

Essay 1: What is anthropology, what is biological anthropology, and should I be getting science credit for this?

Theme: Biological anthropology breaks down the boundaries of traditional academic provinces, being both a scientific and a humanistic endeavor. At some universities (like Berkeley), biological anthropology is considered satisfactory fulfillment for a “science” requirement, in others (like Yale) it is not.

What is Anthropology?

Anthropology is the scholarly field of inquiry that studies humans as group members. Other fields study humans as individuals (psychology and physiology, for example), but the focus of anthropology is on clusters of people – how they differ in form and behavior from other clusters of people; and how the largest cluster of people, the human species itself, relates to other species.

By “scholarly,” I mean that it follows a tradition of rigorous argument, logic, high standards of first-hand evidence, and an understanding and appreciation of the errors earlier generations of students committed in their studies of the subject. It is only by confronting those errors that present generations can come to more comprehensive and accurate understandings of the subject.

In studying humans as group members, anthropology is a field of *mediation*. That is, it takes two entities that look like opposites and finds the areas of connection between them. One obvious area of mediation is “individual” versus “group member”. A person is both at the same time. Any person develops from a single egg, containing a genetic program distinct from that of all other people, except an identical twin. On the other hand, that person’s genetic program is far more similar to that of a chimpanzee than to that of a horse – because they are part of the human species, not a part of the zebra species.

Moreover, that distinct genetic program within the specific human egg will develop into a person in a defined context – a context of biology (such as maternal environment, nutrition, hormones, and drugs), society (the other people already in the world, from the immediate family to one’s peer groups), and history (the non-biological things inherited from ancestors, such as money, a home, and a language). Additionally there exists the suite of experiences lived as an individual, filtered and rendered meaningful through one’s own personal

history (praise, abuse, attention, abandonment, accidents, relocation).

With so many variables, it is a daunting task to try and explain why any specific person does any specific thing at any specific time. In fact, that is probably a task for astrologers, not scholars.

What we can do, however, is derive some generalizations about the behavior of groups of individuals and contrast them with others.

Such generalizations, of course, must be based on the extensive careful observations and analyses of what people in different places at different times actually do – such studies comprise *ethnography*, the first-hand study of a human group in a specific place and situation.

Ethnography is particularly valuable in providing us with the data we need to make reliable statements about the breadth of the human experience. How can we talk sensibly about “what it means to be human”, for example, if our only frame of reference is what it means to be human in one particular society, under one particular set of circumstances, at one specific point in time?

Most ethnography, consequently, has involved studying diverse rural, non-Euro-American peoples. Over the course of the last few centuries, these societies have come under the political and economic domination of other, more powerful societies – a set of relationships known as *colonialism*. Thus, while the exotic peoples of Polynesia or Tibet or central Africa have comprised the classical site of ethnography, it has also made anthropology a mediator in the complex relationships between indigenous peoples and colonial powers.

Anthropology assumed this role by demonstrating a mediating role between the *exotic* and the *mundane*. Early 20th century anthropologists in the field showed that not only are lives and daily concerns of the people “out there” very much like your own daily life and concerns (resolving disputes among friends, helping friends against enemies, taking care of a

family, deriving the means of sustenance, having sex, coping with death, and just getting through the day), but conversely the concerns and actions that you take for granted in your daily life can seem arbitrary and bizarre when looked at from a distance. Eating three meals a day, blessing someone who has just sneezed, how you dress, reading this English-language page printed in Roman letters rather than in cuneiform, pictograms, or hieroglyphs, adopting a husband's family name, how you spend your day – these are not features of *human* life, but specifically of a human life lived here and now, and they might have easily been different. And they could be different.

This mediation – standing between opposites and showing how they are connected – is a fundamental part of anthropology. By looking at the historical origins of particular behaviors and peoples, anthropology mediates the *past* and the *present*. It looks at where not only we have come from, but where other peoples have come from, and where we as a species have come from.

In this sense, anthropology also mediates the concept of *human* and *animal*. We are, on the one hand, non-photosynthesizing, multicellular life – animal; and on the other hand, we are a unique form of life that radically transforms its environment and creates its own means by which to survive. We are both governed by the needs and instincts of other species – to survive, eat, breathe, and reproduce, among many other things; and yet we are also governed by laws our ancestors made up, which regulate what we can and cannot do as we try to survive and reproduce. We also season our food in locally specific ways that have negligible nutritional value; and deliberately inhale substances other than air, such as the burning residue of certain dried leaves, for reasons other than breathing. We are both like other animals, and yet different from other animals.

The classic juxtaposition of animalness and non-animalness, melded into the human and mediated in the study of anthropology, is often represented as a dichotomy of *nature* versus *culture*. “Nature” here would mean the biological core or essence of the human animal; while “culture” would refer to those institutions that are “man-made” or in some sense artificial – not part of our genetic endowment, but of our social endowment. That dichotomy is a classically false one.

Another important site of anthropological mediation is derived from the relations of

colonial and indigenous peoples, mentioned above. All peoples have knowledge about the world, which serves not only to help them exploit the natural resources available, but also to orient them and tell them right from wrong. Science, which emerged in 18th century Europe, is the particular form of knowledge of the world used and valued in modern society. It coexists with other forms of knowledge – such as religion, inspiration, and superstition – but is the knowledge most fundamentally identified with modern society.

And yet, other peoples have knowledge that is useful, effective, and insightful. They know what is dangerous in their own environment; they know how to survive and even thrive where you or I would be virtually helpless. They know the tides, the approaching weather, what to plant and when to plant it; and they also know the spirit world, where they came from and where they're going after they die.

Here, of course, traditional or folk knowledge may often come into conflict with scientific or technical knowledge. Anthropology also works to mediate these two realms. Often this antagonism is played out as a clash of science versus “belief systems”; or in university cultures as a conflict between science (like physics and geology) and humanities (like literature and history). Sometimes anthropology is part of a middle ground, “social science” – not quite science, but not quite arts or humanities either.

In fact, anthropology partakes of both.

The subfields of anthropology

Anthropology is an anti-reductive or holistic study of the human species. Its methods range from the scientific to the literary: humans are both physical and mental beings, and so to study their groups rigorously and comprehensively we are obliged to take an eclectic approach to anthropological data and research. Anthropological research ranges from comparative anatomy and genomics (which shed light on the ways in which human populations differ from one another, how the human species differs from its relatives and ancestors, and a human cell differs from a gorilla cell) to the analysis of poetry, song, and jokes (which shed light on how groups of people understand themselves in relation to other groups, in varying situations of economic or political inequality).

Biological anthropology represents the most scientific end of the field, devoted to studying the biological history, evolutionary relationships,

and adaptive diversity that characterize the human species. The field originally came to be called “physical” anthropology in the 19th century, to emphasize the fact that its subject was the physical remains of people – generally their bones and brains – and to contrast with the mental aspects of human life that were becoming the domain of “cultural” anthropologists. In the 20th century, however, it gradually became clear that there were other things to study that fell within the scope of physical anthropology without being strictly “physical” in the sense that bones are – notably, genes and the behavior of nonhuman primates. Consequently, we commonly refer to the field as “biological anthropology”, although the phrase “physical anthropology” remains in use.

Biological anthropology is regarded as one of four intellectual subfields in anthropology. The “four-field” division of anthropology developed in the United States in the 19th century, by early anthropologists from the Smithsonian Institution, interested in studying native Americans, finally “pacified” through a combination of genocide and assimilation. No longer a threat to American expansion, they often lived in poor isolated rural communities, and yet were directly descended from the original inhabitants of the American continent.

The “four-field” approach began as a system of systematically and comprehensively studying indigenous people. In this case, it involved white scientists going out to study the bodies and bones of Indians, the original occupants of the land; their ancient art and architecture; their customs; and their languages. In other words – physical anthropology, archaeology, cultural anthropology, and linguistics.

In other countries, with different colonial and political histories, anthropology developed differently. In England, archaeology became more closely allied with art history, physical anthropology with human biology, and cultural anthropology with the study of social systems. In France, “anthropology” came to mean physical anthropology, and “sociology” came to mean cultural anthropology.

To the extent that the “four-field” approach is now international, it is derived from the American model. That model, however, arose as a 19th century form of “comprehensive othering” – studying powerless, indigenous people different from yourself. As anthropology has matured beyond that original scope, its approach has matured as well. Anthropology now studies all peoples, not just powerless indigenous ones,

and anthropological projects rarely cover more than one subfield; the “four-field approach” is institutionalized, but no longer embodied in the research of any single anthropologist.

The anthropology of science

Modern anthropology not only studies belief systems and practices of exotic peoples, but those of ourselves as well. The act of turning the anthropological gaze inwards is called reflexivity. Classically it serves to make the acts and thoughts of “modern” people seem exotic – and works like these range from Montesquieu’s fictional “Persian Letters” in the 18th century (the French as seen through the eyes of a visitor from Persia), through Horace Miner’s classic study of the “Nacirema” (spell it backwards for the secret message), to modern works such as Rayna Rapp’s ethnography of genetic counseling, George Gmelch’s ethnography of baseball, and Philippe Bourgois’ ethnography of drug dealers.

Science, of course, constitutes a fundamental system of beliefs and practices in modern life, and has itself come under the reflexive anthropological gaze. Some people reject science, others embrace it, and many choose pieces of science to accept or reject. The anthropology of science is a growing area of study that seeks to stand between science and culture and to analyze science as anthropologists explore other belief systems.

Science deals with facts about the world. But where do facts come from? How do ideas become facts? Standard training in science rarely raises such questions. After all, if science is just “reading what’s out there in nature,” it can’t be wrong or have its premises or actions called into question.

And yet science is commonly wrong. Genetics books of the 1940s routinely said that human cells have 48 chromosomes (they only have 46). Scientific books also commonly said that humans diverged from the ape lineage in the early Oligocene (it was in the late Miocene). Indeed in recent years there have been furious adversarial battles about the scientific evidence for breast implants as a health risk, DNA fingerprinting as a tool for criminal prosecution, and the value and status of stem cells in medical research. If science has the property of being self-correcting – which it does – then it stands to reason that there is something to correct, namely, alternative wrong scientific hypotheses.

It is consequently useful to distinguish among three parts of the scientific subject.

Ontology is about being – about the state of existence, or of what “really is”. But that is not really the domain of science. Science is about *epistemology* – what can be known, and how we can know it.

Consider this question: How many angels are in the room right now?

We’ll even simplify it and make it multiple-choice. (A) three or fewer angels; (B) four or more angels; (C) none at all.

Logically, one of those answers must be right. There is an answer to the question. But there is no way for science to find it, because angels are not material entities, and are not amenable to scientific detection and analysis.

So whatever the answer may be, it cannot be revealed by scientific means. Thus, science is not so much about “reality,” or what there “is,” as it is about what we can know. Science is fundamentally about the kinds of questions one can meaningfully ask, the kinds of data one can collect, and the kinds of answers one can generate. In other words, it is about epistemology.

This distinction between ontology and epistemology – being and knowing – is basic in philosophy, but not widely considered in science. Not making the distinction serves to promote the idea that science is simply a continuous revelation of what is true and real, rather than being a series of methods and guidelines, limited by available ideas and technologies.

Not only is there a distinction to be made between what is real and what we can know about it, there is also the fundamental problem of how we communicate it to one another; how we talk, and write, and think about it. We learn that there is a “genetic code” – in other words, that there is something like a language operating in the cell. But this is simply a metaphor devised in 1944 by the biophysicist Erwin Schrödinger; there is no cryptography going on between two communicating, intelligent beings inside the cell. Genetics is like a code in some ways – but is not itself a code. This metaphor has been immensely powerful and helpful in conceptualizing the way the cell works, but it is about what the cell is like, not what the cell is. This is *semiotics*, the domain of meanings, and another fundamental aspect of scientific advance.

We encounter useful metaphors in all parts of science – “black holes” in astrophysics, “bonds” in chemistry, the “adaptive landscape” in biology. It is important, however, to acknowledge that these are aids in conceptualizing and communicating about

reality, not descriptions of it. They are no less valuable, but they are units of language and thought, not of external nature.

Ontology, epistemology, and semiotics are all parts of how knowledge is constructed. First, there is some relationship between what is really out there and what science says about it – but that relationship is never obvious or straightforward. Every new discovery, after all, presupposes a prior state of scientific falsehood which is supplanted by the very discovery. Second, there are ways of discerning aspects of the world, which are bounded by the available instruments and conceptual models. Imagine trying to convince a skeptic about cells, without the aid of microscopy; or radioactive decay without calculus. And third, we make sense of the world scientifically through the introduction and use of key metaphors – “genetic code” as noted above, or “*l’homme machine*” or “natural selection”, or even “man the hunter”. Each of these helps us to see parts of the world in constructive scientific ways, and to frame new questions about how it works.

Finally, there is a process by which ideas become facts. Science is an occupation, and as such, its practitioners face the stresses of life in any other job: promotions, raises, getting the esteem of one’s superiors, networking, and protecting one’s “turf”. Is it any wonder, then, that scientists often promote their own ideas, or those of their friends, or of their professors? As a result, sometimes ideas that are wrong are nevertheless maintained for years after they have been conclusively refuted (for example, that genes are composed of protein rather than of nucleic acid, or that races differ in their innate intellectual capacities); and ideas that are right sometimes have remarkable difficulty getting accepted (for example, Mendel’s work on peas; or that *Australopithecus* is a human ancestor).

Just how this occurs is often the subject of careful work by historians. But it does put the lie to the naïve view that science is simply an upward march to truth.

The normative view of science: Scientific method

There is no single method by which science works, to the exclusion of other modes of thought. Nor is science just “glorified common sense,” as some have suggested. Rather, science is a set of methods for deriving knowledge about the unknown, beginning with the formulation of an answerable question, and proceeding by

paring down the many answers that might be true, to the relatively few that probably are true. There are many kinds of science, but it is useful to look first at the idealized or normative idea of what science is.

The scientific process begins with the formulation of a problem that needs an answer, and which is answerable. The choice of a problem to tackle refutes one of the oldest myths about science – that it takes place with a fully open mind, free of preconceptions. Simply choosing a question implies a pre-existing judgment about what is interesting and important, and is thereby worthy of study. A question that is answerable is one for which a class of data can be rigorously collected, to settle it. Notice that this criterion excludes studies of the supernatural world, which are not amenable to rigorous data collection.

The articulation of the problem to be studied is known as an hypothesis: A statement about the world that may or may not be true, but which can be matched against some information in the real world to help us decide. Hypotheses that do not have this property of *testability* – for which there is nothing you can do to help settle the problem – are metaphysical, and outside the domain of scientific investigation. The example we used earlier – How many angels are in the room? – would be such a question, not amenable to scientific analysis. What counts as a scientific question at one time may not count at another – after all, asking about X-rays would have made no sense in the mid-17th century.

The formulation of a testable hypothesis is the creative element in science. Having formulated such an hypothesis, we invoke the empirical part of science – the collection of *data* that bear on the hypothesis. Once again, this is not carried out in an intellectual vacuum: we have made prior judgments about which kinds of information are relevant or not. There is no innocent observation.

In a famous example, Charles Darwin collected birds while in the Galapagos Islands, and upon his return to London, he gave the collection to a distinguished ornithologist named John Gould for study. Gould, interested in the patterns of variation in the beaks and colors of the birds, asked Darwin which island he had collected each specimen from. Darwin, however, did not know for certain. Why? Because as a young biologist educated at Cambridge in the creationist ideas of the 1820s, the assumption was that God had placed creatures in their appropriate settings, and the

islands in an archipelago would simply have the same creatures. Darwin had not recorded which island each bird had come from, because he did not think it was important! This would precipitate his interest in biogeography – the relationship between life and place – that would ultimately lead to his theory of evolution by natural selection.

The decision about which data to collect or record, then, is crucial to the scientific enterprise. It provides the link to the “real world” that science tries to study. Data can be either in the form of observation (reporting), or experimentation (a controlled activity). In either case, the elimination of extraneous information – control – is crucial to the enterprise, ensuring that the data are in fact relevant to the question at hand. The collection of data cannot be haphazard, but must be done carefully and rigorously.

Thus, for example, there are many old studies that argue that populations of blacks and whites in America have different average IQs. From this, some investigators have claimed that whites are simply innately smarter than blacks. Others, however, recognizing that whites and blacks in America lead very different lives, insist that you cannot simply compare average IQs of different races, but only average IQs of whites and blacks from the same areas, with similar incomes, and similar family histories. And once you control for these variables, you find that the difference in average IQ disappears – which suggests it was not measuring innate differences in intellectual ability, but differences in the circumstances of growing up black and white in America.

The third part of the normative scientific process is *explanation* – the rational, intellectual enterprise that relates the data collected to the problem formulated. There is never any guarantee that a particular explanation is right, but the most useful scientific explanations have several properties that we can use as guidelines for the formulation of scientific explanations generally.

First, they are concerned with proximate cause, rather than ultimate cause. Proximate cause is mechanism, a “how” question. Ultimate cause is a “why” question, a reason for something. This distinction came to the fore around 1700, when Isaac Newton successfully described gravity in mathematical terms. Prior to that, the fact of apples falling from trees or planets orbiting the sun were disparate phenomena, under the guidance of some heavenly forces that sometimes made apples fall,

and held planets in check. The Newtonians, however, showed that gravitational attraction was a property of all matter, and that the descent of the apple to the earth was the same as the attraction of the planets to the sun. This did not mean that God didn't exist, or was not responsible for apples and planets, but simply that we now understood *how* the system worked. One could still ask, "What causes gravity?" or "Why does gravity exist?" – and still end up with a Divine answer – but the advance of science has nevertheless displaced the action of God from the immediacies of the physical world, and relegated Him to setting up the rules by which the universe works.

In a precisely similar fashion, Darwin formulated an answer to the question "How do different species come to be adapted to their surroundings?" – and his answer was natural selection, the greater proliferation of individuals with certain characteristics. Darwin famously ended his work with this line:

There is grandeur in this view of life, with its several powers, having been originally breathed into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved.

But to the accusation that he was espousing atheism, Darwin added three words to that sentence in the second edition: "...having been originally breathed by the Creator into a few forms or into one...". His purpose was to try to follow in Newton's footsteps: God may well exist and have a hand in biology, but if so, the mechanism He used to make species differently adapted was an understandable earthly process of natural selection. Darwin was not interested in the origin of life, and his theory was not designed to conflict with the existence of God, but merely to delimit what could be explained by natural, understandable forces. Slightly later, interestingly, he wrote to a friend,

I have long regretted that I truckled to public opinion, and used the Pentateuchal term of creation, by which I really meant "appeared" by some wholly unknown process. It is mere rubbish, thinking at present of the origin of life; one might as well think of the origin of matter.

Darwin's work was not about the origin of matter or about the origin of life; it was about the origin of species, and he didn't care what people thought of the first two, as long as his argument for the third was convincing.

This brings us to a second aspect of scientific explanations, one that has emerged in the century and a half since Darwin struggled with mentioning a "Creator" – namely, that modern science deals exclusively with the natural world, explaining it in terms of itself, without recourse to a supernatural or spiritual world. This is a methodological assumption of science, which strives to understand the natural world, assuming that it is knowable; if it is acted upon by occult, capricious forces, then these are by their nature unpredictable and unknowable, and they defeat the purpose of science.

That is not to say they do not exist, for we cannot prove that. They are simply external to modern science. They are also mutually contradictory: If we believe the world was created by a divine being, how can we know which of the many possible divine beings it was?

This assumption of naturalism is useful, and has had considerable success in the last few centuries. For example, antibiotics were developed to kill bacteria. The action of antibiotics is predicated on the germ theory of disease, a naturalistic alternative to the "evil spirits" theory of disease. Perhaps antibiotics drive away evil spirits in addition to killing germs – but the value to science has been that they seem to do what they were developed for. There would have been no need to develop antibiotics without the germ theory; and no way to explain their curative value either. This obviously makes it likely that a certain class of bacteria, which respond to antibiotics, cause diseases – rather than evil spirits.

Once again this is not to say that evil spirits do not exist, or cause no disease; only that the domain of diseases that can reasonably be ascribed to them is much smaller than it used to be.

A third characteristic of scientific explanations is that they strive to be parsimonious, by which we mean that they try not to be unnecessarily complicated. This principle is commonly known as "Occam's razor" – after a medieval philosopher who believed in trimming away excessive speculations and assumptions. Parsimony, once again, is a useful assumption – given no other information, the simpler explanation is better – but it can easily be itself an oversimplification.

In evolutionary studies, we use Occam's razor in our assumption that major changes (such as bipedalism) generally only occurred once, and that consequently there is a very little parallel evolution – different species evolving into

similar forms. We assume, rather, that species that share fundamental traits with each other inherited them from a common ancestor, not independently from diverse ancestors. However, it is also clear that parallel evolution in some traits has indeed happened. For example, a group of extinct hominids of the genus *Paranthropus* shares some features of the cranial base with the genus *Homo*, and other features of the teeth with the genus *Australopithecus*. Regardless of which genus we consider to be the closest relative of *Paranthropus*, it evolved a set of traits in parallel. We therefore use the principle of parsimony as simply another methodological tool, to try and invoke evolutionary scenarios that at least keep the idea of parallel evolution to a minimum.

A fourth characteristic of scientific explanations is that they are probabilistic, not deterministic – that is, they can generally rank outcomes as more-or-less likely given certain boundary conditions, but cannot tell you the future like Nostradamus. This, of course, puts science at a distinct disadvantage to other modes of thought that foretell the future with great clarity, even if not with great accuracy. It also tends to make scientists poor witnesses in the courtroom, where definitive statements are sought, not qualified statistical outcomes.

However, that is a classic signature of science: uncertainty. Preachers are far more certain than scientists are, which may be why they are often more convincing. But when you are about to have surgery, you probably want an informed assessment of the possible risks and side effects, rather than a glib prediction of the future.

Often a scientific analysis will use statistical tests to see how likely a particular situation is to occur by chance alone. If it is less than 5% likely to be due to chance, we call the situation in question “statistically significant” – and deduce that we are dealing with a non-random occurrence, which thus requires an explanation. By that very statistical convention, however, we may be up to 5% likely to be wrong, or likely to be wrong on the average 1 in 20 times.

The last signature of a good scientific explanation is logical rigor. Many non-scientific systems are very logical, but nevertheless wrong – so being logical is no guarantee that you are right. Further, many proper inferences have been drawn from premises that are faulty, and thus turn out themselves to be useless. But being logical, and deducing implications rigorously

from data and inferences, makes it more likely you will be right.

The social matrix of science

The sociologist Robert Merton devised a famous list of four attributes of science in 1942, which are at best idealizations of the scientific process. The list shows what science should ideally strive for, although it is exceedingly unlikely that it ever has met these standards, and all indications are that it is moving farther away from them.

Science, to Merton, is *communal* – that is, freely shared, in the public record, and available to all. Only a few years later, however, this was undermined by the Manhattan Project, in which the best science suddenly became Top Secret. In more recent times, genetics has become a home for investment capital, and consequently the scientific research is discussed in far more muted tones, lest a rival company learn too much too soon. A prominent genetics research facility has a sign that says, “Big Blabs Sink Labs.”

Merton’s second idealized aspect of science is *universalism* – that it should be essentially international and transcend the cultural divisions in society. In practice, though, we commonly find national “schools” in particular sciences – Japanese primatology versus American primatology, for example; or British population genetics versus American population genetics – which makes Merton’s idea once again seem over-simplified.

His third aspect is *disinterestedness* – that science should not be for sale to profiteers or ideologues; it should be a fair and open search for truth. But again, we simply do not see that when we look at modern science, for example. Politics looks to science to support its actions, and science is very much for sale in the free market of patenting cell lines and developing new drugs. Indeed, conflicts-of-interests are now so profound and prolix that many journals and universities are at a loss about how to deal with it.

And his fourth is *organized skepticism* – that science relies not on authority, but on doubt, and that the burden of proof falls on the researcher to prove a claim – not on the skeptic to debunk it. In practice, however, we rely greatly on authority, in part because there is simply too much to know and we are obliged to take the word of really smart people; and likewise, much of what we learn about science comes not from scientists themselves, but from journalists. This

can have the effect of side-stepping the critical review and organized skepticism of science; so that it is sadly commonplace now for extraordinary claims to enter the popular consciousness – such as the “gay gene” on the X chromosome – and to shift the burden of proof to those who find the claim ludicrous, and force them to waste their resources to find a fatal flaw in the work.

Relativizing science

Science is a cultural system in which individuals with common ideas, and their own special language, interact with one another in complex ways. In so doing they advance themselves, and they advance the cause of science as well. Science has its own reward system, its own standardized set of obligations and expectations, and its own promise of immortality (the citation index, by which a scientist’s influence is commonly judged).

Unlike other cultural systems, science appears to advance universally. Our knowledge of the world is indeed continually increasing; more things are being discovered, and virtually nothing is forgotten. This is a rare instance of cultural improvement, which is more commonly a series of trade-offs – for example an increase in technology with greater fear of the safety hazards associated with that technology, or longer lifespans accompanied by greater alienation of the elderly.

But science as a cultural system does advance, and it does so for a simple reason – that is its goal. Science generates origin narratives about the human species, as do all cultural systems; and the principal scientific one is of course the evolution of the human species from the apes of Africa. It is certainly more nearly correct than any of its alternatives. But does that mean that the alternatives should be suppressed?

Yes, in the context of science classes; no, in the context of the free market of ideas in the modern world. Some scientists are appalled that so many Americans reject evolution in favor of the diverse strains of Christian creationism. Such an attitude, however, makes science sound as if it were a competing religion, which it should not be.

The difference between the scientific origin myth (evolution) and the Christian one, or any culture’s origin myth, is a fundamental one. Science is founded in 18th century European philosophy as a search for truth – truth that can be demonstrated to other people and doesn’t

require individual revelation or prior commitment to accept. Science has a single goal – to describe and explain the universe most accurately and most fully. Much of scientific method can be thought of simply as ways of attaining that end. And as a result, science provides the most accurate descriptions and explanations of the universe.

The fact that most Americans reject it may not be so much a result of their stupidity, but of their possession of different priorities than scientists have. After all, how much does it really matter whether or not you are descended from a late Miocene ape?

Other origin myths have features that science lacks. For example, they bind you to the community. They tell you right from wrong, and give you moral orientation. They tell you the universe is ultimately just, and benign, and that your life is important. They make you feel good about your place in the spiritual order, and impart meaning to your life and to the events within it.

Science does none of these. It just seeks the most accurate description and explanation of the universe. Because it lacks the other goals that origin myths commonly have, it is hard to say that evolution is “better” than those other myths, if we use “better” in an ordinary and fairly broad sense. Evolution is clearly better, however, if we use the narrow criterion of simply “being the most empirically accurate”. But that, of course, is science’s own criterion – a highly non-random scale of comparison. And it should not be surprising that science fares well by that criterion, because that is what scientific methodologies were developed for. It has been said that science is a “self-correcting myth” – that is, a linear narrative continually changing to bring itself into line with reality.

Most science, like most of any industry, consists of boring work – “turning the crank,” so to speak. Historian of science Thomas Kuhn called this “normal science”. But rarely a revolutionary new idea comes along, one that causes the community, or a large segment of it, to re-think their work and to re-interpret their data. This “paradigm shift” (in Kuhn’s phrase) signals a time of great intellectual instability and great creativity, a scientific revolution. Unfortunately these are only observable in retrospect, and since Kuhn’s work appeared in the 1960s, it has become unfortunately too commonplace for scientists to claim to be leading, participating in, or witnessing a paradigm shift in their field.

The origins of anthropology

Anthropology, however, began with just such a paradigm shift, articulated in 1872 by Edward B. Tylor, a professor at Oxford, in his book *Primitive Culture*. Writing at a time when Darwinism was revolutionizing the biological sciences, Tylor took an interest in the behavioral differences among human groups. The common wisdom of the age was that northern Europe was the most advanced place on earth, both mentally and physically, and its inhabitants had a right – perhaps even a duty – to colonize the rest of the world, and to subdue and supplant its indigenous inhabitants. This was justified on the grounds that Europeans were superior beings – morally, mentally, technologically, and physically. And as Darwin had articulated in the subtitle of his most famous book, it was the fate of the unfavored races to be eliminated by the favored ones.

Tylor undermined this argument with a two-part attack that became central to the development of anthropology. The first came to be known as “the psychic unity of mankind” – that people everywhere have pretty much the same intellectual capacities. Thus, people from Zimbabwe or Tibet or New Zealand can pilot jet planes and splice DNA and write anthropology books, if they are so inclined. There is no good reason to think, when we surveyed the world’s works and the accomplishments of its diverse peoples, that any of them is a substantially superior organic being than any other.

The second part of Tylor’s attack is one that is so familiar to us now that we hardly can even think it might have been a new idea – namely, that the customs and laws of a people comprise something categorically distinct from their biological natures. He called this “culture” – “that complex whole which includes knowledge, belief, art, law, morals, custom, and any other capabilities and habits acquired by man as a member of society.”

The distinction between the learned and the instinctual had been long acknowledged, but Tylor meant something more – specifically, the cumulative social traditions of a group of people, which could even be thought of as having a life of their own.

This new distinction between biology (or nature, or race – all often used synonymously that the time) and “culture” carried a very important political implication. If people’s primitive-seeming lifeways did not imply their physical primitiveness or inferiority, then there

was no longer a justification for maltreating or exterminating them. And if people everywhere had pretty much the same capabilities for acquiring culture, the humane and reasonable course of action would be to educate them, not to kill them. Anthropology, wrote Tylor, was “a reformer’s science.”

In America, the German-born anthropologist Franz Boas gave “culture” its more modern use, as the localized, and generally unconscious, ways that particular groups of people impose meaning on their surroundings, and to some extent construct their world and their lives. “Culture” was to become more than just the social components of “nurture” as opposed to “nature” – it was like the unified spirit of a people, suffusing all aspects of what they did and how they thought about things. It was acquired by growing up with them, and studied by living with them. Most importantly, it was now used as a plural, for each people had their own “culture”. And although groups of people differed from one another in their gene pool, in the language they spoke, and in their culture, all three of these features were distinct from one another and could change independently of one another.

The Origins of Physical Anthropology

Physical anthropology, on the other hand, began in no such radical conceptual break. If anything, it began in a far more intellectually primitive climate, one which held that “civilized races” must have better (or at least, bigger) brains than “uncivilized races”, and thus began intensively to investigate variation in size and shape of the skull – the bones in which the brain is encased – across the human species.

By the 1840s early American physical anthropologists were busy studying the skulls of Indians and of other non-white peoples in the hopes of finding an organic, “physical” basis for their social and economic inferiority. Some found in this activity a justification for slavery, holding that the heads of Africans were so different from those of Europeans that they must have been the products of separate creations. In France at this time, the first professional society of physical anthropology was founded on such ideas by the great cranial anatomist Paul Broca.

The advent of Darwinism did little to curb such odious science. Where pre-Darwinian students of human form freely associated Africans with apes, as somehow “lower” than Europeans, post-Darwinian scholars appropriated their familiar imagery, but cloaked the arguments

in evolutionary terms. Thus, where previously it might have been maintained that Africans had been created by God as intermediate beings between Europeans and apes, it could now be argued that they had evolved from apes, but just not as far as Europeans had.

By the end of the 19th century, there was little recognizable as professional physical anthropology. American practitioners had amassed collections of skulls and skeletons from Indian burials; Europeans trained in anatomy were studying the fossils of Neandertals and comparing the bodies of humans and apes. German anthropologists were surveying the human form and measuring the bodies of schoolchildren to assess the “racial” composition of their populations.

One such scholar was Franz Boas, who was trained initially in physics, then in geography, and lastly in anthropology in Germany. Boas lived among the natives of the Northwest coast of the US and the neighboring regions in Canada in the 1880s, supporting his studies of their lifeways by selling their goods (and their bones) to museums. Hired in 1897 by Columbia University for his expertise in human body form, he ultimately made his major impact in cultural anthropology and is largely responsible for professionalizing the field of anthropology, with his formalization of the distinctions among race, language, and culture.



The person credited with professionalizing the subfield of physical anthropology, however, was a Bohemian-born doctor named Aleš Hrdlička. An avid student of the skeleton and the skull, he studied physical anthropology in France and obtained an appointment at the Smithsonian Institution, building up its collections, and becoming the foremost authority on the skeletons of Indians. Hrdlička founded the *American Journal of Physical Anthropology* in 1918, and the American Association of Physical Anthropologists in 1930.

Hrdlička, however, as a museum scientist, did little teaching or training of junior scientists. That part was taken by a classicist from Wisconsin, who studied anthropology as a Rhodes Scholar at Oxford, and subsequently took a post at Harvard that he held for about 40 years – Earnest Hooton. Hooton trained virtually the entire field of physical anthropologists over those decades.

Much of physical anthropology through World War II consisted in documenting the physical differences among human groups and attempting to classify them on that basis. World War II was a crisis for physical anthropology, however, as its evil German manifestation was both an embarrassment to the field, and yet surprisingly difficult to distinguish from its American counterpart.

Physical anthropology was essentially rebuilt intellectually in the 1950s by Sherwood Washburn, who had done his doctorate with Hooton in 1940 on the anatomy of monkeys. Washburn slammed the door on the physical anthropology that was centered on measuring people’s skulls and relegating them to one group or another – it was static and typological, he argued. It reflected neither modern evolutionary theory nor the reality of human populations. What was needed was a “new” physical anthropology, one focused on the dynamics of evolution and adaptation; one that would be better integrated with modern evolutionary biology. Human evolution, rather than simply classification, would be at the center of the “new” science; and it would be rooted in an understanding of how humans fit into the biology and behavior of the primates. Moreover, the study of superior or inferior human races should be supplanted by the study of what could be considered a common and primordial heritage in human existence – the biology of human populations, and particularly of hunter-gatherers.

Importantly, Washburn envisioned this as a biological subfield integrated into anthropology. For example he interpreted the interactions of baboons as socially cohesive forces, as social anthropologists were inclined to do for human societies. Today, a generation later, many of the issues have changed, but Washburn’s agenda for biological anthropology has profoundly shaped the field. Most field primatologists work, for example, in concert with local people and government agencies, for primate conservation. Most students of the human form work within the framework of human adaptability studies, documenting the plasticity of the human form under different ecological and economic circumstances. And the study of human evolution is becoming increasingly dominated by a field Washburn nurtured, the study of molecular evolution.

Biological anthropology today

At the present time, biological anthropology is a diverse field of study, still centered on the study of the physical aspects of humans as group-members. We generally recognize a three-part division in the field: primatology, paleoanthropology, and human variation.

Each of these areas, however, is highly interdisciplinary, and within each of them, there is considerable variation in the scholarly training and approaches of practitioners. Thus, primatology commonly attracts researchers trained principally in psychology or zoology; paleoanthropology commonly attracts researchers trained in geology or anatomy; and human variation may attract researchers from genetics, forensic sciences, or medicine. On the other hand, it is also quite rare for a university psychology department to house a primatologist, or a geology department to house a paleoanthropologist, or a criminal justice department to house a forensic scientist.

Biological anthropology affords a large enough intellectual umbrella for all of these areas of study, for they are all relevant to the field's focus. At the same time, though, this breadth sometimes results in a strong centripetal force – as scholars engaged in biological anthropology research are pulled away from the field's core, anthropology.

Counteracting this is an academic centrifugal force, drawing from contemporary anthropological ideas and themes in our understanding of the field's biological aspects. Many biological anthropologists study the anthropological themes of power, gender and difference as they are manifested either in the biology of human populations or in our ancestors or primate relatives. Others are involved in analyzing the ways in which modern genetic research is changing our ideas about the body, about who we are, about where we came from, and about who owns body parts. After all, the field took its modern shape with the large-scale collection of Indian bones without much concern for the descendants or even relatives of the people whose bones they were. Federal legislation enacted in 1990, the Native American Graves Protection and Repatriation Act, makes it clear that the bones have different meanings to different peoples, and the alternatives to the scientific meanings must be acknowledged and respected.

Thus, for example, a biological anthropologist in 1950 could examine a

thighbone (femur) and treat it as an object – an “it” – a disembodied piece of dead matter. The old biological anthropologist might well handle it delicately and acknowledge that the femur once was part of a person, but the view of science is that there is a boundary between life and non-life, and once dead the femur is an object, not a person.

And yet the boundary between life and non-life may not be so clear. After all, there is still organic matter – DNA and protein – present in the cells of the bones. And in spite of the reality of the transformation from human to corpse, is the transformation really so profoundly different from other transformations, such as adolescence and old age, that the femur cannot be seen any more as part of a person? Could one not make a case that any body part remains a part of that person, even through the transition of death? If your leg remained your leg through birth, childhood, sexual maturity, physical adulthood, and senescence, why should it cease being your leg just because you have stopped breathing and have begun decomposing?

These are questions confronting modern biological anthropologists, who have to navigate between the sensibilities of peoples and the study of their ancestors' body parts. Similarly, anthropological genetics has had to face such issues in recent years, as its stock-in-trade, the blood of exotic peoples, has come increasingly to be a valuable commodity in pharmaceutical and genomic research. If there are patents to be filed and money to be made, should not the person whose body it came from share in the profit? Alternatively, if the blood belongs only to the researcher after it enters the test tube, why should anyone participate in a genetic study?

These are, of course, issues of property rights and ethics, which have emerged by virtue of new scientific technologies intersecting with economic and political forces. Half a century ago, biological anthropology could shield itself behind a screen of “value-neutral science” – but that privilege no longer exists.

Science is a part of the culture of the modern world and of the global economy. Biological anthropology is consequently bound up in new ideas about science, new ideas about the body, and new ideas about rights. And as such, it is becoming situated once more in an anthropological dialogue, a dialogue of mediation.

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