatomist Friedrich Tiedemann, for example, had argued that blacks and whites did not differ in cranial capacity. Broca nailed Tiedemann for the same error I uncovered in Morton's work (see pp. 50-69). When Morton used a subjective and imprecise method of reckoning, he calculated systematically lower capacities for blacks than when he measured the same skulls with a precise technique. Tiedemann, using an even more imprecise method, calculated a black average 45 cc above the mean value recorded by other scientists. Yet his measures for white skulls were no larger than those reported by colleagues. (For all his delight in exposing Tiedemann, Broca apparently never checked Morton's figures, though Morton was his hero and model. Broca once published a one-hundred-page paper analyzing Morton's techniques in the most minute detail—Broca, 1873b.)

Why had Tiedemann gone astray? "Unhappily," Broca wrote (1873b, p. 12), "he was dominated by a preconceived idea. He set out to prove that the cranial capacity of all human races is the same." But "it is an axiom of all observational sciences that facts must precede theories" (1868, p. 4). Broca believed, sincerely I

assume, that facts were his only constraint and that his success in affirming traditional rankings arose from the precision of his measures and his care in establishing repeatable procedures.

Indeed, one cannot read Broca without gaining enormous respect for his care in generating data. I believe his numbers and doubt that any better have ever been obtained. Broca made an exhaustive study of all previous methods used to determine cranial capacity. He decided that lead shot, as advocated by "le célèbre Morton" (1861, p. 183), gave the best results, but he spent months refining the technique, taking into account such factors as the form and height of the cylinder used to receive the shot after it is poured from the skull, the speed of pouring shot into the skull, and the mode of shaking and tapping the skull to pack the shot and to determine whether or not more will fit in (Broca, 1873b). Broca finally developed an objective method for measuring cranial capacity. In most of his work, however, he preferred to weigh the brain directly after autopsies performed by his own hands.

I spent a month reading all of Broca's major work, concentrating on his statistical procedures. I found a definite pattern in his methods. He traversed the gap between fact and conclusion by what may be the usual route—predominantly in reverse. Conclusions came first and Broca's conclusions were the shared assumptions of most successful white males during his time—themselves on top by the good fortune of nature, and women, blacks, and poor people below. His facts were reliable (unlike Morton's), but they were gathered selectively and then manipulated unconsciously in the service of prior conclusions. By this route, the conclusions achieved not only the blessing of science, but the prestige of numbers. Broca and his school used facts as illustrations, not as constraining documents: They began with conclusions, peered through their facts, and came back in a circle to the same conclusions. Their example repays a closer study, for unlike Morton (who manipulated data, however unconsciously), they reflected their prejudices by another, and probably more common, route: advocacy masquerading as objectivity.

Women's brains

Of all his comparisons between groups, Broca collected most information on the brains of women vs. men—presumably because it was more accessible, not because he held any special animus toward women. “Inferior” groups are interchangeable in the general theory of biological determinism. They are continually juxtaposed, and one is made to serve as a surrogate for all—for the general proposition holds that society follows nature, and that social rank reflects innate worth. Thus, E. Huschke, a German anthropologist, wrote in 1854: “The Negro brain possesses a spinal cord of the type found in children and women and, beyond this, approaches the type of brain found in higher apes” (in Mall, 1909, pp. 1–2). The celebrated German anatomist Carl Vogt wrote in 1864:

By its rounded apex and less developed posterior lobe the Negro brain resembles that of our children, and by the protuberance of the parietal lobe, that of our females. . . . The grown-up Negro partakes, as regards his intellectual faculties, of the nature of the child, the female, and the senile white. . . . Some tribes have founded states, possessing a peculiar organization; but, as to the rest, we may boldly assert that the whole race has, neither in the past nor in the present, performed anything tending to the progress of humanity or worthy of preservation (1864, pp. 183–192).

G. Hervé, a colleague of Broca, wrote in 1881: “Men of the black races have a brain scarcely heavier than that of white women” (1881, p. 692). I do not regard as empty rhetoric a claim that the battles of one group are for all of us.

Broca centered his argument about the biological status of modern women upon two sets of data: the larger brains of men in modern societies and a supposed widening through time of the disparity in size between male and female brains. He based his most extensive study upon autopsies he performed in four Parisian hospitals. For 292 male brains, he calculated a mean weight of 1,325 grams; 140 female brains averaged 1,144 grams for a difference of 181 grams, or 14 percent of the male weight. Broca understood, of course, that part of this difference must be attributed to the larger

size of males. He had used such a correction to rescue Frenchmen from a claim of German superiority (p. 89). In that case, he knew how to make the correction in exquisite detail. But now he made no attempt to measure the effect of size alone, and actually stated that he didn't need to do so. Size, after all, cannot account for the entire difference because we know that women are not as intelligent as men.

We might ask if the small size of the female brain depends exclusively upon the small size of her body. Tiedemann has proposed this explanation. But we must not forget that women are, on the average, a little less intelligent than men, a difference which we should not exaggerate but which is, nonetheless, real. We are therefore permitted to suppose that the relatively small size of the female brain depends in part upon her physical inferiority and in part upon her intellectual inferiority (1861, p. 153).

To record the supposed widening of the gap through time, Broca measured the cranial capacities of prehistoric skulls from L'Homme Mort cave. Here he found a difference of only 99.5 cc between males and females, while modern populations range from 129.5 to 220.7 cc. Topinard, Broca's chief disciple, explained the increasing discrepancy through time as a result of differing evolutionary pressures upon dominant men and passive women:

The man who fights for two or more in the struggle for existence, who has all the responsibility and the cares of tomorrow, who is constantly active in combatting the environment and human rivals, needs more brain than the woman whom he must protect and nourish, than the sedentary woman, lacking any interior occupations, whose role is to raise children, love, and be passive (1888, p. 22).

In 1879 Gustave Le Bon, chief misogynist of Broca's school, used these data to publish what must be the most vicious attack upon women in modern scientific literature (it will take some doing to beat Aristotle). Le Bon was no marginal hate-monger. He was a founder of social psychology and wrote a study of crowd behavior still cited and respected today (*La psychologie des foules*, 1895). His writings also had a strong influence upon Mussolini. Le Bon concluded:

In the most intelligent races, as among the Parisians, there are a large number of women whose brains are closer in size to those of gorillas than to the most developed male brains. This inferiority is so obvious that no one can contest it for a moment; only its degree is worth discussion. All

psychologists who have studied the intelligence of women, as well as poets and novelists, recognize today that they represent the most inferior forms of human evolution and that they are closer to children and savages than to an adult, civilized man. They excel in fickleness, inconstancy, absence of thought and logic, and incapacity to reason. Without doubt there exist some distinguished women, very superior to the average man, but they are as exceptional as the birth of any monstrosity, as, for example, of a gorilla with two heads; consequently, we may neglect them entirely (1879, pp. 60-61).

Nor did Le Bon shrink from the social implications of his views. He was horrified by the proposal of some American reformers to grant women higher education on the same basis as men:

A desire to give them the same education, and, as a consequence, to propose the same goals for them, is a dangerous chimera. . . . The day when, misunderstanding the inferior occupations which nature has given her, women leave the home and take part in our battles; on this day a social revolution will begin, and everything that maintains the sacred ties of the family will disappear (1879, p. 62).

Sound familiar?*

I have reexamined Broca's data, the basis for all this derivative pronouncement, and I find the numbers sound but Broca's interpretation, to say the least, ill founded. The claim for increasing difference through time is easily dismissed. Broca based this contention on the sample from L'Homme Mort alone. It consists of seven male, and six female, skulls. Never has so much been coaxed from so little!

In 1888 Topinard published Broca's more extensive data on Parisian hospitals. Since Broca recorded height and age as well as brain size, we may use modern statistical procedures to remove their effect. Brain weight decreases with age, and Broca's women were, on average, considerably older than his men at death. Brain weight increases with height, and his average man was almost half a foot taller than his average woman. I used multiple regression, a technique that permits simultaneous assessment of the influence of

*Ten years later, America's leading evolutionary biologist, E. D. Cope, dreaded the result if "a spirit of revolt become general among women." "Should the nation have an attack of this kind," he wrote (1890, p. 2071), "like a disease, it would leave its traces in many after-generations." He detected the beginnings of such anarchy in pressures exerted by women "to prevent men from drinking wine and smoking tobacco in moderation," and in the carriage of misguided men who supported female suffrage: "Some of these men are effeminate and long-haired."

height and age upon brain size. In an analysis of the data for women, I found that, at average male height and age, a woman's brain would weigh 1,212 grams.* Correction for height and age reduces the 181 gram difference by more than a third to 113 grams.

It is difficult to assess this remaining difference because Broca's data contain no information about other factors known to influence brain size in a major way. Cause of death has an important effect, as degenerative disease often entails a substantial diminution of brain size. Eugene Schreider (1966), also working with Broca's data, found that men killed in accidents had brains weighing, on average, 60 grams more than men dying of infectious diseases. The best modern data that I can find (from American hospitals) records a full 100 gram difference between death by degenerative heart disease and by accident or violence. Since so many of Broca's subjects were elderly women, we may assume that lengthy degenerative disease was more common among them than among the men.

More importantly, modern students of brain size have still not agreed on a proper measure to eliminate the powerful effect of body size (Jerison, 1973; Gould, 1975). Height is partly adequate, but men and women of the same height do not share the same body build. Weight is even worse than height, because most of its variation reflects nutrition rather than intrinsic size—and fat vs. skinny exerts little influence upon the brain. Léonce Manouvrier took up this subject in the 1880s and argued that muscular mass and force should be used. He tried to measure this elusive property in various ways and found a marked difference in favor of men, even in men and women of the same height. When he corrected for what he called "sexual mass," women came out slightly ahead in brain size.

Thus, the corrected 113 gram difference is surely too large; the true figure is probably close to zero and may as well favor women as men. One hundred thirteen grams, by the way, is exactly the average difference between a five-foot four-inch and a six-foot-four-inch male in Broca's data†—and we would not want to ascribe

*I calculate, where y is brain size in grams, x_1 age in years, and x_2 body height in cm: $y = 764.5 - 2.55x_1 + 3.47x_2$

† For his largest sample of males, and using the favored power function for bivariate

greater intelligence to tall men. In short, Broca's data do not permit any confident claim that men have bigger brains than women.

Maria Montessori did not confine her activities to educational reform for young children. She lectured on anthropology for several years at the University of Rome and wrote an influential book entitled *Pedagogical Anthropology* (English edition, 1913). She was, to say the least, no egalitarian. She supported most of Broca's work and the theory of innate criminality proposed by her compatriot Cesare Lombroso (next chapter). She measured the circumference of children's heads in her schools and inferred that the best prospects had bigger brains. But she had no use for Broca's conclusions about women. She discussed Manouvrier's work at length and made much of his tentative claim that women have slightly larger brains when proper corrections are made. Women, she concluded, are intellectually superior to men, but men have prevailed heretofore by dint of physical force. Since technology has abolished force as an instrument of power, the era of women may soon be upon us: "In such an epoch there will really be superior human beings, there will really be men strong in morality and in sentiment. Perhaps in this way the reign of woman is approaching, when the enigma of her anthropological superiority will be deciphered. Woman was always the custodian of human sentiment, morality and honor" (1913, p. 259).

Montessori's argument represents one possible antidote to "scientific" claims for the constitutional inferiority of certain groups. One may affirm the validity of biological distinctions, but argue that the data have been misinterpreted by prejudiced men with a stake in the outcome, and that disadvantaged groups are truly superior. In recent years, Elaine Morgan has followed this strategy in her *Descent of Woman*, a speculative reconstruction of human prehistory from the woman's point of view—and as farcical as more famous tall tales by and for men.

I dedicate this book to a different position. Montessori and Morgan follow Broca's method to reach a more congenial conclusion. I would rather label the whole enterprise of setting a biological value upon groups for what it is: irrelevant, intellectually unsound, and highly injurious.

analysis of brain allometry, I calculate, where y is brain weight in grams and x is body height in cm: $y = 121.6x^{0.47}$