Mr. Cecil
Website: www.mrcecil.org/seminar
Email: max.cecil@grantmagnet.net

AP SEMINAR SUMMER ASSIGNMENT 2019

Welcome to AP Seminar—and to the AP Capstone Diploma program!

Over the next year you will explore what it means to be human by looking at a wide range of perspectives, and along the way you'll develop skills that will enable you to conduct independent research on topics that interest you. This summer assignment is designed to introduce you to the major themes of the course, and to give you a sense of the work you'll be doing all year. Specifically, the readings in this packet will encourage you to think about the following questions:

* What characterizes our basic human nature?
* What, if anything, separates human beings from plants, animals, and machines?
* What should be emphasized about the mental lives of human beings?
* Why do human beings create art, fall in love, go to war, and engage in other behaviors?

As you actively read the enclosed sources, take note of the way each author answers one or more of these questions. In particular, pay close attention to the **arguments** each author presents: What **claims** do they make about our human nature, our mental life, or the extent to which we're similar to other animals? What **evidence** do they use to support their claims, and where does this evidence come from? (First-hand observations? Expert opinion? Scientific studies?) Finally, consider <u>your own</u> thoughts about the subject matter: Do you agree with the author's argument? Why do you find the argument convincing (or not)? Is it because the argument is well-reasoned and sufficiently supported with credible evidence? Or is it because the author's ideas confirm (or challenge) your own assumptions about human life?

A quick warning: some of these readings will be challenging, and you might find yourself wanting to throw your hands in the air and admit defeat. Don't be discouraged! Expect to face obstacles—you'll certainly encounter them over the next year—and start learning from difficult experiences. Pay attention to what you can and can't yet do easily. I don't expect you to have mastered the skills needed to get an "A" on the first day of class, and you shouldn't either! I do expect you to have an open mind and a strong desire to learn.

<u>To sum up, here is what you need to have ready by the first day of class:</u>

* This packet, actively read according to the instructions in this packet
* A précis for <u>each</u> source, written on a separate sheet of paper (see instructions inside)
* At least five (5) questions about <u>each</u> source, written on the same paper as the précis

I can't wait to discuss these readings with you when we return to school in August!

So, what are you waiting for?

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MONTAIGNE'S *ESSAYS*

The French writer Michel de Montaigne (1533-1595) was one of the major writers of the Renaissance. He created a new literary form called the personal "essay" (which for him meant a writing about something that serves as a "self-try-out" or a "test-upon-oneself"), and he wrote essays on a wide range of topics, including classical philosophy, skepticism, education, sex, smells, the emotions, witches, and cannibals. He also came to realize that the main topic of his essays was himself, and that when an individual writes an essay about anything, what above all comes into view is the author's self—i.e., how he or she thinks and feels about whatever the essay is about.

The following essays are excerpts from his three volumes of The Essays of Montaigne*, and in reading them, focus in particular on Montaigne's view of human life in general. Writing just before Shakespeare, Montaigne has some strikingly modern ideas about human beings, e.g., about human nature, our mental life, the causes of our behavior, why we mess up, and what we can do to live a better life on Earth. He provides a good starting point for thinking about human life—which will be the main topic in AP Seminar.*

ON REPENTANCE

In the following passage, taken from the beginning of the essay, Montaigne speaks specifically on the subject matter of his Essays:

Other [writers] form man; I describe him, and offer to the reader's view one in particular, who is ill-formed enough—and who, if I had to fashion him anew, I should certainly make very different from what he is. But there is no chance of that.

Now the lines of my portrait are never at fault, although they change and vary. The world is but a perpetual see-saw. Everything goes incessantly up and down—the earth, the rocks of the Caucasus, the pyramids of Egypt—both with the universal motion and with their own motion. Constancy itself is nothing but a more sluggish movement. I cannot fix my subject. He is always restless, and reels with a natural intoxication. I catch him here, as he is at the moment when I turn my attention to him. I do not portray his being—I portray his passage; not a passage from one age to another age, or, as common people say, from seven years to seven years, but from day to day, from minute to minute. I must suit my story to the hour, for soon I may change—not only by chance, but also by intention. It is a record of various and variable occurrences, an account of thoughts that are unsettled and, as chance will have it, at times contradictory—either because I am then another self, or because I approach my subject under different circumstances and with other considerations. Hence it is that I may indeed contradict myself, but the truth I do not contradict. If my mind could find a firm footing, I should not be making essays, but coming to conclusions; my mind, however, is always in its apprenticeship and on trial.

I present here a humble life, without distinction; but that is no matter. Moral philosophy, as a whole, can be just as well applied to a common and private existence as to one of richer stuff. Every man carries within himself the complete pattern of human nature.

Authors communicate with the world in some special and peculiar capacity; I am the first to do so with my whole being, as Michel de Montaigne—not as a grammarian, a poet, or a lawyer. If people complain that I speak too much of myself, I complain that they do not think of themselves at all.

But is it reasonable that, being so private in my way of life, I should set out to make myself known to the public? Is it reasonable that I should present to the world, in which style and artifice receive so much credit and authority, the crude and simple products of nature, and of a weakish nature at that? Is it not like building a wall without stone, to construct books without learning or art? Musical compositions are the product of skill, while my essays are the product of chance.

To this extent, at least, I have conformed to the rules: that no man ever came to a project with better knowledge and understanding than I have of this matter, in regard to which I am the most learned man alive; and secondly, that no man ever went more deeply into his subject, or more thoroughly examined its elements and effects, or more exactly and completely achieved the purpose he set out to work for. To perfect it I need only bring fidelity to my task; and that is here, the purest and sincerest that is to be found anywhere. I speak the truth, not to the full, but as much as I dare—and as I grow older I become a little more daring, for custom seems to allow age greater freedom to be talkative and indiscreet in speaking of itself. It cannot happen here, as I often see it elsewhere, that the craftsman and his work are in contradiction. A learned person is not learned in all things, but a man of talent is accomplished in every respect, even in his ignorance. Here my book and I proceed in agreement, and at the same pace. In other cases the work may be praised or blamed apart from the workman; but here that cannot be. Who touches one, touches the other. . . .

OF THE INCONSISTENCY OF OUR ACTIONS

Those who make a practice of comparing human actions are never so perplexed as when they try to see them as a whole and in the same light; for human actions commonly contradict each other so strangely that it seems impossible that they have come from the same shop. One moment young Marius is the son of Mars, another moment he is the son of Venus. Pope Boniface VIII entered office like a fox, behaved in it like a lion, and died like a dog. And who would believe that it was Nero, that living image of cruelty, who said, when they brought him the sentence of a condemned criminal to sign: “Would to God I had never learned to write!”—so much his heart was wrung at condemning a man to death!

Everything is so full of such examples—each man, in fact, can supply himself with so many—that I find it strange to see intelligent men sometimes going to great pains to match these pieces. Our nature seems so wavering and undecided. . . .

There is some justification for basing a judgment of a man on the most ordinary acts of his life; but in view of the natural instability of our conduct and opinions, it has often seemed to me that even good authors are wrong to insist on fashioning a consistent and solid fabric out of

us. Historians typically choose one general characteristic, and then go and arrange and interpret all a man's actions to fit their picture of him; and if they cannot twist his actions enough to fit their picture, they go and set them down to hypocrisy. Augustus Caesar has escaped this, for there is in this man throughout his life such an obvious, abrupt, and continual variety of actions that even the boldest judges have had to let him go, intact and unsolved. Nothing is harder for me than to believe in men's consistency, nothing easier than to believe in their inconsistency. He who would judge men in detail and distinctly, bit by bit, would more often hit upon the truth.

In all antiquity it is hard to pick out a dozen men who set their lives to a certain and constant course, which is the principal goal of wisdom. For to sum up wisdom in one word, says an ancient, it is "always to will the same things, and always to oppose the same things, provided the will is just."

In truth, I once learned that vice is only unruliness and lack of moderation, and consequently consistency cannot be attributed to it. As Demosthenes said, the beginning of all virtue is consultation and deliberation, and the result—the perfection—is consistency. If it were by reasoning that we settled on a particular course of action, we would choose the best course—but no one has thought of that:

> He spurns the thing he sought, and seeks anew
> What he just spurned; he seethes, his life's askew.
> —Horace

Our ordinary practice is not to follow our reason but the inclinations of our appetite, to the left, to the right, uphill and down, as the wind of circumstance carries us. We think of what we want only at the moment we want it, and we change like that animal which takes the color of the place you set it on. What we have just now planned, we presently change, and presently we retrace our steps; we are nothing but oscillation and inconsistency:

> Like puppets we are moved by outside strings.
> —Horace

We do not go; we are carried away, like floating objects, now gently, now violently, according as the water is angry or calm:

> Do we not see all humans unaware And changing
> place, as if to drop the load they bear?
> —Lucretius

Every day a new fancy, and our moods shift with the shifts of the weather. We float between different states of mind; we wish nothing freely, nothing absolutely, nothing constantly. If any man could establish beforehand definite laws and definite organization in his head, we should see shining throughout his life an evenness of habits, an order, and an infallible relation between his principles and his behavior. This disciplined man would be easy to understand: he

who has touched one chord of him has touched all; such a man would be a harmony of perfectly concordant sounds, which cannot conflict. But with us it is the opposite: for so many actions we need so many individual judgments. The surest thing, in my opinion, would be to trace our actions to the neighboring circumstances, without getting into any further research and without drawing from them any other conclusions.

During the disorders of our poor country[1] I was told that a girl had thrown herself out of a high window to avoid the violence of a knavish soldier quartered in her house. Not killed by the fall, she reasserted her purpose by trying to cut her throat with a knife. From this she was prevented, but only after wounding herself gravely. She herself confessed that the soldier had as yet pressed her only with requests and gifts; but she had been afraid, she said, that he would finally resort to force. And all this with such words, such expressions, not to mention the blood that testified to her virtue. Yet recently I learned that, as a matter of fact, both before and since, she was a wench not so hard to come to terms with. As the story says: "Handsome and gentlemanly as you may be, when you have had no luck, do not promptly conclude that you mistress is inviolably chaste; for all you know, the mule driver may get his will with her."

Antigonus, having taken a liking to one of his soldiers for his virtue and valor, ordered his physicians to treat the man for a persistent internal malady that had long tormented him. After the soldier's cure, his master noticed that he was going about his business much less warmly, and asked him what had changed him so and made him such a coward. "You yourself, Sire," answered the soldier, "by delivering me from the ills that made my life indifferent to me."

We read that Sultan Mohammed outrageously criticized Hassan, leader of his troops, because he saw the troops giving way to the Hungarians and Hassan himself behaving like a coward in the fight. Hassan's only reply was to go and hurl himself furiously, alone, just as he was, arms in hand—into the first body of enemies that he met, by whom he was promptly swallowed up; this was perhaps not so much self- justification as a change of mood, nor so much his natural valor as fresh spite.

That man whom you saw so brave yesterday, do not think it strange to find him just as cowardly today: either anger, or necessity, or company, or wine, or the sound of a trumpet made him brave yesterday. His was a courage formed not by reason, but by one of these circumstances: it is no wonder if he has now been made different by other, contrary circumstances.

These supple variations and contradictions that are seen in us have made some imagine that we have two souls, and others that two powers accompany us and drive us, each in its own way: one toward good, the other toward evil; for such sudden diversity of behavior cannot well be reconciled with a simple subject.

Not only does the wind of accident move me at will, but, besides, I am moved as a result of my own unstable posture; and anyone who observes carefully can hardly find himself twice in the same state. I give my soul now one face, now another, according to which direction I turn it. If I speak of myself in different ways, that is because I look at myself in different ways. All

[1] Montaigne is here referring to the civil wars between Catholics and Protestants, which were fought intermittently in France from 1562 to 1594.

contradictions may be found in me by some twist and in some fashion. Bashful, bold; chaste, lascivious; talkative, quiet; tough, delicate; clever, stupid; amiable, unfriendly; lying, truthful; learned, ignorant; liberal, miserly, and wasteful: all this I see in myself to some extent according to how I turn. And whoever studies himself really closely finds in himself constant change and discord. I have nothing to say about myself absolutely, simply, and solidly, without confusion and without mixture, or in one word. . . .

Therefore one courageous deed must not be taken to prove that a man is valiant; a man who was really valiant would be so always and on all occasions. If valor were a habit of virtue, it would make a man equally resolute in any situation, the same alone as in company, the same in single combat as it battle. As bravely would he bear an illness in his bed as a wound in camp, and he would fear death no more in his home than in an assault. When, though weak against the surgeon's knives, he is steadfast against the enemy's swords, the action is praiseworthy, not the man.

It is no wonder, says an ancient, that chance has so much power over us, since we live by chance. A man who has not directed his life as a whole toward a definite goal cannot possibly set his particular actions in order. A man who does not have a picture of the whole in his head cannot possibly arrange the pieces. What good does it do a man to lay in a supply of paints if he does not know what he is to paint? No one makes a definite plan of his life; we think about it only piecemeal. The archer must first know what he is aiming at, and then set his hand, his bow, his string, his arrow, and his movements for that goal. Our plans go astray because they have no direction and no aim. No wind works for the man who has no port of destination. . . .

We are all patchwork, and so shapeless and diverse in composition that each bit, each moment, plays its own game. And there is as much difference between us and ourselves as between us and others. Consider it a great thing to play the part of one single man. Ambition can teach men valor, and prudence, and even justice. Greed can implant in the heart of a shop apprentice, brought up in obscurity, the confidence to cast himself far from home, in a frail boat at the mercy of the waves and angry Neptune: it can also teach discretion and wisdom. . . . In view of all this, a sound mind will refuse to judge men simply by their outward actions; we must probe the inside and discover what springs set men in motion. But since this is an extremely different and hazardous undertaking, I wish fewer people would meddle with it.

HOW WE CRY AND LAUGH FOR THE SAME THING

We read in the history books that Antigonus was very angry with his son for having presented him with the head of his enemy King Pyrrhus, who that very moment had been killed fighting against him, and that upon seeing it he began to weep very hard; and we also read that Duke Rene of Lorraine also lamented the death of Duke Charles of Burgundy, whom he had just defeated, and wore mourning at his burial. But in reading of these events we should not immediately exclaim:

And thus it happens that each soul conceals,
Showing the opposite, now gay, now sad,
The passion that it genuinely feels.
—Petrarch

. . . . For although most of our actions are indeed only mask and make-up . . . yet in judging these accidents we must consider how our soul is often agitated by diverse passions. And just as in our body they say there is an assemblage of diverse humors, of which that one is master which most ordinarily rules within us, according to our constitution; so in our soul, though various impulses stir it, there must be one that remains master of that field. Its advantage is not complete, however; because of the volatility and pliancy of our soul, the weaker ones on occasion regain the lost ground and make a brief attack in their turn. Hence we see children, who quite spontaneously follow nature, often cry and laugh at the same thing. And not only that, but not one of us can boast, however much he wants to make a trip, that on parting from his family and friends he does not feel a tremor in his heart; if he does not actually shed tears, at least he puts his foot in the stirrup with a sad and mournful face. And however sweet the flame that warms the heart of wellborn maidens, still they have to be pulled by force from their mother's neck to be delivered over to their husband, no matter what this good companion says:

Is Venus really hateful to each blushing bride,
Or false those tears which dash their parents' joy and pride,
When on the bedroom threshold they pour out like rain?
Heaven help me, no; not from the heart do they complain.
—Catullus

Thus it in not strange to lament a person dead whom one would not in the least want to have alive.

When I scold my valet, I scold him with all my heart; my words are real, not feigned. But when the stroke has blown away, let him need my help, and I am glad to do him a service; I instantly turn over the leaf. When I call him a clown or a calf, I do not undertake to sew those labels on him forever; nor do I think I contradict myself when I presently call him a fine fellow.

No quality embraces us purely and universally. If it did not seem crazy to talk to oneself, there is not a day when I would not be heard growling at myself: "Confounded fool!" And yet I do not intend that to be my definition.

Whoever supposes, to see me look sometimes coldly, sometimes lovingly, on my wife, that either look is feigned, is a fool. . . .

Artabanus came on his nephew Xerxes by surprise and chided him for his sudden change of countenance. Xerxes had been considering the immeasurable greatness of his forces at the crossing of the Hellespont for the expedition against Greece. At first he quivered with joy to see so many thousands of men in his service, and showed his feelings by the happiness and delight on his face. And quite suddenly, at the same instant, as his thought suggested to him how all

those lives would give out within a century at the latest, he knit his brows and was saddened even to tears.

We have with resolute will sought revenge for an injury, and felt singular satisfaction in gaining it, and yet we weep. It is not for our victory that we weep, there is nothing changed; but our soul looks on the thing with a different eye, and represents it to itself in another aspect, for each thing, has many angles and many lights. Kinship, old acquaintance, and friendship seize our imagination and get it passionately involved for the moment, according to their character; but the turn is so quick that it escapes us.

Nothing is known to match in lightning speed
The mind of man, passing from thought to deed.
Whatever nature shows to human sight
Is not so swift as is the soul in flight.
—Lucretius

And for this reason we are wrong to try to compose a continuous body out of all this succession of feelings. . . .

HOW THE SOUL DISCHARGES ITS PASSIONS ON FALSE OBJECTS WHEN THE TRUE ARE WANTING

One of our gentlemen who was wondrously subject to the gout, on being urged by the doctors to give up entirely the use of salt meats, used to answer them very humorously that in the agonies and torments of the illness he wanted to have something to blame, and by crying out and cursing now the sausage, now the ox tongue and the ham, he felt just that much relieved. It seems that the soul, once stirred and set in motion, is lost in itself unless we give it something to grasp; and we must always give it an object to aim at and act on. Plutarch says of those who grow fond of monkeys and little dogs that the loving part that is in us, lacking a legitimate object, rather than remain idle, thus forges itself a false and frivolous one. And we see that the soul in its passions will sooner deceive itself by setting up a false and fantastical object, even contrary to its own belief, than not act against something.

Thus animals are carried away by their rage to attack the stone or the metal that has wounded them and to take revenge tooth and nail on themselves for the pain they feel.

So the Pannonian bear, made fiercer by the sting,
When struck by the dart-from the Libyan hunter's sling,
Turns on the wound enraged. Attacks the buried spear,
Which whirls as she whirls after, flees as she draws near.
—Lucan

What causes do we not invent for the misfortunes that befall us? On what do we not place the blame, rightly or wrongly, so as to have something at which to thrust? It is not that blonde tresses that you are tearing, nor the whiteness of that bosom that in your anger you beat so cruelly, that have made you lose by an unlucky bullet that well-loved brother: place the blame elsewhere. Livy, speaking of the Roman army in Spain after the loss or the two brothers, their great captains, says: "Immediately all began to weep and beat their heads." It is a common practice. And was it not amusing of the philosopher Bion to say about that king who was tearing his hair for grief, "Does this man think that baldness relieves grief?" Who has not seen people chew and swallow the cards or stuff themselves with a set of dice to avenge the loss of their money? Xerxes whipped the waters of the Hellespont, put irons on it and had a thousand insults hurled at it, and wrote a challenge to Mount Athos. . . .

In my youth the people used to say that one of our neighboring kings, having received a beating from God, swore to take revenge; and ordered that for ten years no one should pray to God, or speak of him, or, as far as the king's authority could prevent it, believe in him. By which they wanted to portray not so much the folly but the vainglory natural to the nation about whom the story was told. These are vices that always go together; but in truth such actions spring from presumption even more than from stupidity.

Augustus Caesar, having been battered by a tempest at sea, set about defying the god Neptune, and in celebration of the circus games had his image removed from the place where it was among the other gods, to take vengeance on him. Wherein he is still less excusable than the preceding ones, and less than he was later, when, having lost a battle, he went about in anger and despair banging his head against the wall and crying: "Varus, give me back my soldiers." For those surpass all madness who, adding impiety to folly, turn their blame against God himself, or against Fortune, as if she had ears susceptible to our assault; like the Thracians who, when there is thunder or lightning, start shooting the heavens with a Titan's vengeance, to bring God to reason by arrow shots. Now, as that ancient poet says in Plutarch,

> Anger at things that happen shows small wit;
> For all our wrath concerns them not a bit.
> —author unknown

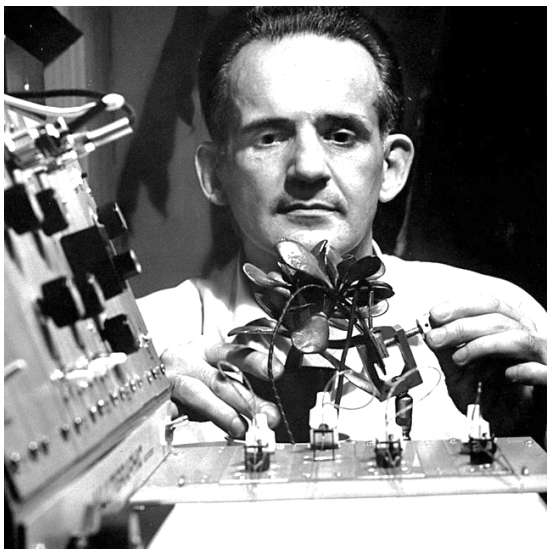
But we shall never heap enough insults on the unruliness of our mind.

Source: Montaigne, Michel. *The Complete Essays of Montaigne*. 1588. Translated by Donald M. Frame, Stanford University Press, 1976.

THE INTELLIGENT PLANT

By Michael Pollan
From *The New Yorker*, December 23, 2013

In 1973, a book claiming that plants were sentient beings that feel emotions, prefer classical music to rock and roll, and can respond to the unspoken thoughts of humans hundreds of miles away landed on the *New York Times* best-seller list for nonfiction. *The Secret Life of Plants*, by Peter Tompkins and Christopher Bird, presented a beguiling mashup of legitimate plant science, quack experiments, and mystical nature worship that captured the public imagination at a time when New Age thinking was seeping into the mainstream. The most memorable passages described the experiments of a former C.I.A. polygraph expert named Cleve Backster [pictured below], who, in 1966, on a whim, hooked up a galvanometer to the leaf of a dracaena, a houseplant that he kept in his office. To his astonishment, Backster found that simply by imagining the dracaena being set on fire he could make it rouse the needle of the polygraph machine, registering a surge of electrical activity suggesting that the plant felt stress. "Could the plant have been reading his mind?" the authors ask. "Backster felt like running into the street and shouting to the world, 'Plants can think!'"



Backster and his collaborators went on to hook up polygraph machines to dozens of plants, including lettuces, onions, oranges, and bananas. He claimed that plants reacted to the thoughts (good or ill) of humans in close proximity and, in the case of humans familiar to them, over a great distance. In one experiment designed to test plant memory, Backster found that a plant that had witnessed the murder (by stomping) of another plant could pick out the killer from a lineup of six suspects, registering a surge of electrical activity when the murderer was brought before it. Backster's plants also displayed a strong aversion to interspecies violence. Some had a stressful response when an egg was cracked in their presence, or when live shrimp were dropped into boiling water, an experiment that Backster wrote up for the *International Journal of Parapsychology*, in 1968.

In the ensuing years, several legitimate plant scientists tried to reproduce the "Backster effect" without success. Much of the science in *The Secret Life of Plants* has been discredited. But the book had made its mark on the culture. Americans began talking to their plants and playing Mozart for them, and no doubt many still do. This might seem harmless enough; there will probably always be a strain of romanticism running through our thinking about plants. (Luther Burbank and George Washington Carver both reputedly talked to, and listened to, the plants they did such brilliant work with.) But in the view of many plant scientists *The Secret Life*

of Plants has done lasting damage to their field. According to Daniel Chamovitz, an Israeli biologist who is the author of the recent book *What a Plant Knows*, Tompkins and Bird "stymied important research on plant behavior as scientists became wary of any studies that hinted at parallels between animal senses and plant senses." Others contend that *The Secret Life of Plants* led to "self-censorship" among researchers seeking to explore the "possible homologies between neurobiology and phytobiology"; that is, the possibility that plants are much more intelligent and much more like us than most people think—capable of cognition, communication, information processing, computation, learning, and memory.

The quotation about self-censorship appeared in a controversial 2006 article in *Trends in Plant Science* proposing a new field of inquiry that the authors, perhaps somewhat recklessly, elected to call "plant neurobiology." The six authors—among them Eric D. Brenner, an American plant molecular biologist; Stefano Mancuso, an Italian plant physiologist; František Baluška, a Slovak cell biologist; and Elizabeth Van Volkenburgh, an American plant biologist—argued that the sophisticated behaviors observed in plants cannot at present be completely explained by familiar genetic and biochemical mechanisms. Plants are able to sense and optimally respond to so many environmental variables—light, water, gravity, temperature, soil structure, nutrients, toxins, microbes, herbivores, chemical signals from other plants—that there may exist some brainlike information-processing system to integrate the data and coordinate a plant's behavioral response. The authors pointed out that electrical and chemical signaling systems have been identified in plants which are homologous to those found in the nervous systems of animals. They also noted that neurotransmitters such as serotonin, dopamine, and glutamate have been found in plants, though their role remains unclear.

Hence the need for plant neurobiology, a new field "aimed at understanding how plants perceive their circumstances and respond to environmental input in an integrated fashion." The article argued that plants exhibit intelligence, defined by the authors as "an intrinsic ability to process information from both abiotic and biotic stimuli that allows optimal decisions about future activities in a given environment." Shortly before the article's publication, the Society for Plant Neurobiology held its first meeting, in Florence, in 2005. A new scientific journal, with the less tendentious title *Plant Signaling & Behavior,* appeared the following year.

Depending on whom you talk to in the plant sciences today, the field of plant neurobiology represents either a radical new paradigm in our understanding of life or a slide back down into the murky scientific waters last stirred up by *The Secret Life of Plants*. Its proponents believe that we must stop regarding plants as passive objects—the mute, immobile furniture of our world—and begin to treat them as protagonists in their own dramas, highly skilled in the ways of contending in nature. They would challenge contemporary biology's reductive focus on cells and genes and return our attention to the organism and its behavior in the environment. It is only human arrogance, and the fact that the lives of plants unfold in what amounts to a much slower dimension of time, that keep us from appreciating their intelligence and consequent success. Plants dominate every terrestrial environment, composing ninety-nine

per cent of the biomass on earth. By comparison, humans and all the other animals are, in the words of one plant neurobiologist, "just traces."

Many plant scientists have pushed back hard against the nascent field, beginning with a tart, dismissive letter in response to the Brenner manifesto, signed by thirty-six prominent plant scientists (Alpi et al., in the literature) and published in *Trends in Plant Science*. "We begin by stating simply that there is no evidence for structures such as neurons, synapses or a brain in plants," the authors wrote. No such claim had actually been made—the manifesto had spoken only of "homologous" structures—but the use of the word "neurobiology" in the absence of actual neurons was apparently more than many scientists could bear.

"Yes, plants have both short- and long-term electrical signaling, and they use some neurotransmitter-like chemicals as chemical signals," Lincoln Taiz, an emeritus professor of plant physiology at U.C. Santa Cruz and one of the signers of the Alpi letter, told me. "But the mechanisms are quite different from those of true nervous systems." Taiz says that the writings of the plant neurobiologists suffer from "over-interpretation of data, teleology, anthropomorphizing, philosophizing, and wild speculations." He is confident that eventually the plant behaviors we can't yet account for will be explained by the action of chemical or electrical pathways, without recourse to "animism." Clifford Slayman, a professor of cellular and molecular physiology at Yale, who also signed the Alpi letter (and who helped discredit Tompkins and Bird), was even more blunt. "'Plant intelligence' is a foolish distraction, not a new paradigm," he wrote in a recent e-mail. Slayman has referred to the Alpi letter as "the last serious confrontation between the scientific community and the nuthouse on these issues." Scientists seldom use such language when talking about their colleagues to a journalist, but this issue generates strong feelings, perhaps because it smudges the sharp line separating the animal kingdom from the plant kingdom. The controversy is less about the remarkable discoveries of recent plant science than about how to interpret and name them: whether behaviors observed in plants which look very much like learning, memory, decision-making, and intelligence deserve to be called by those terms or whether those words should be reserved exclusively for creatures with brains.

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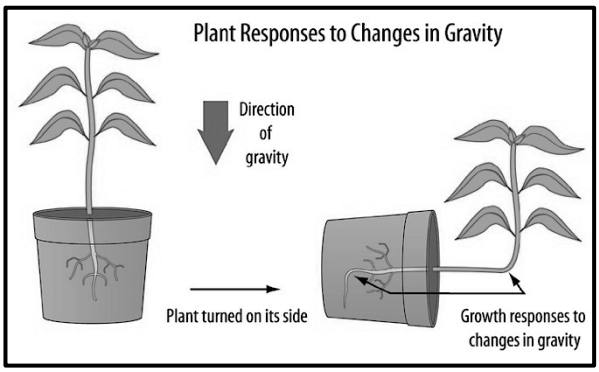
No one I spoke to in the loose, interdisciplinary group of scientists working on plant intelligence claims that plants have telekinetic powers or feel emotions. Nor does anyone believe that we will locate a walnut-shaped organ somewhere in plants which processes sensory data and directs plant behavior. More likely, in the scientists' view, intelligence in plants resembles that exhibited in insect colonies, where it is thought to be an emergent property of a great many mindless individuals organized in a network. Much of the research on plant intelligence has been inspired by the new science of networks, distributed computing, and swarm behavior, which has demonstrated some of the ways in which remarkably brainy behavior can emerge in the absence of actual brains.

"If you are a plant, having a brain is not an advantage," Stefano Mancuso points out. Mancuso is perhaps the field's most impassioned spokesman for the plant point of view. A slight, bearded Calabrian in his late forties, he comes across more like a humanities professor than like a scientist. When I visited him earlier this year at the International Laboratory of Plant Neurobiology, at the University of Florence, he told me that his conviction that humans grossly underestimate plants has its origins in a science-fiction story he remembers reading as a teen-ager. A race of aliens living in a radically sped-up dimension of time arrive on Earth and, unable to detect any movement in humans, come to the logical conclusion that we are "inert material" with which they may do as they please. The aliens proceed ruthlessly to exploit us. (Mancuso subsequently wrote to say that the story he recounted was actually a mangled recollection of an early *Star Trek* episode called "Wink of an Eye.")

In Mancuso's view, our "fetishization" of neurons, as well as our tendency to equate behavior with mobility, keeps us from appreciating what plants can do. For instance, since plants can't run away and frequently get eaten, it serves them well not to have any irreplaceable organs. "A plant has a modular design, so it can lose up to ninety per cent of its body without being killed," he said. "There's nothing like that in the animal world. It creates a resilience."
Indeed, many of the most impressive capabilities of plants can be traced to their unique existential predicament as beings rooted to the ground and therefore unable to pick up and move when they need something or when conditions turn unfavorable. The "sessile life style," as plant biologists term it, calls for an extensive and nuanced understanding of one's immediate environment, since the plant has to find everything it needs, and has to defend itself, while remaining fixed in place. A highly developed sensory apparatus is required to locate food and identify threats. Plants have evolved between fifteen and twenty distinct senses, including analogues of our five: smell and taste (they sense and respond to chemicals in the air or on their bodies); sight (they react differently to various wavelengths of light as well as to shadow); touch (a vine or a root "knows" when it encounters a solid object); and, it has been discovered, sound. In a recent experiment, Heidi Appel, a chemical ecologist at the University of Missouri, found that, when she played a recording of a caterpillar chomping a leaf for a plant that hadn't been touched, the sound primed the plant's genetic machinery to produce defense chemicals. Another experiment, done in Mancuso's lab and not yet published, found that plant roots would seek out a buried pipe through which water was flowing even if the exterior of the pipe was dry, which suggested that plants somehow "hear" the sound of flowing water.

The sensory capabilities of plant roots fascinated Charles Darwin, who in his later years became increasingly passionate about plants; he and his son Francis performed scores of ingenious experiments on plants. Many involved the root, or radicle, of young plants, which the Darwins demonstrated could sense light, moisture, gravity, pressure, and several other environmental qualities, and then determine the optimal trajectory for the root's growth. The last sentence of Darwin's 1880 book, *The Power of Movement in Plants*, has assumed scriptural authority for some plant neurobiologists: "It is hardly an exaggeration to say that the tip of the radicle … having the power of directing the movements of the adjoining parts, acts like the brain

of one of the lower animals; the brain being seated within the anterior end of the body, receiving impressions from the sense organs and directing the several movements." Darwin was asking us to think of the plant as a kind of upside-down animal, with its main sensory organs and "brain" on the bottom, underground, and its sexual organs on top.



Scientists have since found that the tips of plant roots, in addition to sensing gravity, moisture, light, pressure, and hardness, can also sense volume, nitrogen, phosphorus, salt, various toxins, microbes, and chemical signals from neighboring plants. Roots about to encounter an impenetrable obstacle or a toxic substance change course before they make contact with it. Roots can tell whether nearby roots are self or other and, if other, kin or stranger. Normally, plants compete for root space with strangers, but, when researchers put four closely related Great Lakes sea-rocket plants (*Cakile edentula*) in the same pot, the plants restrained their usual competitive behaviors and shared resources.

Somehow, a plant gathers and integrates all this information about its environment, and then "decides"—some scientists deploy the quotation marks, indicating metaphor at work; others drop them—in precisely what direction to deploy its roots or its leaves. Once the definition of "behavior" expands to include such things as a shift in the trajectory of a root, a reallocation of resources, or the emission of a powerful chemical, plants begin to look like much more active agents, responding to environmental cues in ways more subtle or adaptive than the word "instinct" would suggest. "Plants perceive competitors and grow away from them," Rick Karban, a plant ecologist at U.C. Davis, explained, when I asked him for an example of plant decision-making. "They are more leery of actual vegetation than they are of inanimate objects, and they respond to potential competitors before actually being shaded by them." These are sophisticated behaviors, but, like most plant behaviors, to an animal they're either invisible or really, really slow.

The sessile life style also helps account for plants' extraordinary gift for biochemistry, which far exceeds that of animals and, arguably, of human chemists. (Many drugs, from aspirin to opiates, derive from compounds designed by plants.) Unable to run away, plants deploy a complex molecular vocabulary to signal distress, deter or poison enemies, and recruit animals to perform various services for them. A recent study in *Science* found that the caffeine produced by many plants may function not only as a defense chemical, as had previously been thought, but in some cases as a psychoactive drug in their nectar. The caffeine encourages bees to remember a particular plant and return to it, making them more faithful and effective pollinators.

One of the most productive areas of plant research in recent years has been plant signaling. Since the early nineteen-eighties, it has been known that when a plant's leaves are infected or chewed by insects they emit volatile chemicals that signal other leaves to mount a

defense. Sometimes this warning signal contains information about the identity of the insect, gleaned from the taste of its saliva. Depending on the plant and the attacker, the defense might involve altering the leaf's flavor or texture, or producing toxins or other compounds that render the plant's flesh less digestible to herbivores. When antelopes browse acacia trees, the leaves produce tannins that make them unappetizing and difficult to digest. When food is scarce and acacias are overbrowsed, it has been reported, the trees produce sufficient amounts of toxin to kill the animals.

Perhaps the cleverest instance of plant signaling involves two insect species, the first in the role of pest and the second as its exterminator. Several species, including corn and lima beans, emit a chemical distress call when attacked by caterpillars. Parasitic wasps some distance away lock in on that scent, follow it to the afflicted plant, and proceed to slowly destroy the caterpillars. Scientists call these insects "plant bodyguards."

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Plants speak in a chemical vocabulary we can't directly perceive or comprehend. The first important discoveries in plant communication were made in the lab in the nineteen-eighties, by isolating plants and their chemical emissions in Plexiglas chambers, but Rick Karban, the U.C. Davis ecologist, and others have set themselves the messier task of studying how plants exchange chemical signals outdoors, in a natural setting. Recently, I visited Karban's study plot at the University of California's Sagehen Creek Field Station, a few miles outside Truckee. On a sun-flooded hillside high in the Sierras, he introduced me to the ninety-nine sagebrush plants—low, slow-growing gray-green shrubs marked with plastic flags—that he and his colleagues have kept under close surveillance for more than a decade.

Karban, a fifty-nine-year-old former New Yorker, is slender, with a thatch of white curls barely contained by a floppy hat. He has shown that when sagebrush leaves are clipped in the spring—simulating an insect attack that triggers the release of volatile chemicals—both the clipped plant and its unclipped neighbors suffer significantly less insect damage over the season. Karban believes that the plant is alerting all its leaves to the presence of a pest, but its neighbors pick up the signal, too, and gird themselves against attack. "We think the sagebrush are basically eavesdropping on one another," Karban said. He found that the more closely related the plants the more likely they are to respond to the chemical signal, suggesting that plants may display a form of kin recognition. Helping out your relatives is a good way to improve the odds that your genes will survive.

The field work and data collection that go into making these discoveries are painstaking in the extreme. At the bottom of a meadow raked by the slanted light of late summer, two collaborators from Japan, Kaori Shiojiri and Satomi Ishizaki, worked in the shade of a small pine, squatting over branches of sagebrush that Karban had tagged and cut. Using clickers, they counted every trident-shaped leaf on every branch, and then counted and recorded every instance of leaf damage, one column for insect bites, another for disease. At the top of the meadow,

another collaborator, James Blande, a chemical ecologist from England, tied plastic bags around sagebrush stems and inflated the bags with filtered air. After waiting twenty minutes for the leaves to emit their volatiles, he pumped the air through a metal cylinder containing an absorbent material that collected the chemical emissions. At the lab, a gas chromatograph-mass spectrometer would yield a list of the compounds collected—more than a hundred in all. Blande offered to let me put my nose in one of the bags; the air was powerfully aromatic, with a scent closer to aftershave than to perfume. Gazing across the meadow of sagebrush, I found it difficult to imagine the invisible chemical chatter, including the calls of distress, going on all around—or that these motionless plants were engaged in any kind of "behavior" at all.

Research on plant communication may someday benefit farmers and their crops. Plant-distress chemicals could be used to prime plant defenses, reducing the need for pesticides. Jack Schultz, a chemical ecologist at the University of Missouri, who did some of the pioneering work on plant signaling in the early nineteen-eighties, is helping to develop a mechanical "nose" that, attached to a tractor and driven through a field, could help farmers identify plants under insect attack, allowing them to spray pesticides only when and where they are needed.

Karban told me that, in the nineteen-eighties, people working on plant communication faced some of the same outrage that scientists working on plant intelligence (a term he cautiously accepts) do today. "This stuff has been enormously contentious," he says, referring to the early days of research into plant communication, work that is now generally accepted. "It took me years to get some of these papers published. People would literally be screaming at one another at scientific meetings." He added, "Plant scientists in general are incredibly conservative. We all think we want to hear novel ideas, but we don't, not really."

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I first met Karban at a scientific meeting in Vancouver last July, when he presented a paper titled "Plant Communication and Kin Recognition in Sagebrush." The meeting would have been the sixth gathering of the Society for Plant Neurobiology, if not for the fact that, under pressure from certain quarters of the scientific establishment, the group's name had been changed four years earlier to the less provocative Society for Plant Signaling and Behavior. The plant biologist Elizabeth Van Volkenburgh, of the University of Washington, who was one of the founders of the society, told me that the name had been changed after a lively internal debate; she felt that jettisoning "neurobiology" was probably for the best. "I was told by someone at the National Science Foundation that the N.S.F. would never fund anything with the words 'plant neurobiology' in it. He said, and I quote, '"Neuro" belongs to animals.'" (An N.S.F. spokesperson said that, while the society is not eligible for funding by the foundation's neurobiology program, "the N.S.F. does not have a boycott of any sort against the society.") Two of the society's co-founders, Stefano Mancuso and František Baluška, argued strenuously against the name change, and continue to use the term "plant neurobiology" in their own work and in the names of their labs.

The meeting consisted of three days of PowerPoint presentations delivered in a large, modern lecture hall at the University of British Columbia before a hundred or so scientists. Most of the papers were highly technical presentations on plant signaling—the kind of incremental science that takes place comfortably within the confines of an established scientific paradigm, which plant signaling has become. But a handful of speakers presented work very much within the new paradigm of plant intelligence, and they elicited strong reactions.

The most controversial presentation was "Animal-Like Learning in Mimosa Pudica," an unpublished paper by Monica Gagliano, a thirty-seven-year-old animal ecologist at the University of Western Australia who was working in Mancuso's lab in Florence. Gagliano, who is tall, with long brown hair parted in the middle, based her experiment on a set of protocols commonly used to test learning in animals. She focused on an elementary type of learning called "habituation," in which an experimental subject is taught to ignore an irrelevant stimulus. "Habituation enables an organism to focus on the important information, while filtering out the rubbish," Gagliano explained to the audience of plant scientists. How long does it take the animal to recognize that a stimulus is "rubbish," and then how long will it remember what it has learned? Gagliano's experimental question was bracing: Could the same thing be done with a plant?

Mimosa pudica, also called the "sensitive plant," [see image below] is that rare plant species with a behavior so speedy and visible that animals can observe it; the Venus flytrap is another. When the fernlike leaves of the mimosa are touched, they instantly fold up, presumably to frighten insects. The mimosa also collapses its leaves when the plant is dropped or jostled. Gagliano potted fifty-six mimosa plants and rigged a system to drop them from a height of fifteen centimeters every five seconds. Each "training session" involved sixty drops. She reported that some of the mimosas started to reopen their leaves after just four, five, or six drops, as if they had concluded that the stimulus could be safely ignored. "By the end, they were completely open," Gagliano said to the audience. "They couldn't care less anymore."

Was it just fatigue? Apparently not: when the plants were shaken, they again closed up. "'Oh, this is something new,'" Gagliano said, imagining these events from the plants' point of view. "You see, you want to be attuned to something new coming in. Then we went back to the drops, and they didn't respond." Gagliano reported that she retested her plants after a week and found that they continued to disregard the drop stimulus, indicating that they "remembered" what they had learned. Even after twenty-eight days, the lesson had not been forgotten. She reminded her colleagues that, in similar experiments with bees, the insects forgot what they had learned after just forty-eight hours.

Gagliano concluded by suggesting that "brains and neurons are a sophisticated solution but not a necessary requirement for learning," and that there is "some unifying mechanism across living systems that can process information and learn."

A lively exchange followed. Someone objected that dropping a plant was not a relevant trigger, since that doesn't happen in nature. Gagliano pointed out that electric shock, an equally artificial trigger, is often used in animal-learning experiments. Another scientist suggested that perhaps her plants were not habituated, just tuckered out. She argued that twenty-eight days would be plenty of time to rebuild their energy reserves.

On my way out of the lecture hall, I bumped into Fred Sack, a prominent botanist at the University of British Columbia. I asked him what he thought of Gagliano's presentation. "Bullshit," he replied. He explained that the word "learning" implied a brain and should be reserved for animals: "Animals can exhibit learning, but plants evolve adaptations." He was making a distinction between behavioral changes that occur within the lifetime of an organism and those which arise across generations. At lunch, I sat with a Russian scientist, who was equally dismissive. "It's not learning," he said. "So there's nothing to discuss."

Later that afternoon, Gagliano seemed both stung by some of the reactions to her presentation and defiant. Adaptation is far too slow a process to explain the behavior she had observed, she told me. "How can they be adapted to something they have never experienced in their real world?" She noted that some of her plants learned faster than others, evidence that "this is not an innate or programmed response." Many of the scientists in her audience were just getting used to the ideas of plant "behavior" and "memory" (terms that even Fred Sack said he was willing to accept); using words like "learning" and "intelligence" in plants struck them, in Sack's words, as "inappropriate" and "just weird." When I described the experiment to Lincoln Taiz, he suggested the words "habituation" or "desensitization" would be more appropriate than "learning." Gagliano said that her mimosa paper had been rejected by ten journals: "None of the reviewers had problems with the data." Instead, they balked at the language she used to describe the data. But she didn't want to change it. "Unless we use the same language to describe the same behavior"—exhibited by plants and animals—"we can't compare it," she said.

Rick Karban consoled Gagliano after her talk. "I went through the same thing, just getting totally hammered," he told her. "But you're doing good work. The system is just not ready." When I asked him what he thought of Gagliano's paper, he said, "I don't know if she's got everything nailed down, but it's a very cool idea that deserves to get out there and be discussed. I hope she doesn't get discouraged."

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Scientists are often uncomfortable talking about the role of metaphor and imagination in their work, yet scientific progress often depends on both. "Metaphors help stimulate the investigative imagination of good scientists," the British plant scientist Anthony Trewavas wrote in a spirited response to the Alpi letter denouncing plant neurobiology. "Plant neurobiology" is obviously a metaphor—plants don't possess the type of excitable, communicative cells we call

neurons. Yet the introduction of the term has raised a series of questions and inspired a set of experiments that promise to deepen our understanding not only of plants but potentially also of brains. If there are other ways of processing information, other kinds of cells and cell networks that can somehow give rise to intelligent behavior, then we may be more inclined to ask, with Mancuso, "What's so special about neurons?"

Mancuso is the poet-philosopher of the movement, determined to win for plants the recognition they deserve and, perhaps, bring humans down a peg in the process. His somewhat grandly named International Laboratory of Plant Neurobiology, a few miles outside Florence, occupies a modest suite of labs and offices in a low-slung modern building. Here a handful of collaborators and graduate students work on the experiments Mancuso devises to test the intelligence of plants. Giving a tour of the labs, he showed me maize plants, grown under lights, that were being taught to ignore shadows; a poplar sapling hooked up to a galvanometer to measure its response to air pollution; and a chamber in which a PTR-TOF machine—an advanced kind of mass spectrometer—continuously read all the volatiles emitted by a succession of plants, from poplars and tobacco plants to peppers and olive trees. "We are making a dictionary of each species' entire chemical vocabulary," he explained. He estimates that a plant has three thousand chemicals in its vocabulary, while, he said with a smile, "the average student has only seven hundred words."

Mancuso is fiercely devoted to plants—a scientist needs to "love" his subject in order to do it justice, he says. He is also gentle and unassuming, even when what he is saying is outrageous. In the corner of his office sits a forlorn *Ficus benjamina,* or weeping fig, and on the walls are photographs of Mancuso in an astronaut's jumpsuit floating in the cabin of a zero-gravity aircraft; he has collaborated with the European Space Agency, which has supported his research on plant behavior in micro- and hyper-gravity. (One of his experiments was carried on board the last flight of the space shuttle Endeavor, in May of 2011.) A decade ago, Mancuso persuaded a Florentine bank foundation to underwrite much of his research and help launch the Society for Plant Neurobiology; his lab also receives grants from the European Union.

Early in our conversation, I asked Mancuso for his definition of "intelligence." Spending so much time with the plant neurobiologists, I could feel my grasp on the word getting less sure. It turns out that I am not alone: philosophers and psychologists have been arguing over the definition of intelligence for at least a century, and whatever consensus there may once have been has been rapidly slipping away. Most definitions of intelligence fall into one of two categories. The first is worded so that intelligence requires a brain; the definition refers to intrinsic mental qualities such as reason, judgment, and abstract thought. The second category, less brain-bound and metaphysical, stresses behavior, defining intelligence as the ability to respond in optimal ways to the challenges presented by one's environment and circumstances. Not surprisingly, the plant neurobiologists jump into this second camp.

"I define it very simply," Mancuso said. "Intelligence is the ability to solve problems." In place of a brain, "what I am looking for is a distributed sort of intelligence, as we see in the swarming of birds." In a flock, each bird has only to follow a few simple rules, such as

maintaining a prescribed distance from its neighbor, yet the collective effect of a great many birds executing a simple algorithm is a complex and supremely well-coordinated behavior. Mancuso's hypothesis is that something similar is at work in plants, with their thousands of root tips playing the role of the individual birds—gathering and assessing data from the environment and responding in local but coordinated ways that benefit the entire organism.

"Neurons perhaps are overrated," Mancuso said. "They're really just excitable cells." Plants have their own excitable cells, many of them in a region just behind the root tip. Here Mancuso and his frequent collaborator, František Baluška, have detected unusually high levels of electrical activity and oxygen consumption. They've hypothesized in a series of papers that this so-called "transition zone" may be the locus of the "root brain" first proposed by Darwin. The idea remains unproved and controversial. "What's going on there is not well understood," Lincoln Taiz told me, "but there is no evidence it is a command center."

How plants do what they do without a brain—what Anthony Trewavas has called their "mindless mastery"—raises questions about how our brains do what they do. When I asked Mancuso about the function and location of memory in plants, he speculated about the possible role of calcium channels and other mechanisms, but then he reminded me that mystery still surrounds where and how our memories are stored: "It could be the same kind of machinery, and figuring it out in plants may help us figure it out in humans."

The hypothesis that intelligent behavior in plants may be an emergent property of cells exchanging signals in a network might sound far-fetched, yet the way that intelligence emerges from a network of neurons may not be very different. Most neuroscientists would agree that, while brains considered as a whole function as centralized command centers for most animals, within the brain there doesn't appear to be any command post; rather, one finds a leaderless network. That sense we get when we think about what might govern a plant—that there is no *there* there, no wizard behind the curtain pulling the levers—may apply equally well to our brains.

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In Martin Amis's 1995 novel, *The Information*, we meet a character who aspires to write "The History of Increasing Humiliation," a treatise chronicling the gradual dethronement of humankind from its position at the center of the universe, beginning with Copernicus. "Every century we get smaller," Amis writes. Next came Darwin, who brought the humbling news that we are the product of the same natural laws that created animals. In the last century, the formerly sharp lines separating humans from animals—our monopolies on language, reason, toolmaking, culture, even self-consciousness—have been blurred, one after another, as science has granted these capabilities to other animals.

Mancuso and his colleagues are writing the next chapter in "The History of Increasing Humiliation." Their project entails breaking down the walls between the kingdoms of plants and animals, and it is proceeding not only experiment by experiment but also word by word. Start with that slippery word "intelligence." Particularly when there is no dominant definition (and

when measurements of intelligence, such as I.Q., have been shown to be culturally biased), it is possible to define intelligence in a way that either reinforces the boundary between animals and plants (say, one that entails abstract thought) or undermines it. Plant neurobiologists have chosen to define intelligence democratically, as an ability to solve problems or, more precisely, to respond adaptively to circumstances, including ones unforeseen in the genome.

"I agree that humans are special," Mancuso says. "We are the first species able to argue about what intelligence is. But it's the quantity, not the quality" of intelligence that sets us apart. We exist on a continuum with the acacia, the radish, and the bacterium. "Intelligence is a property of life," he says. I asked him why he thinks people have an easier time granting intelligence to computers than to plants. (Fred Sack told me that he can abide the term "artificial intelligence," because the intelligence in this case is modified by the word "artificial," but not "plant intelligence." He offered no argument, except to say, "I'm in the majority in saying it's a little weird.") Mancuso thinks we're willing to accept artificial intelligence because computers are our creations, and so reflect our own intelligence back at us. They are also our dependents, unlike plants: "If we were to vanish tomorrow, the plants would be fine, but if the plants vanished . . ." Our dependence on plants breeds a contempt for them, Mancuso believes. In his somewhat topsy-turvy view, plants "remind us of our weakness."

"Memory" may be an even thornier word to apply across kingdoms, perhaps because we know so little about how it works. We tend to think of memories as immaterial, but in animal brains some forms of memory involve the laying down of new connections in a network of neurons. Yet there are ways to store information biologically that don't require neurons. Immune cells "remember" their experience of pathogens, and call on that memory in subsequent encounters. In plants, it has long been known that experiences such as stress can alter the molecular wrapping around the chromosomes; this, in turn, determines which genes will be silenced and which expressed. This so-called "epigenetic" effect can persist and sometimes be passed down to offspring. More recently, scientists have found that life events such as trauma or starvation produce epigenetic changes in animal brains (coding for high levels of cortisol, for example) that are long-lasting and can also be passed down to offspring, a form of memory much like that observed in plants.

While talking with Mancuso, I kept thinking about words like "will," "choice," and "intention," which he seemed to attribute to plants rather casually, almost as if they were acting consciously. At one point, he told me about the dodder vine, *Cuscuta europaea*, a parasitic white vine that winds itself around the stalk of another plant and sucks nourishment from it. A dodder vine will "choose" among several potential hosts, assessing, by scent, which offers the best potential nourishment. Having selected a target, the vine then performs a kind of cost-benefit calculation before deciding exactly how many coils it should invest—the more nutrients in the victim, the more coils it deploys. I asked Mancuso whether he was being literal or metaphorical in attributing intention to plants.

"Here, I'll show you something," he said. "Then you tell me if plants have intention." He swiveled his computer monitor around and clicked open a video.

Time-lapse photography is perhaps the best tool we have to bridge the chasm between the time scale at which plants live and our own. This example was of a young bean plant, shot in the lab over two days, one frame every ten minutes. A metal pole on a dolly stands a couple of feet away. The bean plant is "looking" for something to climb. Each spring, I witness the same process in my garden, in real time. I always assumed that the bean plants simply grow this way or that, until they eventually bump into something suitable to climb. But Mancuso's video seems to show that this bean plant "knows" exactly where the metal pole is long before it makes contact with it. Mancuso speculates that the plant could be employing a form of echolocation. There is some evidence that plants make low clicking sounds as their cells elongate; it's possible that they can sense the reflection of those sound waves bouncing off the metal pole.

The bean plant wastes no time or energy "looking"—that is, growing—anywhere but in the direction of the pole. And it is striving (there is no other word for it) to get there: reaching, stretching, throwing itself over and over like a fly rod, extending itself a few more inches with every cast, as it attempts to wrap its curling tip around the pole. As soon as contact is made, the plant appears to relax; its clenched leaves begin to flutter mildly. All this may be nothing more than an illusion of time-lapse photography. Yet to watch the video is to feel, momentarily, like one of the aliens in Mancuso's formative science-fiction story, shown a window onto a dimension of time in which these formerly inert beings come astonishingly to life, seemingly conscious individuals with intentions.

In October, I loaded the bean video onto my laptop and drove down to Santa Cruz to play it for Lincoln Taiz. He began by questioning its value as scientific data: "Maybe he has ten other videos where the bean didn't do that. You can't take one interesting variation and generalize from it." The bean's behavior was, in other words, an anecdote, not a phenomenon. Taiz also pointed out that the bean in the video was leaning toward the pole in the first frame. Mancuso then sent me another video with two perfectly upright bean plants that exhibited very similar behavior. Taiz was now intrigued. "If he sees that effect consistently, it would be exciting," he said—but it would not necessarily be evidence of plant intention. "If the phenomenon is real, it would be classified as a tropism," such as the mechanism that causes plants to bend toward light. In this case, the stimulus remains unknown, but tropisms "do not require one to postulate either intentionality or 'brainlike' conceptualization," Taiz said. "The burden of proof for the latter interpretation would clearly be on Stefano."

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Perhaps the most troublesome and troubling word of all in thinking about plants is "consciousness." If consciousness is defined as inward awareness of oneself experiencing reality—"the feeling of what happens," in the words of the neuroscientist Antonio Damasio—then we can (probably) safely conclude that plants don't possess it. But if we define the term simply as the state of being awake and aware of one's environment—"online," as the neuroscientists say—then plants may qualify as conscious beings, at least according to Mancuso and Baluška. "The bean knows exactly what is in the environment around it," Mancuso said.

"We don't know how. But this is one of the features of consciousness: You know your position in the world. A stone does not."

In support of their contention that plants are conscious of their environment, Mancuso and Baluška point out that plants can be rendered unconscious by the same anesthetics that put animals out: drugs can induce in plants an unresponsive state resembling sleep. (A snoozing Venus flytrap won't notice an insect crossing its threshold.) What's more, when plants are injured or stressed, they produce a chemical—ethylene—that works as an anesthetic on animals. When I learned this startling fact from Baluška in Vancouver, I asked him, gingerly, if he meant to suggest that plants could feel pain. Baluška, who has a gruff mien and a large bullet-shaped head, raised one eyebrow and shot me a look that I took to mean he deemed my question impertinent or absurd. But apparently not.

"If plants are conscious, then, yes, they should feel pain," he said. "If you don't feel pain, you ignore danger and you don't survive. Pain is adaptive." I must have shown some alarm. "That's a scary idea," he acknowledged with a shrug. "We live in a world where we must eat other organisms."

Unprepared to consider the ethical implications of plant intelligence, I could feel my resistance to the whole idea stiffen. Descartes, who believed that only humans possessed self-consciousness, was unable to credit the idea that other animals could suffer from pain. So he dismissed their screams and howls as mere reflexes, as meaningless physiological noise. Could it be remotely possible that we are now making the same mistake with plants? That the perfume of jasmine or basil, or the scent of freshly mowed grass, so sweet to us, is (as the ecologist Jack Schultz likes to say) the chemical equivalent of a scream? Or have we, merely by posing such a question, fallen back into the muddied waters of *The Secret Life of Plants*?

Lincoln Taiz has little patience for the notion of plant pain, questioning what, in the absence of a brain, would be doing the feeling. He puts it succinctly: "No brain, no pain." Mancuso is more circumspect. We can never determine with certainty whether plants feel pain or whether their perception of injury is sufficiently like that of animals to be called by the same word. (He and Baluška are careful to write of "plant-specific pain perception.") "We just don't know, so we must be silent."

Mancuso believes that, because plants are sensitive and intelligent beings, we are obliged to treat them with some degree of respect. That means protecting their habitats from destruction and avoiding practices such as genetic manipulation, growing plants in monocultures, and training them in bonsai. But it does not prevent us from eating them. "Plants evolved to be

eaten—it is part of their evolutionary strategy," he said. He cited their modular structure and lack of irreplaceable organs in support of this view.

The central issue dividing the plant neurobiologists from their critics would appear to be this: Do capabilities such as intelligence, pain perception, learning, and memory require the existence of a brain, as the critics contend, or can they be detached from their neurobiological moorings? The question is as much philosophical as it is scientific, since the answer depends on how these terms get defined. The proponents of plant intelligence argue that the traditional definitions of these terms are anthropocentric—a clever reply to the charges of anthropomorphism frequently thrown at them. Their attempt to broaden these definitions is made easier by the fact that the meanings of so many of these terms are up for grabs. At the same time, since these words were originally created to describe animal attributes, we shouldn't be surprised at the awkward fit with plants. It seems likely that, if the plant neurobiologists were willing to add the prefix "plant-specific" to intelligence and learning and memory and consciousness (as Mancuso and Baluška are prepared to do in the case of pain), then at least some of this "scientific controversy" might evaporate.

Indeed, I found more consensus on the underlying science than I expected. Even Clifford Slayman, the Yale biologist who signed the 2007 letter dismissing plant neurobiology, is willing to acknowledge that, although he doesn't think plants possess intelligence, he does believe they are capable of "intelligent behavior," in the same way that bees and ants are. In an e-mail exchange, Slayman made a point of underlining this distinction: "We do not know what constitutes intelligence, only what we can observe and judge as intelligent behavior." He defined "intelligent behavior" as "the ability to adapt to changing circumstances" and noted that it "must always be measured relative to a particular environment." Humans may or may not be intrinsically more intelligent than cats, he wrote, but when a cat is confronted with a mouse its behavior is likely to be demonstrably more intelligent.

Slayman went on to acknowledge that "intelligent behavior could perfectly well develop without such a nerve center or headquarters or director or brain—whatever you want to call it. Instead of 'brain,' think 'network.' It seems to be that many higher organisms are internally networked in such a way that local changes," such as the way that roots respond to a water gradient, "cause very local responses which benefit the entire organism." Seen that way, he added, the outlook of Mancuso and Trewavas is "pretty much in line with my understanding of biochemical/biological networks." He pointed out that while it is an understandable human prejudice to favor the "nerve center" model, we also have a second, autonomic nervous system governing our digestive processes, which "operates most of the time without instructions from higher up." Brains are just one of nature's ways of getting complex jobs done, for dealing intelligently with the challenges presented by the environment. But they are not the only way: "Yes, I would argue that intelligent behavior is a property of life."

* * * * *

To define certain words in such a way as to bring plants and animals beneath the same semantic umbrella—whether of intelligence or intention or learning—is a philosophical choice with important consequences for how we see ourselves in nature. Since *The Origin of Species*, we have understood, at least intellectually, the continuities among life's kingdoms—that we are all cut from the same fabric of nature. Yet our big brains, and perhaps our experience of inwardness, allow us to feel that we must be fundamentally different—suspended above nature and other species as if by some metaphysical "skyhook," to borrow a phrase from the philosopher Daniel Dennett. Plant neurobiologists are intent on taking away our skyhook, completing the revolution that Darwin started but which remains—psychologically, at least—incomplete.

"What we learned from Darwin is that competence precedes comprehension," Dennett said when I called to talk to him about plant neurobiology. Upon a foundation of the simplest competences—such as the on-off switch in a computer, or the electrical and chemical signaling of a cell—can be built higher and higher competences until you wind up with something that looks very much like intelligence. "The idea that there is a bright line, with real comprehension and real minds on the far side of the chasm, and animals or plants on the other—that's an archaic myth." To say that higher competences such as intelligence, learning, and memory "mean nothing in the absence of brains" is, in Dennett's view, "cerebrocentric."

All species face the same existential challenges—obtaining food, defending themselves, reproducing—but under wildly varying circumstances, and so they have evolved wildly different tools in order to survive. Brains come in handy for creatures that move around a lot; but they're a disadvantage for ones that are rooted in place. Impressive as it is to us, self-consciousness is just another tool for living, good for some jobs, unhelpful for others. That humans would rate this particular adaptation so highly is not surprising, since it has been the shining destination of our long evolutionary journey, along with the epiphenomenon of self-consciousness that we call "free will."

In addition to being a plant physiologist, Lincoln Taiz writes about the history of science. "Starting with Darwin's grandfather, Erasmus," he told me, "there has been a strain of teleology in the study of plant biology"—a habit of ascribing purpose or intention to the behavior of plants. I asked Taiz about the question of "choice," or decision-making, in plants, as when they must decide between two conflicting environmental signals—water and gravity, for example.

"Does the plant decide in the same way that we choose at a deli between a Reuben sandwich or lox and bagel?" Taiz asked. "No, the plant response is based entirely on the net flow of auxin and other chemical signals. The verb 'decide' is inappropriate in a plant context. It implies free will. Of course, one could argue that humans lack free will too, but that is a separate issue."

I asked Mancuso if he thought that a plant decides in the same way we might choose at a deli between a Reuben or lox and bagels.

"Yes, in the same way," Mancuso wrote back, though he indicated that he had no idea what a Reuben was. "Just put ammonium nitrate in the place of Reuben sandwich (whatever it is)

and phosphate instead of salmon, and the roots will make a decision." But isn't the root responding simply to the net flow of certain chemicals? "I'm afraid our brain makes decisions in the same exact way."

* * * * *

"Why would a plant care about Mozart?" the late ethnobotanist Tim Plowman would reply when asked about the wonders catalogued in *The Secret Life of Plants*. "And even if it did, why should that impress us? They can eat light, isn't that enough?"

One way to exalt plants is by demonstrating their animal-like capabilities. But another way is to focus on all the things plants can do that we cannot. Some scientists working on plant intelligence have questioned whether the "animal-centric" emphasis, along with the obsession with the term "neurobiology," has been a mistake and possibly an insult to the plants. "I have no interest in making plants into little animals," one scientist wrote during the dustup over what to call the society. "Plants are unique," another wrote. "There is no reason to … call them demi-animals."

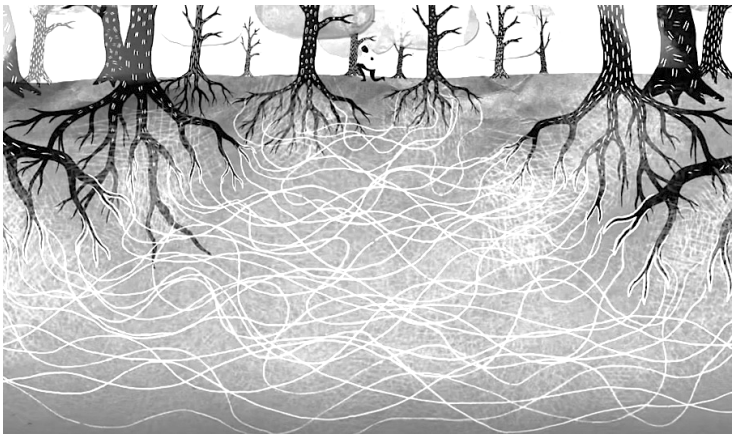
When I met Mancuso for dinner during the conference in Vancouver, he sounded very much like a plant scientist getting over a case of "brain envy"—what Taiz had suggested was motivating the plant neurologists. If we could begin to understand plants on their own terms, he said, "it would be like being in contact with an alien culture. But we could have all the advantages of that contact without any of the problems—because it doesn't want to destroy us!" How do plants do all the amazing things they do without brains? Without locomotion? By focussing on the otherness of plants rather than on their likeness, Mancuso suggested, we stand to learn valuable things and develop important new technologies. This was to be the theme of his presentation to the conference, the following morning, on what he called "bioinspiration." How might the example of plant intelligence help us design better computers, or robots, or networks?

Mancuso was about to begin a collaboration with a prominent computer scientist to design a plant-based computer, modelled on the distributed computing performed by thousands of roots processing a vast number of environmental variables. His collaborator, Andrew Adamatzky, the director of the International Center of Unconventional Computing, at the University of the West of England, has worked extensively with slime molds, harnessing their maze-navigating and computational abilities. (Adamatzky's slime molds, which are a kind of amoeba, grow in the direction of multiple food sources simultaneously, usually oat flakes, in the process computing and remembering the shortest distance between any two of them; he has used these organisms to model transportation networks.) In an e-mail, Adamatzky said that, as a substrate for biological computing, plants offered both advantages and disadvantages over slime molds. "Plants are more robust," he wrote, and "can keep their shape for a very long time," although they are slower-growing and lack the flexibility of slime molds. But because plants are already "analog electrical computers," trafficking in electrical inputs and outputs, he is hopeful that he and Mancuso will be able to harness them for computational tasks.

Mancuso was also working with Barbara Mazzolai, a biologist-turned-engineer at the Italian Institute of Technology, in Genoa, to design what he called a "plantoid": a robot designed

on plant principles. “If you look at the history of robots, they are always based on animals—they are humanoids or insectoids. If you want something swimming, you look at a fish. But what about imitating plants instead? What would that allow you to do? Explore the soil!” With a grant from the European Union’s Future and Emerging Technologies program, their team is developing a “robotic root” that, using plastics that can elongate and then harden, will be able to slowly penetrate the soil, sense conditions, and alter its trajectory accordingly. “If you want to explore other planets, the best thing is to send plantoids.”

The most bracing part of Mancuso’s talk on bioinspiration came when he discussed underground plant networks. Citing the research of Suzanne Simard, a forest ecologist at the University of British Columbia, and her colleagues, Mancuso showed a slide depicting how trees in a forest organize themselves into far-flung networks, using the underground web of mycorrhizal fungi which connects their roots to exchange information and even goods. This “wood-wide web,” as the title of one paper put it, allows scores of trees in a forest to convey warnings of insect attacks, and also to deliver carbon, nitrogen, and water to trees in need.



When I reached Simard by phone, she described how she and her colleagues track the flow of nutrients and chemical signals through this invisible underground network. They injected fir trees with radioactive carbon isotopes, then followed the spread of the isotopes through the forest community using a variety of sensing methods, including a Geiger counter. Within a few days, stores of radioactive carbon had been routed from tree to tree. Every tree in a plot thirty meters square was connected to the network; the oldest trees functioned as hubs, some with as many as forty-seven connections. The diagram of the forest network resembled an airline route map.

The pattern of nutrient traffic showed how “mother trees” were using the network to nourish shaded seedlings, including their offspring—which the trees can apparently recognize as kin—until they’re tall enough to reach the light. And, in a striking example of interspecies cooperation, Simard found that fir trees were using the fungal web to trade nutrients with paper-bark birch trees over the course of the season. The evergreen species will tide over the deciduous one when it has sugars to spare, and then call in the debt later in the season. For the forest community, the value of this cooperative underground economy appears to be better over-all health, more total photosynthesis, and greater resilience in the face of disturbance.

In his talk, Mancuso juxtaposed a slide of the nodes and links in one of these subterranean forest networks with a diagram of the Internet, and suggested that in some respects the former was superior. “Plants are able to create scalable networks of self-maintaining, self-operating, and self-repairing units,” he said. “Plants.”

As I listened to Mancuso limn the marvels unfolding beneath our feet, it occurred to me that plants do have a secret life, and it is even stranger and more wonderful than the one described by Tompkins and Bird. When most of us think of plants, to the extent that we think about plants at all, we think of them as old—holdovers from a simpler, prehuman evolutionary past. But for Mancuso plants hold the key to a future that will be organized around systems and technologies that are networked, decentralized, modular, reiterated, redundant—and green, able to nourish themselves on light. "Plants are the great symbol of modernity." Or should be: their brainlessness turns out to be their strength, and perhaps the most valuable inspiration we can take from them.

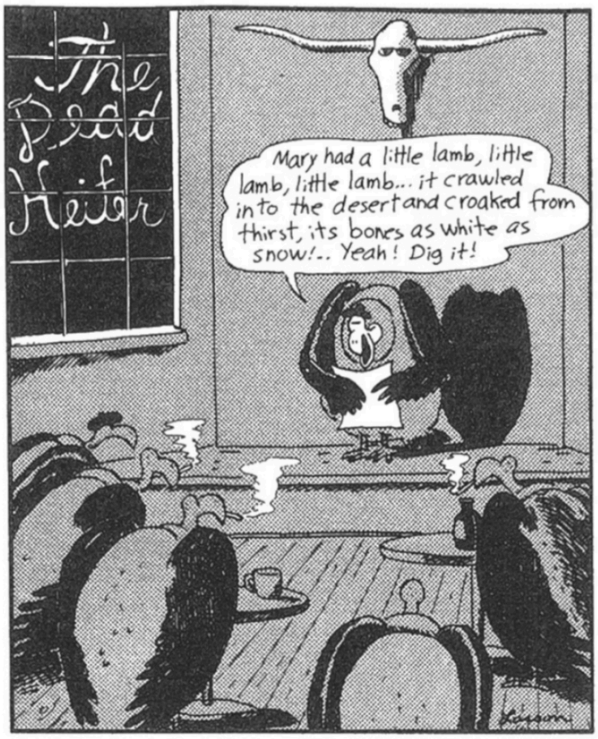
At dinner in Vancouver, Mancuso said, "Since you visited me in Florence, I came across this sentence of Karl Marx, and I became obsessed with it: 'Everything that is solid melts into air.' Whenever we build anything, it is inspired by the architecture of our bodies. So it will have a solid structure and a center, but that is inherently fragile. This is the meaning of that sentence—'Everything solid melts into air.' So that's the question: Can we now imagine something completely different, something inspired instead by plants?

Source: Pollan, Michael. "The Intelligent Plant." *The New Yorker*, December 23, 2013. michaelpollan.com/articles-archive/the-intelligent-plant/.

Selected Comics from *The Far Side*

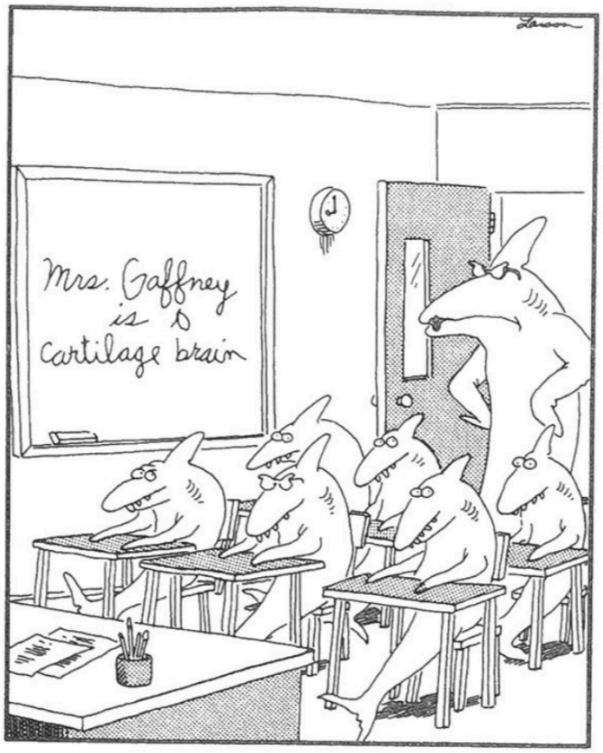
By Gary Larson
From *Unnatural Selections*, 1991.

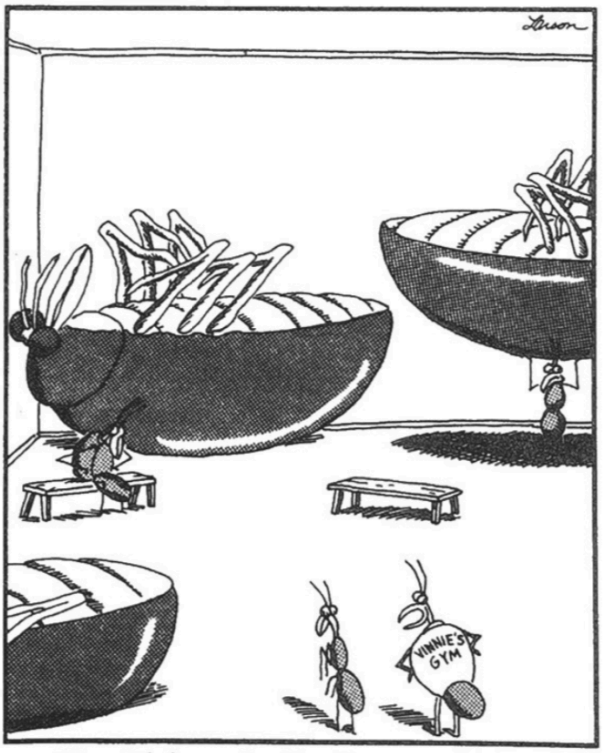
Saturday mornings in cockroach households



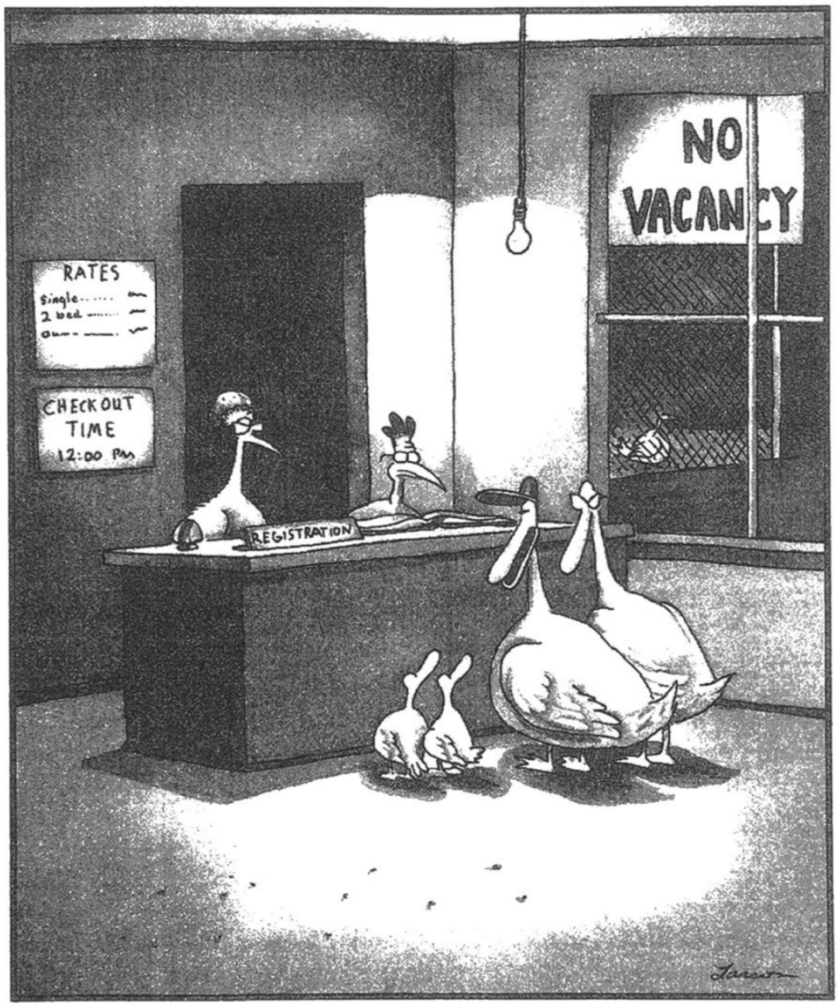
Buzzard beakniks

"Just ignore him. That's our rebellious young calf Matthew—he's into wearing leather clothes just for the shock value."





"Now, this is our dead beetle room, and some of these babies are 50 times an ant's body weight. . . . 'Course, we'll want to start *you* out on dried ladybugs."



"Sorry, kids—they've got cable, but no pond."

THE IMPACT OF THE CONCEPT OF CULTURE ON THE CONCEPT OF MAN

By Clifford Geertz
From *The Interpretations of Cultures*, 1973.

Toward the end of his recent study of the ideas used by tribal peoples, *La Pensée Sauvage,* the French anthropologist Lévi-Strauss remarks that scientific explanation does not consist, as we have been led to imagine, in the reduction of the complex to the simple. Rather, it consists, he says, in a substitution of a complexity more intelligible for one which is less. So far as the study of man is concerned, one may go even further, I think, and argue that explanation often consists of substituting complex pictures for simple ones while striving somehow to retain the persuasive clarity that went with the simple ones.

Elegance remains, I suppose, a general scientific ideal; but in the social sciences, it is very often in departures from that ideal that truly creative developments occur. Scientific advancement commonly consists in a progressive complication of what once seemed a beautifully simple set of notions but now seems an unbearably simplistic one. . . . Whitehead once offered to the natural sciences the maxim "Seek simplicity and distrust it"; to the social sciences he might well have offered "Seek complexity and order it."

Certainly the study of culture has developed as though this maxim were being followed. The rise of a scientific concept of culture amounted to, or at least was connected with, the overthrow of the view of human nature dominant in the Enlightenment—a view that, whatever else may be said for or against it, was both clear and simple—and its replacement by a view not only more complicated but enormously less clear. The attempt to clarify it, to reconstruct an intelligible account of what man is, has underlain scientific thinking about culture ever since. Having sought complexity and, on a scale grander than they ever imagined, found it, anthropologists became entangled in a tortuous effort to order it. And the end is not yet in sight.

The Enlightenment view of man was, of course, that he was wholly of a piece with nature and shared in the general uniformity of composition which natural science, under Bacon's urging and Newton's guidance, had discovered there. There is, in brief, a human nature as regularly organized, as thoroughly invariant, and as marvelously simple as Newton's universe. Perhaps some of its laws are different, but there *are* laws; perhaps some of its immutability is obscured by the trappings of local fashion, but it *is* immutable.

A quotation that Lovejoy (whose magisterial analysis I am following here) gives from an Enlightenment historian, Mascou, presents the position with the useful bluntness one often finds in a minor writer:

> The stage setting [in different times and places] is, indeed, altered, the actors change their garb and their appearance; but their inward motions arise from the same desires and passions of men, and produce their effects in the vicissitudes of kingdoms and peoples.[2]

[2] A. O. Lovejoy, *Essays in the History of Ideas* (New York, 1960), p. 173.

Now, this view is hardly one to be despised; nor, despite my easy references a moment ago to "overthrow," can it be said to have disappeared from contemporary anthropological thought. The notion that men are men under whatever guise and against whatever backdrop has not been replaced by "other mores, other beasts."

Yet, cast as it was, the Enlightenment concept of the nature of human nature had some much less acceptable implications, the main one being that, to quote Lovejoy himself this time, "anything of which the intelligibility, verifiability, or actual affirmation is limited to men of a special age, race, temperament, tradition or condition is [in and of itself] without truth or value, or at all events without importance to a reasonable man."[3] The great, vast variety of differences among men, in beliefs and values, in customs and institutions, both over time and from place to place, is essentially without significance in defining his nature. It consists of mere accretions, distortions even, overlaying and obscuring what is truly human—the constant, the general, the universal—in man.

Thus, in a passage now notorious, Dr. Johnson saw Shakespeare's genius to lie in the fact that "his characters are not modified by the customs of particular places, unpracticed by the rest of the world; by the peculiarities of studies or professions, which can operate upon but small numbers; or by the accidents of transient fashions or temporary opinions."[4] And Racine regarded the success of his plays on classical themes as proof that "the taste of Paris . . . conforms to that of Athens; my spectators have been moved by the same things which, in other times, brought tears to the eyes of the most cultivated classes of Greece."[5]

The trouble with this kind of view, aside from the fact that it sounds comic coming from someone as profoundly English as Johnson or as French as Racine, is that the image of a constant human nature independent of time, place, and circumstance, of studies and professions, transient fashions and temporary opinions, may be an illusion; that what man is may be so entangled with where he is, who he is, and what he believes that it is inseparable from them. It is precisely the consideration of such a possibility that led to the rise of the concept of culture and the decline of the uniformitarian view of man. Whatever else modern anthropology asserts— and it seems to have asserted almost everything at one time or another—it is firm in the conviction that men modified by the customs of particular places do not in fact exist, have never existed, and most important, could not in the very nature of the case exist. There is, there can be, no backstage where we can go to catch a glimpse of Mascou's actors as "real persons" lounging about in street clothes, disengaged from their profession, displaying with artless candor their spontaneous desires and unprompted passions. They may change their roles, their styles of acting, even the dramas in which they play; but—as Shakespeare himself of course remarked—they are always performing.

This circumstance makes the drawing of a line between what is natural, universal, and constant in man and what is conventional, local, and variable extraordinarily difficult. In fact, it

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[3] Ibid., p. 80.
[4] "Preface to Shakespeare," *Johnson on Shakespeare* (London, 1931), pp. 11-12.
[5] From the Preface to *Iphi génie*.

suggests that to draw such a line is to falsify the human situation, or at least to misrender it seriously.

Consider Balinese trance. The Balinese fall into extreme dissociated states in which they perform all sorts of spectacular activities—biting off the heads of living chickens, stabbing themselves with daggers, throwing themselves wildly about, speaking with tongues, performing miraculous feats of equilibration, mimicking sexual intercourse, eating feces, and so on—rather more easily and much more suddenly than most of us fall asleep. Trance states are a crucial part of every ceremony. In some, fifty or sixty people may fall, one after the other ("like a string of firecrackers going off," as one observer puts it), emerging anywhere from five minutes to several hours later, totally unaware of what they have been doing and convinced, despite the amnesia, that they have had the most extraordinary and deeply satisfying experience a man can have.

What does one learn about human nature from this sort of thing and from the thousand similarly peculiar things anthropologists discover, investigate, and describe? That the Balinese are peculiar sorts of beings, South Sea Martians? That they are just the same as we at base, but with some peculiar, but really incidental, customs we do not happen to have gone in for? That they are innately gifted or even instinctively driven in certain directions rather than others? Or that human nature does not exist and men are pure and simply what their culture makes them?

It is among such interpretations as these, all unsatisfactory, that anthropology has attempted to find its way to a more viable concept of man, one in which culture, and the variability of culture, would be taken into account rather than written off as caprice and prejudice, and yet, at the same time, one in which the governing principle of the field, "the basic unity of mankind," would not be turned into an empty phrase. To take the giant step away from the uniformitarian view of human nature is, so far as the study of man is concerned, to leave the Garden [of Eden]. To entertain the idea that the diversity of custom across time and over space is not a mere matter of garb and appearance, of stage settings and comedic masques, is to entertain also the idea that humanity is as various in its essence as it is in its expression. And with that reflection some well-fastened philosophical moorings are loosed and an uneasy drifting into perilous waters begins. . . .

* * * * *

The major reason why anthropologists have shied away from cultural particularities when it came to a question of defining man and have taken refuge instead in bloodless universals is that, faced as they are with the enormous variation in human behavior, they are haunted by a fear of historicism, of becoming lost in a whirl of cultural relativism so convulsive as to deprive them of any fixed bearings at all. Nor has there not been some occasion for such a fear: Ruth Benedict's *Patterns of Culture*, probably the most popular book in anthropology ever published in this country, with its strange conclusion that anything one group of people is inclined toward doing is worthy of respect by another, is perhaps only the most outstanding example of the

awkward positions one can get into by giving oneself over rather too completely to what Marc Bloch called "the thrill of learning singular things."

Yet the fear is a bogey. The notion that unless a cultural phenomenon is empirically universal it cannot reflect anything about the nature of man is about as logical as the notion that because sickle-cell anemia is, fortunately, not universal, it cannot tell us anything about human genetic processes. It is not whether phenomena are empirically common that is critical in science . . . but whether they can be made to reveal the enduring natural processes that underly them. Seeing heaven in a grain of sand is not a trick only poets can accomplish.

In short, we need to look for systematic relationships among diverse phenomena, not for substantive identities among similar ones. And to do that with any effectiveness, we need to replace the "stratigraphic" conception of the relations between the various aspects of human existence with a synthetic one; that is, one in which biological, psychological, sociological, and cultural factors can be treated as variables within unitary systems of analysis. The establishment of a common language in the social sciences is not a matter of mere coordination of terminologies or, worse yet, of coining artificial new ones; nor is it a matter of imposing a single set of categories upon the area as a whole. It is a matter of integrating different types of theories and concepts in such a way that one can formulate meaningful propositions embodying findings now sequestered in separate fields of study.

In attempting to launch such an integration from the anthropological side and to reach, thereby, a more exact image of man, I want to propose two ideas. The first of these is that culture is best seen not as complexes of concrete behavior patterns—customs, usages, traditions, habit clusters—as has, by and large, been the case up to now, but as a set of control mechanisms—plans, recipes, rules, instructions (what computer engineers call "programs")—for the governing of behavior. The second idea is that man is precisely the animal most desperately dependent upon such extra-genetic, outside-the-skin control mechanisms, such cultural programs, for ordering his behavior.

Neither of these ideas is entirely new, but a number of recent developments, both within anthropology and in other sciences (cybernetics, information theory, neurology, molecular genetics) have made them susceptible of more precise statement as well as lending them a degree of empirical support they did not previously have. And out of such reformulations of the concept of culture and of the role of culture in human life comes, in turn, a definition of man stressing not so much the empirical commonalities in his behavior, from place to place and time to time, but rather the mechanisms by whose agency the breadth and indeterminateness of his inherent capacities are reduced to the narrowness and specificity of his actual accomplishments. One of the most significant facts about us may finally be that we all begin with the natural equipment to live a thousand kinds of life but end in the end having lived only one.

The "control mechanism" view of culture begins with the assumption that human thought is basically both social and public—that its natural habitat is the house yard, the marketplace, and the town square. Thinking consists not of "happenings in the head" (though happenings there and elsewhere are necessary for it to occur) but of a traffic in what have been called, by G. H.

Mead and others, significant symbols—words for the most part but also gestures, drawings, musical sounds, mechanical devices like clocks, or natural objects like jewels—anything, in fact, that is disengaged from its mere actuality and used to impose meaning upon experience. From the point of view of any particular individual, such symbols are largely given. He finds them already current in the community when he is born, and they remain, with some additions, subtractions, and partial alterations he may or may not have had a hand in, in circulation after he dies. While he lives he uses them, or some of them, sometimes deliberately and with care, most often spontaneously and with ease, but always with the same end in view: to put a construction upon the events through which he lives, to orient himself within "the ongoing course of experienced things," to adopt a vivid phrase of John Dewey's.

Man is so in need of such symbolic sources of illumination to find his bearings in the world because the non-symbolic sort that are constitutionally ingrained in his body cast so diffused a light. The behavior patterns of lower animals are, at least to a much greater extent, given to them with their physical structure; genetic sources of information order their actions within much narrower ranges of variation, the narrower and more thoroughgoing the lower the animal. For man, what are innately given are extremely general response capacities, which, although they make possible far greater plasticity, complexity, and, on the scattered occasions when everything works as it should, effectiveness of behavior, leave it much less precisely regulated. This, then, is the second face of our argument: Undirected by culture patterns—organized systems of significant symbols—man's behavior would be virtually ungovernable, a mere chaos of pointless acts and exploding emotions, his experience virtually shapeless. Culture, the accumulated totality of such patterns, is not just an ornament of human existence but—the principal basis of its specificity—an essential condition for it.

Within anthropology some of the most telling evidence in support of such a position comes from recent advances in our understanding of what used to be called the descent of man: the emergence of *Homo sapiens* out of his general primate background. Of these advances three are of critical importance: (1) the discarding of a sequential view of the relations between the physical evolution and the cultural development of man in favor of an overlap or interactive view; (2) the discovery that the bulk of the biological changes that produced modern man out of his most immediate progenitors took place in the central nervous system and most especially in the brain; (3) the realization that man is, in physical terms, an incomplete, an unfinished, animal; that what sets him off most graphically from non-men is less his sheer ability to learn (great as that is) than how much and what particular sorts of things he has to learn before he is able to function at all. Let me take each of these points in turn.

The traditional view of the relations between the biological and the cultural advance of man was that the former, the biological, was for all intents and purposes completed before the latter, the cultural, began. That is to say, it was again stratigraphic: Man's physical being evolved, through the usual mechanisms of genetic variation and natural selection, up to the point where his anatomical structure had arrived at more or less the status at which we find it today; then cultural development got under way. At some particular stage in his phylogenetic history, a

marginal genetic change of some sort rendered him capable of producing and carrying culture, and thenceforth his form of adaptive response to environmental pressures was almost exclusively cultural rather than genetic. As he spread over the globe, he wore furs in cold climates and loin cloths (or nothing at all) in warm ones; he didn't alter his innate mode of response to environmental temperature. He made weapons to extend his inherited predatory powers and cooked foods to render a wider range of them digestible. Man became man, the story continues, when, having crossed some mental Rubicon, he became able to transmit "knowledge, belief, law, morals, custom" (to quote the items of Sir Edward Tylor's classical definition of culture) to his descendants and his neighbors through teaching and to acquire them from his ancestors and his neighbors through learning. After that magical moment, the advance of the hominids depended almost entirely on cultural accumulation, on the slow growth of conventional practices, rather than, as it had for ages past, on physical organic change.

The only trouble is that such a moment does not seem to have existed. By the most recent estimates the transition to the cultural mode of life took the genus *Homo* several million years to accomplish; and stretched out in such a manner, it involved not one or a handful of marginal genetic changes but a long, complex, and closely ordered sequence of them. In the current view, the evolution of *Homo sapiens*—modern man—out of his immediate pre-*sapiens* background got definitely under way nearly four million years ago with the appearance of the now famous *Australopithecines*—the so-called ape men of southern and eastern Africa—and culminated with the emergence of *sapiens* himself only some one to two or three hundred thousand years ago. Thus, as at least elemental forms of cultural, or if you wish proto-cultural, activity (simple tool-making, hunting, and so on) seem to have been present among some of the *Australopithecines*, there was an overlap—of, as I say, well over a million years between the beginning of culture and the appearance of man as we know him today. The precise dates—which are tentative and which further research may later alter in one direction or another—are not critical; what is critical is that there was an overlap and that it was a very extended one. The final phases (final to date, at any rate) of the phylogenetic history of man took place in the same grand geological era—the so-called Ice Age—as the initial phases of his cultural history. Men have birthdays, but man does not.

What this means is that culture, rather than being added on, so to speak, to a finished or virtually finished animal, was ingredient, and centrally ingredient, in the production of that animal itself. The slow, steady, almost glacial growth of culture through the Ice Age altered the balance of selection pressures for the evolving *Homo* in such a way as to play a major directive role in his evolution. The perfection of tools, the adoption of organized hunting and gathering practices, the beginnings of true family organization, the discovery of fire, and, most critically, though it is as yet extremely difficult to trace it out in any detail, the increasing reliance upon systems of significant symbols (language, art, myth, ritual) for orientation, communication, and self-control all created for man a new environment to which he was then obliged to adapt. As culture, step by infinitesimal step, accumulated and developed, a selective advantage was given to those individuals in the population most able to take advantage of it—the effective hunter, the

persistent gatherer, the adept toolmaker, the resourceful leader—until what had been a small-brained, proto-human *Australopithecus* became the large-brained fully human *Homo sapiens*. Between the cultural pattern, the body, and the brain, a positive feedback system was created in which each shaped the progress of the other, a system in which the interaction among increasing tool use, the changing anatomy of the hand, and the expanding representation of the thumb on the cortex is only one of the more graphic examples. By submitting himself to governance by symbolically mediated programs for producing artifacts, organizing social life, or expressing emotions, man determined, if unwittingly, the culminating stages of his own biological destiny. Quite literally, though quite inadvertently, he created himself.

Though, as I mentioned, there were a number of important changes in the gross anatomy of genus *Homo* during this period of his crystallization—in skull shape, dentition, thumb size, and so on—by far the most important and dramatic were those that evidently took place in the central nervous system; for this was the period when the human brain, and most particularly the forebrain, ballooned into its present top—heavy proportions. The technical problems are complicated and controversial here, but the main point is that though the *Australopithecines* had a torso and arm configuration not drastically different from our own, and a pelvis and leg formation at least well-launched toward our own, they had cranial capacities hardly larger than those of the living apes—that is to say, about a third to a half of our own. What sets true men off most distinctly from proto-men is apparently not overall bodily form but complexity of nervous organization. The overlap period of cultural and biological change seems to have consisted in an intense concentration on neural development and perhaps associated refinements of various behaviors—of the hands, bipedal locomotion, and so on—for which the basic anatomical foundations—mobile shoulders and wrists, a broadened ilium, and so on—had already been securely laid. In itself, this is perhaps not altogether startling; but, combined with what I have already said, it suggests some conclusions about what sort of animal man is that are, I think, rather far not only from those of the eighteenth century but from those of the anthropology of only ten or fifteen years ago.

Most bluntly, it suggests that there is no such thing as a human nature independent of culture. Men without culture would not be the clever savages of Golding's *Lord of the Flies* thrown back upon the cruel wisdom of their animal instincts; nor would they be the nature's noblemen of Enlightenment primitivism or even, as classical anthropological theory would imply, intrinsically talented apes who had somehow failed to find themselves. They would be unworkable monstrosities with very few useful instincts, fewer recognizable sentiments, and no intellect: mental basket cases. As our central nervous system—and most particularly its crowning curse and glory, the neo-cortex—grew up in great part in interaction with culture, it is incapable of directing our behavior or organizing our experience without the guidance provided by systems of significant symbols. What happened to us in the Ice Age is that we were obliged to abandon the regularity and precision of detailed genetic control over our conduct for the flexibility and adaptability of a more generalized, though of course no less real, genetic control over it. To supply the additional information necessary to be able to act, we were forced, in turn, to rely

more and more heavily on cultural sources—the accumulated fund of significant symbols. Such symbols are thus not mere expressions, instrumentalities, or correlates of our biological, psychological, and social existence; they are prerequisites of it. Without men, no culture, certainly; but equally, and more significantly, without culture, no men.

We are, in sum, incomplete or unfinished animals who complete or finish ourselves through culture—and not through culture in general but through highly particular forms of it: Dobuan and Javanese, Hopi and Italian, upperclass and lower-class, academic and commercial. Man's great capacity for learning, his plasticity, has often been remarked, but what is even more critical is his extreme dependence upon a certain sort of learning: the attainment of concepts, the apprehension and application of specific systems of symbolic meaning. Beavers build dams, birds build nests, bees locate food, baboons organize social groups, and mice mate on the basis of forms of learning that rest predominantly on the instructions encoded in their genes and evoked by appropriate patterns of external stimuli: physical keys inserted into organic locks. But men build dams or shelters, locate food, organize their social groups, or find sexual partners under the guidance of instructions encoded in flow charts and blueprints, hunting lore, moral systems and aesthetic judgments: conceptual structures molding formless talents.

We live, as one writer has neatly put it, in an "information gap." Between what our body tells us and what we have to know in order to function, there is a vacuum we must fill ourselves, and we fill it with information (or misinformation) provided by our culture. The boundary between what is innately controlled and what is culturally controlled in human behavior is an ill-defined and wavering one. Some things are, for all intents and purposes, entirely controlled intrinsically: we need no more cultural guidance to learn how to breathe than a fish needs to learn how to swim. Others are almost certainly largely cultural; we do not attempt to explain on a genetic basis why some men put their trust in centralized planning and others in the free market, though it might be an amusing exercise. Almost all complex human behavior is, of course, the interactive, non-additive outcome of the two. Our capacity to speak is surely innate; our capacity to speak English is surely cultural. Smiling at pleasing stimuli and frowning at unpleasing ones are surely in some degree genetically determined (even apes screw up their faces at noxious odors); but sardonic smiling and burlesque frowning are equally surely predominantly cultural, as is perhaps demonstrated by the Balinese definition of a madman as someone who, like an American, smiles when there is nothing to laugh at. Between the basic ground plans for our life that our genes lay down—the capacity to speak or to smile—and the precise behavior we in fact execute— speaking English in a certain tone of voice, smiling enigmatically in a delicate social situation—lies a complex set of significant symbols under whose direction we transform the first into the second, the ground plans into the activity.

Our ideas, our values, our acts, even our emotions, are, like our nervous system itself, cultural products—products manufactured, indeed, out of tendencies, capacities, and dispositions with which we were born, but manufactured nonetheless. Chartres is made of stone and glass. But it is not just stone and glass; it is a cathedral, and not only a cathedral, but a particular cathedral built at a particular time by certain members of a particular society. To understand

what it means, to perceive it for what it is, you need to know rather more than the generic properties of stone and glass and rather more than what is common to all cathedrals. You need to understand also—and, in my opinion, most critically—the specific concepts of the relations among God, man, and architecture that, since they have governed its creation, it consequently embodies. It is no different with men: they, too, every last one of them, are cultural artifacts.

* * * * *

Whatever differences they may show, the approaches to the definition of human nature adopted by the Enlightenment and by classical anthropology have one thing in common: they are both basically typological. They endeavor to construct an image of man as a model, an archetype, a Platonic idea or an Aristotelian form, with respect to which actual men . . . but reflections, distortions, approximations. In the Enlightenment case, the elements of this essential type were to be uncovered by stripping the trappings of culture away from actual men and seeing what then was left— natural man. In classical anthropology, it was to be uncovered by factoring out the commonalities in culture and seeing what then appeared—consensual man. In either case, the result is the same as that which tends to emerge in all typological approaches to scientific problems generally: the differences among individuals and among groups of individuals are rendered secondary. Individuality comes to be seen as eccentricity, distinctiveness as accidental deviation from the only legitimate object of study for the true scientist: the underlying, unchanging, normative type. In such an approach, however elaborately formulated and resourcefully defended, living detail is drowned in dead stereotype: we are in quest of a metaphysical entity, Man with a capital "M," in the interests of which we sacrifice the empirical entity we in fact encounter, man with a small "m."

The sacrifice is, however, as unnecessary as it is unavailing. There is no opposition between general theoretical understanding and circumstantial understanding, between synoptic vision and a fine eye for detail. It is, in fact, by its power to draw general propositions out of particular phenomena that a scientific theory—indeed, science itself—is to be judged. If we want to discover what man amounts to, we can only find it in what men are: and what men are, above all other things, is various. It is in understanding that variousness—its range, its nature, its basis, and its implications— that we shall come to construct a concept of human nature that, more than a statistical shadow and less than a primitivist dream, has both substance and truth.

It is here, to come round finally to my title, that the concept of culture has its impact on the concept of man. When seen as a set of symbolic devices for controlling behavior, extra-somatic sources of information, culture provides the link between what men are intrinsically capable of becoming and what they actually, one by one, in fact become. Becoming human is becoming individual, and we become individual under the guidance of cultural patterns, historically created systems of meaning in terms of which we give form, order, point, and direction to our lives. And the cultural patterns involved are not general but specific—not just "marriage" but a particular set of notions about what men and women are like, how spouses should treat one another, or who should properly marry whom; not just "religion" but belief in

the wheel of karma, the observance of a month of fasting, or the practice of cattle sacrifice. Man is to be defined neither by his innate capacities alone, as the Enlightenment sought to do, nor by his actual behaviors alone, as much of contemporary social science seeks to do, but rather by the link between them, by the way in which the first is transformed into the second, his generic potentialities focused into his specific performances. It is in man's career, in its characteristic course, that we can discern, however dimly, his nature, and though culture is but one element in determining that course, it is hardly the least important. As culture shaped us as a single species—and is no doubt still shaping us—so too it shapes us as separate individuals. This, neither an unchanging subcultural self nor an established cross-cultural consensus, is what we really have in common.

Oddly enough—though on second thought, perhaps not so oddly—many of our subjects seem to realize this more clearly than we anthropologists ourselves. In Java, for example, where I have done much of my work, the people quite flatly say, "To be human is to be Javanese." Small children, boors, simpletons, the insane, the flagrantly immoral, are said to be *ndurung djawa*, "not yet Javanese." A "normal" adult capable of acting in terms of the highly elaborate system of etiquette, possessed of the delicate aesthetic perceptions associated with music, dance, drama, and textile design, responsive to the subtle promptings of the divine residing in the stillnesses of each individual's inward-turning consciousness, is *sampun djawa*, "already Javanese," that is, already human. To be human is not just to breathe; it is to control one's breathing, by yogalike techniques, so as to hear in inhalation and exhalation the literal voice of God pronouncing His own name—"hu Allah." It is not just to talk, it is to utter the appropriate words and phrases in the appropriate social situations in the appropriate tone of voice and with the appropriate evasive indirection. It is not just to eat; it is to prefer certain foods cooked in certain ways and to follow a rigid table etiquette in consuming them. It is not even just to feel but to feel certain quite distinctively Javanese (and essentially untranslatable) emotions—"patience," "detachment," "resignation," "respect."

To be human here is thus not to be Everyman; it is to be a particular kind of man, and of course men differ: "Other fields," the Javanese say, "other grasshoppers." Within the society, differences are recognized, too—the way a rice peasant becomes human and Javanese differs from the way a civil servant does. This is not a matter of tolerance and ethical relativism, for not all ways of being human are regarded as equally admirable by far; the way the local Chinese go about it is, for example, intensely dispraised. The point is that there are different ways; and to shift to the anthropologist's perspective now, it is in a systematic review and analysis of these—of the Plains Indian's bravura, the Hindu's obsessiveness, the Frenchman's rationalism, the Berber's anarchism, the American's optimism (to list a series of tags I should not like to have to defend as such)—that we shall find out what it is, or can be, to be a man.

We must, in short, descend into detail, past the misleading tags, past the metaphysical types, past the empty similarities to grasp firmly the essential character of not only the various cultures but the various sorts of individuals within each culture, if we wish to encounter humanity face to face. In this area, the road to the general, to the revelatory simplicities of

science, lies through a concern with the particular, the circumstantial, the concrete, but a concern organized and directed in terms of the sort of theoretical analyses that I have touched upon— analyses of physical evolution, of the functioning of the nervous system, of social organization, of psychological process, of cultural patterning, and so on— and, most especially, in terms of the interplay among them. That is to say, the road lies, like any genuine Quest, through a terrifying complexity. "Leave him alone for a moment or two," Robert Lowell writes, not as one might suspect of the anthropologist but of that other eccentric inquirer into the nature of man, Nathaniel Hawthorne:

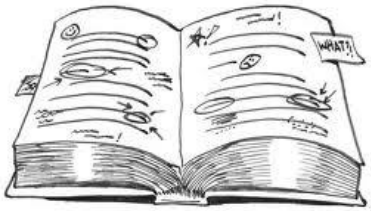
> *Leave him alone for a moment or two,*
> *and you'll see him with his head*
> *bent down, brooding, brooding,*
> *eyes fixed on some chip,*
> *some stone, some common plant,*
> *the commonest thing,*
> *as if it were the clue.*
> *The disturbed eyes rise,*
> *furtive, foiled, dissatisfied*
> *from meditation on the true*
> *and insignificant.*

Bent over his own chips, stones, and common plants, the anthropologist broods, too, upon the true and insignificant, glimpsing in it, or so he thinks, fleetingly and insecurely, the disturbing, changeful image of himself.

Source: Geertz, Clifford. "The Impact of the Concept of Culture on the Concept of Man." *The Interpretations of Cultures: Selected Essays*, Basic Books, 1974, pp. 37-61.

Active Reading

"Reading is to the mind what exercise is to the body."
~Joseph Addison



Many people believe that by moving one's eyes over a piece of text slowly and carefully—in other words, by reading it—that they will automatically comprehend, learn, and remember the content of what they read. But, this could not be more incorrect. To be an effective reader who fully grasps what one reads, who thinks critically about it, and who is able to apply it their own life, you need to do more than sit passively with the book in your hand.

To be an effective reader, you need to be *actively* engaged and involved with the text in front of you. This is no different from the rest of your life. Consider this: do you most effectively learn a musical instrument or a sport by watching someone else play, or by actively working at it and practicing yourself?

Similarly, effective reading is a mental process that requires you to *actively* interact with the text by ***identifying, clarifying, making connections, synthesizing, evaluating,*** and ***creating new ideas.*** This kind of reading is a skill, and becoming a successful active reader will require both an understanding of the purpose of this process and a commitment to incorporating into one's daily life.

- ***Identifying*****,** as we are using it here, means to pick out the main ideas in the text you are reading, as well as any unfamiliar vocabulary terms.
- ***Clarifying*** means to define new terms and comprehends the meaning of the main ideas.
- ***Making Connections*** means to show you understand how different main ideas in the text relate to one another, and also to link these ideas to other reading you have done, to other Core classes, to personal experiences, etc.
- ***Synthesizing*** means to take all the information you have read and critically examined and put it together as a meaningful whole.
- ***Evaluating*** means to think critically about what you are reading and reason out what to accept or reject from the author's claims.
- ***Creating*** means to compose a personalized argument that supports a new meaning of the material.

To help train yourself to be an active reader, there are several things you will be asked to do. To start, you'll need 3 colored pens:

Red Pen: **Identifying/Clarifying Key Terms**
As you are reading, use red pen to circle or underline vocabulary terms. These can include both words that are unfamiliar to you, and essential key words that a reader needs to know in order to understand the text.

- Once you have identified unfamiliar and key vocabulary terms, define them in the margins. Make sure it's clear which definition goes with which word (an arrow can work well for this).
- If you've looked up a word but you're still unclear about what the author means in that particular sentence or passage, try *defining the word in* context. In other words, try rewriting the sentence in your own words using the definition (or synonyms) you found.
- It is always important to "double check" that you understand the meaning of the words in a passage. Even if you think you understand all of the vocabulary in a text, identifying and defining the words that are most essential to the author's main ideas will help you think more clearly and deeply about what the author is trying to communicate.

Blue Pen: **Identifying/Clarifying Main Ideas**
Blue pen should be used to identify the main ideas in a section of the reading.

- Underline key words or phrases that you think are the main and most important ideas the author wants to get across. The purpose is not to underline everything! You should be focused on identifying only what is most essential.
- When you underline, you must paraphrase *in your own words* what the author is saying in the margins. This is the step that will help clarify your understanding; underlining alone accomplishes nothing. Remember that this is a summary, meaning that it should be brief (just a few words or a phrase). You are *not* rewriting the whole passage here!
- Identifying the main ideas in a reading does not necessarily mean you need to summarize each paragraph. You should identify the main ideas when:
    - ✓ You don't understand what the author is saying. (Often the process of paraphrasing helps clarify, especially when paired with the vocabulary work of your red pen!)
    - ✓ You come across a passage that is essential to understanding the whole text.
    - ✓ The author presents a new idea.

Black Pen: **Responding/Analyzing Main Ideas**
Black pen is for analyzing and responding to the text. Underline the part of the text you want to respond to, and then use the space in the margin to make your notes. These kinds of annotations can include:

- *Clarifying Questions* (i.e. a question that can be supported with a factual answer). A good active reader might pause and research the answer, and come back and annotate the text once they've found it.
- *Analytical Questions* (i.e. a question that can help you to gain further insight into a text). A good active reader not only asks analytical questions, but also tries to answer them.
- Your *evaluation/opinion* of a particular passage or idea
- *Examples to support* the author's point
- *Examples or counter-arguments to refute* the author's point
- *Inferences or predictions* about what might happen next (in fiction) or what the author might say next (in a non-fiction text)
- *Connections* to other classes, texts, or personal experiences (Use your outside/prior knowledge to interact directly with ideas stated in the text!)

Active Reading Objectives

Throughout the year, I will provide Active Reading Objectives (AROs) for articles that are particularly challenging. Use them to help you pick out only the most important key terms and to guide you toward the main ideas. The numbers indicate page numbers in this packet.

"The Intelligent Plant" by Michael Pollan

Vocabulary/Key Terms: "Backster effect" (11); animism (13); "emergent property" (13); fetishization (14); "sessile life style" (14); habituation (18); *Mimosa pudica* (18); epigenetic (22); anthropocentric (24); "competence precedes comprehension" (25); teleology (26); bioinspiration (27)

Main Ideas:

* Why the notion of "plant neurobiology" is controversial? (11-13)
* What researchers have discovered about the sensory capabilities of plants? (14-15)
* How plant research is challenging traditional definitions of words like "learning," "intelligence," "memory," "choice," "consciousness," and "pain"? (17-25)
* The implications/consequences of plant research, according to philosophers like Dennett and scientists like Mancuso? (25-28)

Analysis/Evaluation/Connection/Response: *I leave this up to you!*

"The Impact of the Concept of Culture…" by Clifford Geertz

Vocabulary/Key Terms: immutable (34); "uniformitarian view of human nature" (36); cultural relativism (36); "control mechanism view of culture" (37); "significant symbols" (38); "stratigraphic" (38); infinitesimal (39); plasticity (41); "information gap" (41); typological (42).

Main Ideas:

* The Enlightenment view of human beings, and the problem with this view? (34-35)
* The reasons why anthropologists have continued the Enlightenment quest to discover human universals? (36-37)
* The traditional definition of culture—vs. Geertz's new "control mechanism" view? (37-38)
* The traditional story of the "descent of man"—vs. Geertz's new version? (38-40)
* What humans would be like without culture, according to Geertz? (40-41)
* What it means to "become human," according to Geertz? (43-44)

Analysis/Evaluation/Connection/Response: *I leave this up to you!*

How to Write a Rhetorical Précis in AP Seminar

Adapted from Margaret Woodworth (1988), Andrea Caruso, and a variety of online sources

In order to help us quickly and effectively describe the argument an author is making in a given work—an essay, a speech, an image, a performance, etc.—we will be using a method of analytical writing called the ***rhetorical précis*** (pronounced pray-see). "Précis" is French for "specific" or "precise," and when writing a rhetorical précis, your goal should be to succinctly account for the most important parts of an author's argument. Yet unlike a summary, a précis shouldn't just focus on *what* an author says, but also *how* they say it and *why* they say it.

Writing a précis can thus help you in a number of ways. Used in conjunction with active reading (i.e., annotating), it guides your reading and directs your attention to the key aspects of a text. Précis writing also prepares you to discuss a text and sets you up for that important next step: analysis. A rhetorical précis can even help you structure an annotated bibliography—a key component of any research project.

This genre was originally developed by Margaret K. Woodworth and described in a 1988 article for *Rhetoric Review*, consists of four short—but detailed—sentences. In AP Seminar, we're going to add a fifth. Here is a brief summary of what you'll need to do in each sentence:

1. Introduce the writer or speaker, the work, and the central claim.
2. Explain an author's line of reasoning, i.e., how they develop their argument.
3. State the author's purpose in making the work.
4. Describe the intended audience and the author's relationship to the audience.
5. Explain the significance of the work.

Let's review each of these sentences in more detail.

The First Sentence: Introduce the author, the work, and the central claim.

Start by identifying the author and offering any information that might help clarify who this person is in relation to this text. Is this a scholar? If so, what is her field? Is she a public official or a prominent blogger? Is he a public intellectual? A reporter? A spokesperson? Has he written other stuff? Locate a bio in the journal, in the introduction to the text, or the book cover. Do a quick internet search. Figuring out who writer this is will help you understand some of the texts' context.

Next up, the publication. What is its title? Is it a book in a series or an article in a special collection? Does it appear in the leisure section of a local newspaper? Sometimes the title of the journal is self-explanatory, but at other times it's unfamiliar or not clearly connected to a specific discipline. Explain it as necessary. Add the date in parentheses after the title of the text. Unless it's a newspaper, magazine, or time sensitive online article, usually just the year will suffice.

The rest of the sentence should be about the article's topic—what it is about. In order to make this part particularly precise, use a rhetorically strong verb (see the next handout) to describe the author's claim.

The Second Sentence: Explain an author's line of reasoning.

In this sentence, provide a condensed outline of how the author develops, structures, and supports the argument. What kind of evidence does the argument draw upon? How is the case built? Perhaps by comparing and contrasting, illustrating, defining, or providing context? Perhaps the text starts out with a narrative and then moves into a description of

several research studies? This sentence should account for all the most important rhetorical and structural moves made across this piece.

The Third Sentence: State the author's purpose.

What does the writer want the reader to do, believe, feel, or think about all this? What was the purpose of this text? In the first sentence, you told us what that author is arguing; now it is time to consider why the author has done all of this. Use an "in order to" phrase in this sentence to very clearly indicate the purpose.

The Fourth Sentence: Describe the intended audience.

In the fourth sentence, identify the author's intended audience and offer some rationale for how you know that to be the audience. Look back at the publication and think about who is likely to read this kind of magazine, journal, or book. Pay attention to the language used in this piece and how much background the writer provides. What does the writer assume readers believe, know, or value? Identifying the audience helps you consider how rhetorically effective this text is.

The Fifth Sentence: Explain the significance of the work.

In the fifth and final sentence, state what you think is the significance of the author's argument. Basically, why should someone care about the argument? Does it help us better understand some unexplained phenomena? Does it challenge preconceived wisdom about a topic or issue? Does it stimulate new thinking? Does it provide a solution to a current problem?

As you use the rhetorical précis during the research process, you might consider using this final sentence to indicate the significance of the work within the larger context of your research project. How does the source help you answer your research question? To what extent does it confirm, challenge, or modify perspectives found in other sources?

Below is a sample rhetorical précis that closely follows the structure outlined above:

In the Declaration of Independence (1776), Thomas Jefferson, an American statesman and philosopher, argues that the God-given rights of life, liberty, and the pursuit of happiness entitle the colonists to freedom from the oppressive British government and guarantee them the right to declare independence. He supports his claim by first invoking the fact of our inalienable rights, then he establishes the circumstances under which a people can throw off an oppressive government; he next proceeds to show that these circumstances have been created by King George III whose oppressive rule now forces the colonists to the separation. The purpose of this document is to convince all readers of the necessity to officially declare independence from Great Britain in order to establish a separate independent nation, the United States of America. Jefferson establishes a passionate and challenging tone for a worldwide audience, but particularly the British and King George III. This work is significant for at least two reasons: first, because it establishes the founding principles of the United States of America; and second, because its words inspired numerous democratic revolutions throughout world history.

On the next page is a framework for the rhetorical précis that you can easily adapt to the specifics any written, visual, or audio work:

Rhetorical Précis Framework

In _____ (*date*), _____, _____,
(title of work) *(author's full name)* *(author's credentials)*

_____ that _____.
(A) *(central assertion or thesis)*

He/She/They supports his/her/their _____ by first _____,
(claim, assertion, argument, etc.) *(B)*

then _____, next _____, and
(B) *(B)*

finally _____. _____'s purpose is to _____
(B) *(author's last name)* *(description of purpose)*

in order to _____. He/She/They _____ in
(C) *(write, speak, draw, etc.)*

a(n) _____ tone for _____.
(D) *(intended audience)*

This work is significant because _____.
(explanation of the work's importance)

** Note that the number of clauses in the second sentence will depend on the length and complexity of an author's argument. Use as many verbs from column B and the "sexy verbs" handout as you find it necessary to accurately and succinctly outline the argument.

Rhetorical Précis Word Bank

(A) rhetorically accurate verbs	(B) verbs to describe a line of reasoning	(C) in order to . . .	(D) adjectives to describe tone
argues asserts claims explains implies suggests questions	comparing . . . contrasting . . . defining . . . describing . . . exploring . . . explaining . . . illustrating . . .	convince inform persuade point out demonstrate that show suggest that	formal earnest grave humorous concerned informal serious

"Sexy Verbs" in Academic Writing

accentuates (stresses, emphasizes)
accepts
achieves
advocates (supports)
affects
alleviates (lessens)
allows
alludes (references)
analyzes
approaches
argues
ascertains (establishes, makes certain)
asserts
assesses
attacks
attempts
attributes
avoids bases
believes
challenges
characterizes
chooses
chronicles
claims
clarifies
comments
compares
completes
concerns
concludes
condescends
conducts
conforms
confronts
considers
constrains
constructs
construes (interprets)
contends (challenges, argues)
contests (questions)
contrasts
contributes
conveys
convinces
creates
defends
defines
defies
demonstrates
denigrates (degrades, belittles)
depicts
describes
despises
details
determines
develops
differentiates
differs
directs
disappoints
discerns
discovers
discusses
dispels
displays
disputes
disrupts
distorts
dramatizes
elevates
elicits (brings out, extracts)
elucidates (expounds, illuminates)
embodies
empowers
encounters
enhances
enriches
ensues (follows, develops)
enumerates (details, specifies, lists)
envisions
evokes
excludes
expands
exemplifies
experiences
explains
extrapolates (estimates)
fantasizes
focuses
forces
foreshadows
functions
generalizes
guides
heightens
highlights
hints
holds
honors
identifies
illustrates
imagines
impels (drives, forces)
implies
includes
indicates
infers
inspires
intends
interprets
interrupts
inundates (overwhelms, engulfs)
justifies
juxtaposes
lampoons (satirizes, ridicules)
lists
maintains
makes
manages
manipulates
masters
meanders (roams)
minimizes
moralizes
muses (ponders, deliberates)
notes
observes
opposes
organizes
overstates
outlines
patronizes
performs
permits
personifies
persuades
pervades (encompasses)
ponders
portrays
postulates (guesses)
predicts
prepares
presents

presumes
produces
projects
promotes
proposes
provides
qualifies
questions
rationalizes
reasons
recalls
recites
recollects
records
reflects
refers
refutes (contests, disproves)
regales (entertains, amuses)
regards
regrets
rejects
represents
repudiates (disclaims, renounces)
results
reveals
reverts
ridicules
satirizes
seems
sees
selects
serves
shows
solidifies
specifies
speculates
states
strives
suggests
summarizes
supplies
supports
sustains
symbolizes
sympathizes
transcends
traces
transforms
understands
understates
uses
vacillates (hesitates, fluctuates)
values
verifies
views
wants
wishes