

Suggestions for Writing

- A. From your own contemporary perspective, write a letter in response to the Gustave Le Bon excerpt in paragraph 6.
- B. From your own experiences, opinions, and feelings write a position paper for or against the Le Bon quote in paragraph 7.

Evolution as Fact and Theory

¹ Kirtley Mather, who died last year at age ninety, was a pillar of both science and Christian religion in America and one of my dearest friends. The difference of a half-century in our ages evaporated before our common interests. The most curious thing we shared was a battle we each fought at the same age. For Kirtley had gone to Tennessee with Clarence Darrow to testify for evolution at the Scopes trial of 1925. When I think that we are enmeshed again in the same struggle for one of the best documented, most compelling and exciting concepts in all of science, I don't know whether to laugh or cry.

² According to idealized principles of scientific discourse, the arousal of dormant issues should reflect fresh data that give renewed life to abandoned notions. Those outside the current debate may therefore be excused for suspecting that creationists have come up with something new, or that evolutionists have generated some serious internal trouble. But nothing has changed; the creationists have presented not a single new fact or argument. Darrow and Bryan were at least more entertaining than we lesser antagonists today. The rise of creationism is politics, pure and simple; it represents one issue (and by no means the major concern) of the resurgent evangelical right. Arguments that seemed kooky just a decade ago have reentered the mainstream.

³ The basic attack of modern creationists falls apart on two general counts before we even reach the supposed factual details of their assault against evolution. First, they play upon a vernacular misunderstanding of the word "theory" to convey the false impression that we evolutionists are covering up the rotten core of our edifice. Second, they misuse a popular philosophy of science to argue that they are behaving scientifically in attacking

evolution. Yet the same philosophy demonstrates that their ^{own} belief is not science, and that "scientific creationism" is a meaningless and self-contradictory phrase, an example of what Orwell called "newspeak."

⁴ In the American vernacular, "theory" often means "imperfect fact"—part of a hierarchy of confidence running downhill from fact to theory to hypothesis to guess. Thus, creationists can (and do) argue: evolution is "only" a theory, and intense debate now rages about many aspects of the theory. If evolution is less than a fact, and scientists can't even make up their minds about the theory, then what confidence can we have in it? Indeed, President Reagan echoed this argument before an evangelical group in Dallas when he said (in what I devoutly hope was campaign rhetoric): "Well, it is a theory. It is a scientific theory only, and it has in recent years been challenged in the world of science—that is, not believed in the scientific community to be as infallible as it once was."

⁵ Well, evolution is a theory. It is also a fact. And facts and theories are different things, not rungs in a hierarchy of increasing certainty. Facts are the world's data. Theories are structures of ideas that explain and interpret facts. Facts do not go away while scientists debate rival theories for explaining them. Einstein's theory of gravitation replaced Newton's, but apples did not suspend themselves in mid-air pending the outcome. And human beings evolved from apelike ancestors whether they did so by Darwin's proposed mechanism or by some other, yet to be discovered.

⁶ Moreover, "fact" does not mean "absolute certainty." The final proofs of logic and mathematics flow deductively from stated premises and achieve certainty only because they are *not* about the empirical world. Evolutionists make no claim for perpetual truth, though creationists often do (and then attack us for a style of argument that they themselves favor). In science, "fact" can only mean "confirmed to such a degree that it would be perverse to withhold provisional assent." I suppose that apples might start to rise tomorrow, but the possibility does not merit equal time in physics classrooms.

⁷ Evolutionists have been clear about this distinction between fact and theory from the very beginning, if only because we have always acknowledged how far we are from completely understanding the mechanisms (theory) by which evolution (fact) occurred. Darwin continually emphasized the difference between his two

great and separate accomplishments: establishing the fact of evolution, and proposing a theory—natural selection—to explain the mechanism of evolution. He wrote in *The Descent of Man*: “I had two distinct objects in view; firstly, to show that species had not been separately created, and secondly, that natural selection had been the chief agent of change . . . Hence if I have erred in . . . having exaggerated its [natural selection’s] power . . . I have at least, as I hope, done good service in aiding to overthrow the dogma of separate creations.”

⁸ Thus Darwin acknowledged the provisional nature of natural selection while affirming the fact of evolution. The fruitful theoretical debate that Darwin initiated has never ceased. From the 1940s through the 1960s, Darwin’s own theory of natural selection did achieve a temporary hegemony that it never enjoyed in his lifetime. But renewed debate characterizes our decade, and, while no biologist questions the importance of natural selection, many now doubt its ubiquity. In particular, many evolutionists argue that substantial amounts of genetic change may not be subject to natural selection and may spread through populations at random. Others are challenging Darwin’s linking of natural selection with gradual, imperceptible change through all intermediary degrees; they are arguing that most evolutionary events may occur far more rapidly than Darwin envisioned.

⁹ Scientists regard debates on fundamental issues of theory as a sign of intellectual health and a source of excitement. Science is—and how else can I say it?—most fun when it plays with interesting ideas, examines their implications, and recognizes that old information may be explained in surprisingly new ways. Evolutionary theory is now enjoying this uncommon vigor. Yet amidst all this turmoil no biologist has been led to doubt the fact that evolution occurred; we are debating *how* it happened. We are all trying to explain the same thing: the tree of evolutionary descent linking all organisms by ties of genealogy. Creationists pervert and caricature this debate by conveniently neglecting the common conviction that underlies it, and by falsely suggesting that we now doubt the very phenomenon we are struggling to understand.

¹⁰ Secondly, creationists claim that “the dogma of separate creations,” as Darwin characterized it a century ago, is a scientific theory meriting equal time with evolution in high school biology curricula. But a popular viewpoint among philosophers of science

believes this creationist argument. Philosopher Karl Popper has argued for decades that the primary criterion of science is the falsifiability of its theories. We can never prove absolutely, but we can falsify. A set of ideas that cannot, in principle, be falsified is not science.

¹¹ The entire creationist program includes little more than a rhetorical attempt to falsify evolution by presenting supposed contradictions among its supporters. Their brand of creationism, they claim, is "scientific" because it follows the Popperian model in trying to demolish evolution. Yet Popper's argument must apply in both directions. One does not become a scientist by the simple act of trying to falsify a rival and truly scientific system; one has to present an alternative system that also meets Popper's criterion—it too must be falsifiable in principle.

¹² "Scientific creationism" is a self-contradictory, nonsense phrase precisely because it cannot be falsified. I can envision observations and experiments that would disprove any evolutionary theory I know, but I cannot imagine what potential data could lead creationists to abandon their beliefs. Unbeatable systems are dogma, not science. Lest I seem harsh or rhetorical, I quote creationism's leading intellectual, Duane Gish, Ph.D., from his recent (1978) book, *Evolution? The Fossils Say No!* "By creation we mean the bringing into being by a supernatural Creator of the basic kinds of plants and animals by the process of sudden, or fiat, creation. We do not know how the Creator created, what processes He used, *for He used processes which are not now operating anywhere in the natural universe* [Gish's italics]. This is why we refer to creation as special creation. We cannot discover by scientific investigations anything about the creative processes used by the Creator." Pray tell, Dr. Gish, in the light of your last sentence, what then is "scientific" creationism?

¹³ Our confidence that evolution occurred centers upon three general arguments. First, we have abundant, direct, observational evidence of evolution in action, from both field and laboratory. This evidence ranges from countless experiments on change in nearly everything about fruit flies subjected to artificial selection in the laboratory to the famous populations of British moths that became black when industrial soot darkened the trees upon which the moths rest. (Moths gain protection from sharp-sighted bird predators by blending into the background.) Creationists do not deny these observations; how could they? Creationists have

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tightened their act. They now argue that God only created "basic kinds," and allowed for limited evolutionary meandering within them. Thus toy poodles and Great Danes come from the dog to and moths can change color, but nature cannot convert a dog to a cat or a monkey to a man.

¹⁴ The second and third arguments for evolution—the case for major changes—do not involve direct observation of evolution in action. They rest upon inference, but are no less secure for that reason. Major evolutionary change requires too much time for direct observation on the scale of recorded human history. All historical sciences rest upon inference, and evolution is no different. In from geology, cosmology, or human history in this respect. In principle, we cannot observe processes that operated in the past. We must infer them from results that still surround us: living and fossil organisms for evolution, documents and artifacts for human history, strata and topography for geology.

¹⁵ The second argument—that the imperfection of nature reveals evolution—strikes many people as ironic, for they feel that evolution should be most elegantly displayed in the nearly perfect adaptation expressed by some organisms—the camber of a gull's wing, or butterflies that cannot be seen in ground litter because they mimic leaves so precisely. But perfection could be imposed by a wise creator or evolved by natural selection. Perfection covers the tracks of past history. And past history—the evidence of descent—is the mark of evolution.

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¹⁷ The third argument is more direct: transitions are often found in the fossil record. Preserved transitions are not common—and should not be, according to our understanding of evolution . . .—but they are not entirely wanting, as creationists often claim. The lower jaw of reptiles contains several bones, that of mammals only one. The non-mammalian jawbones, that reduced, step by step, in mammalian ancestors until they become tiny nubbins located at the back of the jaw. The “hammer” and “anvil” bones of the mammalian ear are descendants of these nubbins. How could such a transition be accomplished? the creationists ask. Surely a bone is either entirely in the jaw or in the ear. Yet paleontologists have discovered two transitional lineages of therapsids (the so-called mammal-like reptiles) with a double jaw joint—one composed of the old quadrate and articular bones (soon to become the hammer and anvil), the other of the squamosal and dentary bones (as in modern mammals). For that matter, what better transitional form could we expect to find than the oldest human, *Australopithecus afarensis*, with its apelike palate, its human upright stance, and a cranial capacity larger than any ape’s of the same body size but a full 1,000 cubic centimeters below ours? If God made each of the half-dozen human species discovered in ancient rocks, why did he create in an unbroken temporal sequence of progressively more modern features—increasing cranial capacity, reduced face and teeth, larger body size? Did he create to mimic evolution and test our faith thereby?

¹⁸ Faced with these facts of evolution and the philosophical bankruptcy of their own position, creationists rely upon distortion and innuendo to buttress their rhetorical claim. If I sound sharp or bitter, indeed I am—for I have become a major target of these practices.

¹⁹ I count myself among the evolutionists who argue for a jerky, or episodic, rather than a smoothly gradual, pace of change. In 1972 my colleague Niles Eldredge and I developed the theory of punctuated equilibrium. We argued that two outstanding facts of the fossil record—geologically “sudden” origin of new species and failure to change thereafter (stasis)—reflect the predictions of evolutionary theory, not the imperfections of the fossil record. In most theories, small isolated populations are the source of new species, and the process of speciation takes thousands or tens of thousands of years. This amount of time, so long when measured against our lives, is a geological microsecond. It represents much less than 1 per cent of the average life-span for a fossil

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Large, invertebrate species—more than ten million years, are widespread, and well established species, on the other hand, are not expected to change very much. We believe that the inertia of large populations explains the stasis of most fossil species over millions of years.

²⁰ We proposed the theory of punctuated equilibrium largely to provide a different explanation for pervasive trends in the fossil record. Trends, we argued, cannot be attributed to gradual differential formation within lineages, but must arise from the differential success of certain kinds of species. A trend, we argued, is more like climbing a flight of stairs (punctuations and stasis) than rolling up an inclined plane.

²¹ Since we proposed punctuated equilibria to explain trends, it is infuriating to be quoted again and again by creationists—whether through design or stupidity, I do not know—as admitting that the fossil record includes no transitional forms. Transitional forms are generally lacking at the species level, but they are abundant between larger groups. Yet a pamphlet entitled "Harvard Scientists Agree Evolution Is a Hoax" states: "The facts of punctuated equilibrium which Gould and Eldredge . . . are forcing Darwinists to swallow fit the picture that Bryan insisted on, and which God has revealed to us in the Bible."

²² Continuing the distortion, several creationists have equated the theory of punctuated equilibrium with a caricature of the beliefs of Richard Goldschmidt, a great early geneticist. Goldschmidt argued, in a famous book published in 1940, that new groups can arise all at once through major mutations. He referred to these suddenly transformed creatures as "hopeful monsters." (I am attracted to some aspects of the non-caricatured version, but Goldschmidt's theory still has nothing to do with punctuated equilibrium.) Creationist Luther Sunderland talks of the "punctuated equilibrium hopeful monster theory" and tells his hopeful readers that "it amounts to tacit admission that anti-evolutionists are correct in asserting there is no fossil evidence supporting the theory that all life is connected to a common ancestor." Duane Gish writes, "According to Goldschmidt, and now apparently according to Gould, a reptile laid an egg from which the first bird, feathers and all, was produced." Any evolutionist who believed such nonsense would rightly be laughed off the intellectual stage; yet the only theory that could ever envision such a scenario for the origin of birds is creationism—with God acting in the egg.

²³ I am both angry at and amused by the creationists; but mostly I am deeply sad. Sad for many reasons. Sad because so many people who respond to creationist appeals are troubled for the right reason, but venting their anger at the wrong target. It is true that scientists have often been dogmatic and elitist. It is true that we have often allowed the white-coated, advertising image to represent us—"Scientists say that Brand X cures bunions ten times faster than . . ." We have not fought it adequately because we derive benefits from appearing as a new priesthood. It is also true that faceless and bureaucratic state power intrudes more and more into our lives and removes choices that should belong to individuals and communities. I can understand that school curricula, imposed from above and without local input, might be seen as one more insult on all these grounds. But the culprit is not, and cannot be, evolution or any other fact of the natural world. Identify and fight your legitimate enemies by all means, but we are not among them.

²⁴ I am sad because the practical result of this brouhaha will not be expanded coverage to include creationism (that would also make me sad), but the reduction or excision of evolution from high school curricula. Evolution is one of the half dozen "great ideas" developed by science. It speaks to the profound issues of genealogy that fascinate all of us—the "roots" phenomenon writ large. Where did we come from? Where did life arise? How did it develop? How are organisms related? It forces us to think, ponder, and wonder. Shall we deprive millions of this knowledge and once again teach biology as a set of dull and unconnected facts, without the thread that weaves diverse material into a supple unity?

²⁵ But most of all I am saddened by a trend I am just beginning to discern among my colleagues. I sense that some now wish to mute the healthy debate about theory that has brought new life to evolutionary biology. It provides grist for creationist mills, they say, even if only by distortion. Perhaps we should lie low and rally around the flag of strict Darwinism, at least for the moment—a kind of old-time religion on our part.

²⁶ But we should borrow another metaphor and recognize that we too have to tread a straight and narrow path, surrounded by roads to perdition. For if we ever begin to suppress our search to understand nature, to quench our own intellectual excitement in a misguided effort to present a united front where it does not and should not exist, then we are truly lost.

QUESTIONS

Ideas

1. How can evolution be both a theory and a fact? What do these terms mean? What is the problem in defining them? What objection does Gould raise to President Reagan's statement, "It is a scientific theory only"?
2. How does Gould's assertion, "Unbeatable systems are dogma, not science," relate to creationism's leading theorist in paragraph 12?
3. What are the three major arguments that evolution is based on? According to Gould, what tactics do creationists rely on in the face of these arguments? How does he support his accusations?
4. In writing an argument, support for one's own ideas is important, as is the careful refutation of the opposition. But equally important is the writer's persona, or voice—how the writer sounds to you. Do you trust Gould's persona here? Does he sound credible? Is he too harsh on the opposition? If you were his editor, would you advise him to change his tone in any way? Why or why not?
5. Do you find Gould's personal response in the last three paragraphs effective? Were you impressed by his aggressive stance in the last paragraph? Do you think presenting a "united front" more important than an individual's search for understanding?

Organization

6. Most theories of argument suggest that the writer first spend some time refuting the opposition's position before presenting evidence. How does Gould pay attention to this?
7. If you were to divide this essay into sections, how would you describe the purpose of each? Write a brief sentence outline of the major divisions.
8. Look at how Gould organizes paragraphs 23, 24, and 25. He begins with a focus ("but mostly I am deeply sad"). Describe how he develops this idea in the next three paragraphs.

Sentences

9. Compare the sentence patterns in paragraphs 3 and 23. Do they seem different, similar? What is Gould's purpose in each paragraph?
10. Note how Gould's sentence length varies; see for example, paragraphs 5, 6, and 7. Does he vary them enough? Is there a purpose in writing long sentences or short sentences?

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⁴ In the American vernacular, "theory" often means "imperfect fact"—part of a hierarchy of confidence running downhill from fact to theory to hypothesis to guess. Thus, creationists can (and do) argue: evolution is "only" a theory, and intense debate now rages about many aspects of the theory. If evolution is less than a fact, and scientists can't even make up their minds about the theory, then what confidence can we have in it? Indeed, President Reagan echoed this argument before an evangelical group in Dallas when he said (in what I devoutly hope was campaign rhetoric): "Well, it is a theory. It is a scientific theory only, and it has in recent years been challenged in the world of science—that is, not believed in the scientific community to be as infallible as it once was."

⁵ Well, evolution is a theory. It is also a fact. And facts and theories are different things, not rungs in a hierarchy of increasing certainty. Facts are the world's data. Theories are structures of ideas that explain and interpret facts. Facts do not go away while scientists debate rival theories for explaining them. Einstein's theory of gravitation replaced Newton's, but apples did not suspend themselves in mid-air pending the outcome. And human beings evolved from apelike ancestors whether they did so by Darwin's proposed mechanism or by some other, yet to be discovered.

⁶ Moreover, "fact" does not mean "absolute certainty." The final proofs of logic and mathematics flow deductively from stated premises and achieve certainty only because they are *not* about the empirical world. Evolutionists make no claim for perpetual truth, though creationists often do (and then attack us for a style of argument that they themselves favor). In science, "fact" can only mean "confirmed to such a degree that it would be perverse to withhold provisional assent." I suppose that apples might start to rise tomorrow, but the possibility does not merit equal time in physics classrooms.

⁷ Evolutionists have been clear about this distinction between fact and theory from the very beginning, if only because we have always acknowledged how far we are from completely understanding the mechanisms (theory) by which evolution (fact) occurred. Darwin continually emphasized the difference between his two

Suggestions for Writing

- A. From your own contemporary perspective, write a letter in response to the Gustave Le Bon excerpt in paragraph 6.
- B. From your own experiences, opinions, and feelings write a position paper for or against the Le Bon quote in paragraph 7.

Evolution as Fact and Theory

¹ Kirtley Mather, who died last year at age ninety, was a pillar of both science and Christian religion in America and one of my dearest friends. The difference of a half-century in our ages evaporated before our common interests. The most curious thing we shared was a battle we each fought at the same age. For Kirtley had gone to Tennessee with Clarence Darrow to testify for evolution at the Scopes trial of 1925. When I think that we are enmeshed again in the same struggle for one of the best documented, most compelling and exciting concepts in all of science, I don't know whether to laugh or cry.

² According to idealized principles of scientific discourse, the arousal of dormant issues should reflect fresh data that give renewed life to abandoned notions. Those outside the current debate may therefore be excused for suspecting that creationists have come up with something new, or that evolutionists have generated some serious internal trouble. But nothing has changed; the creationists have presented not a single new fact or argument. Darrow and Bryan were at least more entertaining than we lesser antagonists today. The rise of creationism is politics, pure and simple; it represents one issue (and by no means the major concern) of the resurgent evangelical right. Arguments that seemed kooky just a decade ago have reentered the mainstream.

³ The basic attack of modern creationists falls apart on two general counts before we even reach the supposed factual details of their assault against evolution. First, they play upon a vernacular misunderstanding of the word "theory" to convey the false impression that we evolutionists are covering up the rotten core of our edifice. Second, they misuse a popular philosophy of science to argue that they are behaving scientifically in attacking

2. At the end of paragraph 4, Gould places another important observation in parentheses. What do you understand by this comment about basing conclusions on *a priori* (before examination) assumptions? Do you think this happens in science today?
3. When Gould writes “Sound familiar?” at the end of paragraph 7, what do you think he has in mind?
4. How do you interpret Gould’s statement in the last sentence of paragraph 13?
5. What conclusion about women’s brains does Gould finally arrive at?
6. Gould assumes he is writing for an audience that shares his values. Look, for example, at the second sentence in paragraph 2. Do you think intelligence testing is a way of making harmful comparisons among races? Find other comments like this that indicate Gould’s strong opinions.

Organization

7. Could begins and ends this essay with quotes from *Middlemarch*. What point is made in each quote?
8. In arranging his argument, Gould first describes Broca’s work on skull measurement. In paragraph 8 Gould begins a new phase of his attack on craniometry. Describe what he attempts to do in this paragraph and where his argument then goes.
9. What role does Montessori play in the structure of Gould’s argument?

Sentences

10. Read the two passages from George Eliot out loud. Do they sound different than the sentences of Gould in, say, paragraph 14? Try to describe why.
11. Gould uses parentheses and dashes throughout this piece. Locate examples of each. What purpose do they serve? Are there effective alternatives?

Words

12. What do the following words mean in their contexts: “invidious” (paragraph 2); “disparagement” (paragraph 13); “surrogates” (paragraph 13); “juxtaposition” (paragraph 13); “rhetoric” (paragraph 13); “scientific” (paragraph 15); “farcical” (paragraph 15).
13. Paraphrase Eliot’s opening quote (paragraph 1), using words a sixth-grader would easily understand.

ing, when the enigma of her anthropological superiority will be deciphered. Woman was always the custodian of human sentiment, morality and honor."

¹⁵ This 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.

¹⁶ I prefer another strategy. Montessori and Morgan followed Broca's philosophy 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 and highly injurious. George Eliot well appreciated the special tragedy that biological labeling imposed upon members of disadvantaged groups. She expressed it for people like herself—women of extraordinary talent. I would apply it more widely—not only to those whose dreams are flouted but also to those who never realize that they may dream—but I cannot match her prose. In conclusion, then, the rest of Eliot's prelude to *Middlemarch*:

The limits of variation are really much wider than anyone would imagine from the sameness of women's coiffure and the favorite love stories in prose and verse. Here and there a cygnet is reared uneasily among the ducklings in the brown pond, and never finds the living stream in fellowship with its own oary-footed kind. Here and there is born a Saint Theresa, foundress of nothing, whose loving heartbeats and sobs after an unattained goodness tremble off and are dispersed among hindrances instead of centering in some long-recognizable deed.

QUESTIONS

Ideas

1. In the parenthetical sentences in paragraph 3, Gould claims that science "is an inferential exercise, not a catalog of facts." Is this what you have been taught in your science class?

difference between a 5 foot 4 inch and a 6 foot 4 inch Broca's data. We would not (especially us short folks) ascribe greater intelligence to tall men. In short, who knows what to do with Broca's data? They certainly don't permit any confident claim that men have bigger brains than women.

¹³ To appreciate the social role of Broca and his school, we must recognize that his statements about the brains of women do not reflect an isolated prejudice toward a single disadvantaged group. They must be weighed in the context of a general theory that supported contemporary social distinctions as biologically ordained. Women, blacks, and poor people suffered the same disparagement, but women bore the brunt of Broca's argument because he had easier access to data on women's brains. Women were singularly denigrated but they also stood as surrogates for other disenfranchised groups. As one of Broca's disciples wrote in 1881: "Men of the black races have a brain scarcely heavier than that of white women." This juxtaposition extended into many other realms of anthropological argument, particularly to claims that, anatomically and emotionally, both women and blacks were like white children—and that white children, by the theory of recapitulation, represented an ancestral (primitive) adult stage of human evolution. I do not regard as empty rhetoric the claim that women's battles are for all of us.

¹⁴ 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). Montessori was no egalitarian. She supported most of Broca's work and the theory of innate criminality proposed by her compatriot Cesare Lombroso. 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, after proper correction of the data, had slightly larger brains than men. Women, she concluded, were intellectually superior, but men had 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 women is approach-

well as brain size, we may use modern statistics to remove their effect. Brain weight decreases with age, and Broca's women were, on average, considerably older than his men. 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 allowed me to assess simultaneously the influence of height and age upon brain size. In an analysis of the data for women, I found that, at average male height and age, a technician would weigh 1,212 grams. Correction for height and age reduces Broca's measured difference of 181 grams for height and age third, to 113 grams.

¹⁰ I don't know what to make of this remaining difference because I cannot assess other factors known to influence brain size in a major way. Cause of death has an important effect: degenerative disease often entails a substantial diminution of brain size. (This effect is separate from the decrease attributed to age alone.) Eugene Schreider, 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 I can find (from American hospitals) records a full 100-gram difference between death by degenerative arteriosclerosis and by violence or accident. Since so many of Broca's subjects were very elderly women, we may assume that lengthy degenerative disease was more common among them than among the men.

¹¹ More importantly, modern students of brain size still have not agreed on a proper measure for eliminating the powerful effect of body size. 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—fat versus skinny exerts little influence upon the brain. 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 women of the same height, "sexual mass," women actually came out slightly ahead in brain size, *size*, is surely too large;

¹² 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. And 113 grams, by the way, is exactly the average

most misogynist imprecations of certain church fathers. The theologians had asked if women had a soul. Several centuries later, some scientists were ready to refuse them a human intelligence.

4 Broca's argument rested upon two sets of data: the larger brains of men in modern societies, and a supposed increase in male superiority through time. His most extensive data came from autopsies performed personally in four Parisian hospitals. For 292 male brains, he calculated an average 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 could be attributed to the greater height of males. Yet he made no attempt to measure the effect of size alone and actually stated that it cannot account for the entire difference because we know, a priori, that women are not as intelligent as men (a premise that the data were supposed to test, not rest upon):

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.

5 In 1873, the year after Eliot published *Middlemarch*, Broca measured the cranial capacities of prehistoric skulls from L'Homme Mort cave. Here he found a difference of only 99.5 cubic centimeters between males and females, while modern populations range from 129.5 to 220.7. 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 combating the environment and human rivals, needs more brain than the woman whom he must protect and nourish, the sedentary woman, lacking any interior occupations, whose role is to raise children, love, and be passive.

tence as strict as the ability to count three and no more, the social lot of women might be treated with scientific certitude.

² Eliot goes on to discount the idea of innate limitation, but while she wrote in 1872, the leaders of European anthropometry were trying to measure "with scientific certitude" the inferiority of women. Anthropometry, or measurement of the human body, is not so fashionable a field these days, but it dominated the human sciences for much of the nineteenth century and remained popular until intelligence testing replaced skull measurement as a favored device for making invidious comparisons among races, classes, and sexes. Craniometry, or measurement of the skull, commanded the most attention and respect. Its unquestioned leader, Paul Broca (1824–80), professor of clinical surgery at the Faculty of Medicine in Paris, gathered a school of disciples and imitators around himself. Their work, so meticulous and apparently irrefutable, exerted great influence and won high esteem as a jewel of nineteenth-century science.

³ Broca's work seemed particularly invulnerable to refutation. Had he not measured with the most scrupulous care and accuracy? (Indeed, he had. I have the greatest respect for Broca's meticulous procedure. His numbers are sound. But science is an inferential exercise, not a catalog of facts. Numbers, by themselves, specify nothing. All depends upon what you do with them.) Broca depicted himself as an apostle of objectivity, a man who bowed before facts and cast aside superstition and sentimentality. He declared that "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." Women, like it or not, had smaller brains than men and, therefore, could not equal them in intelligence. This fact, Broca argued, may reinforce a common prejudice in male society, but it is also a scientific truth. L. Manouvrier, a black sheep in Broca's fold, rejected the inferiority of women and wrote with feeling about the burden imposed upon them by Broca's numbers:

Women displayed their talents and their diplomas. They also invoked philosophical authorities. But they were opposed by numbers unknown to Condorcet or to John Stuart Mill. These numbers fell upon poor women like a sledge hammer, and they were accompanied by commentaries and sarcasms more ferocious than the

Words

8. The title of this essay, "Flaws in a Victorian Veil," uses words with connotations beyond their dictionary definitions for most readers. List a few of the connotations the words "Victorian" or "veil" have for you. Throughout his essay, Gould uses words that refer to things being covered up, hidden, or taken out of view. See how many examples you can find of these words. What is the etymology of the word "bowdlerized"?
9. Gould often uses the word "visceral" in his writing, as in paragraph 18 of this essay. What does this word mean? Do you think it is effective in this context?
10. In paragraph 19, what does the term *sic* mean? Why is it used here? Why is it in brackets? According to Gould in paragraph 5, what are ellipses? Can you expand his definition?

Suggestions for Writing

- A. Imagine that someone has written a letter to the editor, using one of the quotations from the "noted scientist Louis Agassiz" that we have read here. (You choose the quotation.) Write a letter to the editor that refutes Agassiz's statement by pointing out the flaws in his logic and in his interpretations of the behavior and physical characteristics of African-Americans of his day.
- B. Write an encomium to someone you know well and admire. Read it. Then write an analysis of your tribute, describing your writing process. What sorts of things did you decide to omit? What factors influenced your decisions? Did audience play a part? Were you being "objective"?

Women's Brains

¹ In the prelude to *Middlemarch*, George Eliot lamented the unfulfilled lives of talented women:

Some have felt that these blundering lives are due to the inconvenient indefiniteness with which the Supreme Power has fashioned the natures of women: if there were one level of feminine incompe-

with superiority." Discuss this idea in terms of groups who choose separatism to maintain group identity, even though they are not the group in power. Should differences be ignored, aiming for a "melting pot" ideal? Is it possible for a person to be "racist" (or "sexist") if he or she is not a member of the dominant group? How might the situation Gould describes be changed so that marginalized groups could keep valued differences, yet have an equal voice politically and socially?

3. Do you think that the educational policies suggested by Agassiz (paragraph 10) have been eliminated from schools? How might "tracking" or "ability grouping" and culturally biased testing continue to separate students according to race, even when official policies deny such separation occurs? Can you think of examples of Agassiz's logic that you have heard in recent years?

Organization

4. Gould has stated that his favorite method of writing is "beginning with something small and curious and then working outward and onward by a network of lateral connections." What "small and curious" discrepancies led Gould to write this essay? How does he use the repetition of words and ideas to achieve cohesiveness among seemingly unrelated bits of information? How do the concluding paragraphs work to tie the essay together? Does the essay have a thesis statement, i.e., one sentence that summarizes one main idea? What would you say is the main idea of this essay?
5. In his characterization of Agassiz in paragraph 2, Gould includes the phrase "not overly faithful." What reasons could Gould have for including this comment? Does it relate to later content about sexuality? Is it irrelevant? What is its effect at this point in the essay?

Sentences

6. Paragraph 20 begins with a question. What effect does this usage have on your reading of Agassiz's opinions which directly follow? What function does the final sentence of the paragraph seem to play? Find other instances of Gould's use of questions or implied questions. What is their rhetorical effect?
7. Gould's essay contains a great many quotations and paraphrases of Louis Agassiz's ideas. Note several ways in which Gould structures sentences which contain or introduce quotations and/or paraphrases. Can you pinpoint any factors that may come into play when Gould chooses how to cite Agassiz's opinions?

gradually to seek more spicy partners, as I have heard the full blacks called by fast young men. One thing is certain, that there is no elevating element whatever conceivable in the connection of individuals of different races; there is neither love, nor desire for improvement of any kind. It is altogether a physical connection.

How a previous generation of gentlemen overcame their aversion to produce the first mulattoes, we are not told.

²⁰ We cannot know in detail why Elizabeth chose her deletions. I doubt that a conscious desire to convert Louis's motives from prejudice to logical implication prompted all her actions. Simple Victorian prudery probably led her to reject a public airing of any statement about sex. In any case, her deletions did distort Louis Agassiz's thought and did render his intentions according to the fallacious and self-serving model favored by scientists—that opinions arise from dispassionate surveys of raw information.

²¹ These restorations show that Louis Agassiz was jolted to consider the polygenist theory of races as separate species by his initial, visceral reaction to contact with blacks. They also demonstrate that his extreme views on racial mixing were powered more by intense sexual revulsion than by any abstract theory of hybridity.

²² Racism has often been buttressed by scientists who present a public façade of objectivity to mask their guiding prejudices. Agassiz's case may be distant, but its message rings through our century as well.

QUESTIONS

Ideas

1. Stephen Jay Gould says that Victorian biographies often "masqueraded as humbly objective accounts" (paragraph 1) and that scientists have and may continue to "present a public façade of objectivity to mask their guiding prejudices" (paragraph 23). Is it possible for a writer to be unbiased and free of political ideology, to be "a humble and disinterested scholar," as Agassiz claimed to be? Or is "objectivity" always a cover for hidden or unexamined ideas? How would you define "objective" writing? How does Gould's writing fit into this definition?
2. In paragraph 8, Gould says: "In logic, separate needn't mean unequal. . . . But . . . a group in power always conflates separation

I shudder from the consequences. We have already to struggle, in our progress, against the influence of universal equality, in consequence of the difficulty of preserving the acquisitions of individual eminence, the wealth of refinement and culture growing out of select associations. What would be our condition if to these difficulties were added the far more tenacious influences of physical disability. Improvements in our system of education . . . may sooner or later counterbalance the effects of the apathy of the uncultivated and of the rudeness of the lower classes and raise them to a higher standard. But how shall we eradicate the stigma of a lower race when its blood has once been allowed to flow freely into that of our children.

17 Third, and of greatest significance, she expunges several long passages on interbreeding that place the entire correspondence in a different setting from the one she fashioned. In them, we grasp Louis's intense, visceral revulsion toward the idea of sexual contact between races. This deep and irrational fear was as strong a driving force within him as any abstract notion about separate creation: "The production of half-breeds," he writes, "is as much a sin against nature, as incest in a civilized community is a sin against purity of character. . . . I hold it to be a perversion of every natural sentiment."

18 This natural aversion is so strong that abolitionist sentiment cannot reflect any innate sympathy for blacks but must arise because many "blacks" have substantial amounts of white blood and whites instinctively sense this part of themselves: "I have no doubt in my mind that the sense of abhorrence against slavery, which has led to the agitation now culminating in our civil war, has been chiefly if unconsciously fostered by the recognition of our own type in the offspring of southern gentlemen, moving among us as negros [*sic*], which they are not."

19 But if races naturally repel each other, how then do "southern gentlemen" take such willing advantage of their bonded women? Agassiz blames the mulatto house slaves. Their whiteness renders them attractive; their blackness, lascivious. The poor, innocent young men are enticed and entrapped.

As soon as the sexual desires are awakening in the young men of the South, they find it easy to gratify themselves by the readiness with which they are met by colored [mulatto] house servants. [This contact] blunts his better instincts in that direction and leads him

really men. Nonetheless, it is impossible for me to repress the feeling that they are not of the same blood as us. In seeing their black faces with their thick lips and grimacing teeth, the wool on their head, their bent knees, their elongated hands, their large curved nails, and especially the livid color of the palms of their hands, I could not take my eyes off their faces in order to tell them to stay far away. And when they advanced that hideous hand towards my plate in order to serve me, I wished I were able to depart in order to eat a piece of bread elsewhere, rather than to dine with such service. What unhappiness for the white race—to have tied their existence so closely with that of negroes in certain countries! God preserve us from such a contact!

¹⁴ The second set of documents comes from the midst of the Civil War. Samuel Howe, husband of Julia Ward Howe (author of *The Battle Hymn of the Republic*) and a member of President Lincoln's Inquiry Commission, wrote to ask Agassiz his opinion about the role of blacks in a reunited nation. During August 1863, Agassiz responded in four long and impassioned letters. Elizabeth Agassiz bowdlerized them to render Louis's case as a soberly stated opinion (despite its peculiar content), derived from first principles and motivated only by a love of truth.

¹⁵ Louis argued, in short, that races should be kept separate lest white superiority be diluted. This separation should occur naturally since mulattoes, as a weak strain, will eventually die out. Blacks will leave the northern climates so unsuited to them (since they were created as a separate species for Africa); they will move south in droves and will eventually prevail in a few lowland states, although whites will maintain dominion over the seashore and elevated ground. We will have to recognize these states, even admit them to the Union, as the best solution to a bad situation; after all, we do recognize "Haity and Liberia."

¹⁶ Elizabeth's substantial deletions display Louis's motivation in a very different light. They radiate raw fear and blind prejudice. She systematically eliminates three kinds of statements. First, she omits the most denigrating references to blacks: "In everything unlike other races," Louis writes, "they may but be compared to children, grown in the stature of adults, while retaining a childlike mind." Second, she removes all elitist claims about the correlation of wisdom, wealth, and social position within races. In these passages, we begin to sense Louis's real fears about miscegenation.

What would be the best education to be imparted to the different races in consequence of their primitive difference. . . . We entertain not the slightest doubt that human affairs with reference to the colored races would be far more judiciously conducted if, in our intercourse with them, we were guided by a full consciousness of the real differences existing between us and them, and a desire to foster those dispositions that are eminently marked in them, rather than by treating them on terms of equality.

¹¹ Since these "eminently marked" dispositions are submissive-ness, obsequiousness, and imitation, we can well imagine what Agassiz had in mind.

¹² Agassiz had political clout, largely because he spoke as a scientist, supposedly motivated only by the facts of his case and the abstract theory they embodied. In this context, the actual source of Agassiz's ideas on race becomes a matter of some importance. Did he really have no ax to grind, no predisposition, no impetus beyond his love for natural history? The passages expurgated from *Life and Correspondence* shed considerable light. They show a man with strong prejudices based primarily on immediate visceral reactions and deep sexual fears.

¹³ The first passage, almost shocking in its force, even 130 years later, recounts Agassiz's first experience with black people (he had never encountered blacks in Europe). He first visited America in 1846 and sent his mother a long letter detailing his experiences. In the section about Philadelphia, Elizabeth Agassiz records only his visits to museums and the private homes of scientists. She expunges, without ellipses, his first impression of blacks—a visceral reaction to waiters in a hotel restaurant. In 1846 Agassiz still believed in human unity, but this passage exposes an explicit, stunningly nonscientific basis for his conversion to polygeny. For the first time, then, without omissions:

It was in Philadelphia that I first found myself in prolonged contact with negroes; all the domestics in my hotel were men of color. I can scarcely express to you the painful impression that I received, especially since the sentiment that they inspired in me is contrary to all our ideas about the confraternity of the human type and the unique origin of our species. But truth before all. Nevertheless, I experienced pity at the sight of this degraded and degenerate race, and their lot inspired compassion in me in thinking that they are

the *monogenists* advocated a single origin and ranked races by their unequal degeneration from the primeval perfection of Eden—the debate included no egalitarians. In logic, separate needn't mean unequal, as the victors in Plessy vs. Ferguson argued in 1896. But, as the winners in Brown vs. the Topeka Board of Education maintained in 1954, a group in power always conflates separation with superiority. I know of no American polygenist who did not assume that whites were separate *and* superior.

⁹ Agassiz insisted that his defense of polygeny had nothing to do with political advocacy or social prejudice. He was, he argued, merely a humble and disinterested scholar, trying to establish an intriguing fact of natural history.

It has been charged upon the views here advanced that they tend to the support of slavery. . . . Is that a fair objection to a philosophical investigation? Here we have to do only with the question of the origin of men; let the politicians, let those who feel themselves called upon to regulate human society, see what they can do with the results. . . . We disclaim all connection with any question involving political matters. . . . Naturalists have a right to consider the questions growing out of men's physical relations as merely scientific questions, and to investigate them without reference to either politics or religion.

¹⁰ Despite these brave words, Agassiz ends this major statement on race (published in the *Christian Examiner*, 1850) with some definite social recommendations. He begins by affirming the doctrine of separate and unequal: "There are upon earth different races of men, inhabiting different parts of its surface . . . and this fact presses upon us the obligation to settle the relative rank among these races." The resulting hierarchy is self-evident: "The indomitable, courageous, proud Indian—in how different a light he stands by the side of the submissive, obsequious, imitative negro, or by the side of the tricky, cunning, and cowardly Mongolian! Are not these facts indications that the different races do not rank upon one level in nature." Finally, if he hadn't made his political message clear by generalization, Agassiz ends by advocating specific social policy—thus contravening his original pledge to abjure politics for the pure life of the mind. Education, he argues, must be tailored to innate ability; train blacks in hand work, whites in mind work.

tégé of the great Cuvier left his native Switzerland for an American career in the late 1840s. As a celebrated European and a charming man, Agassiz was lionized in social and intellectual circles from Boston to Charleston. He led the study of natural history in America until his death in 1873.

⁴ Louis's public utterances were always models of propriety, but I expected that his private letters would match his ebullient personality. Yet Elizabeth's book, ostensibly a verbatim report of Louis's letters, manages to turn this focus of controversy and source of restless energy into a measured and dignified gentleman.

⁵ Recently, in studying Louis Agassiz's views on race and prompted by some hints in E. Lurie's biography (*Louis Agassiz: a life in science*), I encountered some interesting discrepancies between Elizabeth's version and Louis's original letters. I then discovered that Elizabeth simply expurgated the text and didn't even insert ellipses (those annoying three dots) to indicate her deletions. Harvard has the original letters, and a bit of sleuthing on my part turned up some spicy material.

⁶ During the decade before the Civil War, Agassiz expressed strong opinions on the status of blacks and Indians. As an adopted son of the north, he rejected slavery, but as an upper crust Caucasian, he certainly didn't link this rejection to any notion of racial equality.

⁷ Agassiz presented his racial attitudes as sober and ineluctable deductions from first principles. He maintained that species are static, created entities (at his death in 1873, Agassiz stood virtually alone among biologists as a holdout against the Darwinian tide). They are not placed upon the earth in a single spot, but created simultaneously over their entire range. Related species are often created in separate geographic regions, each adapted to prevailing environments of its own area. Since human races met these criteria before commerce and migration mixed us up, each race is a separate biological species.

⁸ Thus, America's leading biologist came down firmly on the wrong side of a debate that had been raging in America for a decade before he arrived: Was Adam the progenitor of all people or only of white people? Are blacks and Indians our brothers or merely our look-alikes? The *polygenists*, Agassiz among them, held that each major race had been created as a truly separate species;

Suggestions for Writing

- A. Both St. Francis of Assisi and Galileo shook the thinking of the established church. Given Gould's position in evolution/creation controversies, challenged or misquoted by biblical literalists and by some traditional evolutionists, his choice to contrast the thinking of these particular historical figures reflects his own embattled position as a science writer. Research one of the controversies that Gould, Galileo, or St. Francis has been involved in and write a report that outlines both sides of the controversy and the intellectual and social ramifications of each side. You needn't be "objective."
- B. Choose a subject in the natural world with which you are familiar. Try writing about it as a Franciscan thinker might, then as a Galilean. Also write about your writing process in each case. Which did you find easier? In what specific ways was the writing different?

Flaws in a Victorian Veil

¹ The Victorians left some magnificent, if lengthy, novels. But they also foisted upon an apparently willing world a literary genre probably unmatched for tedium and inaccurate portrayal: the multivolumed "life and letters" of eminent men. These extended encomiums, usually written by grieving widows or dutiful sons and daughters, masqueraded as humbly objective accounts, simple documentation of words and activities. If we accepted these works at face value, we would have to believe that eminent Victorians actually lived by the ethical values they espoused—a fanciful proposition that Lytton Strachey's *Eminent Victorians* put to rest more than fifty years ago.

² Elizabeth Cary Agassiz—eminent Bostonian, founder and first president of Radcliffe College, and devoted wife of America's premier naturalist—had all the right credentials for authorship (including a departed and lamented husband). Her *Life and Correspondence of Louis Agassiz* turned a fascinating, cantankerous, and not overly faithful man into a paragon of restraint, statesmanship, wisdom, and rectitude.

³ I write this essay in the structure that Louis Agassiz built in 1859—the original wing of Harvard's Museum of Comparative Zoology. Agassiz, the world's leading student of fossil fishes, pro-