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POINT OF VIEW

Know thyself: Responsible science and the lectotype of *Homo sapiens* Linnaeus, 1758

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Introduction

Among taxonomists there is unsettled murmuring when the subject of a "type specimen" for *Homo sapiens* Linnaeus is mentioned—quizzical or disapproving. In 1994, an invalid designation for the type of *H. sapiens* was published in a trade publication. Decried, but more often dismissed, by taxonomists as superficial, it has been lauded by the public. Curiously, this particular problem of nomenclatural impropriety is glossed over by professionals in a field which honors taxonomy and prides itself for the precise uses of nomenclatural protocol. A cycle of regained attention, discrete inquiry, and unmindfulness promotes impuissance; all the while the wrong story survives glibly in the public domain, with the expense of misperception of scientists and the scientific method. Now the record needs to be documented and set straight in one place.[1]

The second point is that scientists need to come to better terms with the fact that their comments and conclusions find their ways into areas beyond the ones in which they work. In that environment there is little opportunity to use the checks that are used in scientific communication. Popular writers of science and their publishers should be on notice that information conveyed from scientists needs more accountability than it has now. This case is an example of what can go wrong without checks, and that polite dismissal of the problem does not serve the future. Uncorrected misinformation is perpetuated because what reaches the public, particularly with the implicit authority of a popularly recognized scientist, is magisterial.

Unnecessary Acts . . .

In systematics and taxonomy there is no demonstrable need for a type specimen for *Homo sapiens*. It is the most well-studied species; its typification is superfluous. Still, the act of selecting as the lectotype Carolus Linnaeus, the eighteenth-century naturalist who formalized modern binomial taxonomy, was made by Stearn (1959)—as a gesture of respect for Linnaeus and his far-reaching work. There the matter should have rested even if it is not well known.

Now the claim for the type has been misappropriated very publicly, purporting the type of *Homo sapiens* to be nineteenth-century naturalist Edward Drinker Cope (Psihoyos, 1994). Effectively, this supersedes that which appears in less publicly known scientific literature, even if taxonomists understand that the designation of Cope is invalid. And this is what makes the matter troubling. Psihoyos's widely available book rallies sensational feelings just from its title, *Hunting Dinosaurs*. Stearn's historical essay, published in a scholarly journal nearly four decades ago, is not nearly as sensational, nor is the journal generally known by the public. Readers infer that Psihoyos's story is based on the method and truth of science. This very available misinformation is bound to be noticed and used for historical documentation.

In the broad public domain of science reporting, measures of authority are added when writers quote or credit scientists. Only a couple of areas of science have public (though ephemeral) champions from the field, like Stephen Hawking for astrophysics or Stephen Jay Gould for evolution and the history of science. Their trade publications come with the implicit and inferred assurance of correct language and facts. These writing styles may be seen as being only "popular" overviews and opinions, perhaps even folksy, thus of little worth to working scientists. But in fact the passive scientific voice is only a relatively recent invention which, sadly, confuses or repels the general public and journalists alike (Locke, 1998).

By and large, scientific information comes from people less widely known than the likes of Hawking or Gould, many of whom do not do their own popu-

larized writing. In offering information through interview, most scientists do give the same care and attention to factual responsibility as they demand when communicating with their peers. Sometimes they are misquoted or quoted out of context; worse, sometimes they are wrong. But in the popular media there is no forum for review and little incentive for correction. Misinformation is unwittingly referred to and dispersed more widely without question, by writers and journalists and by word of mouth.

Psihoyos (1994) relied upon the authority of a publicly popular scientist who made a seemingly intractable case for designating Edward Cope as the lectotype of the species *Homo sapiens*. It is more than a simple misstatement in popular literature. The general public repeats this as truth and believes that it is sanctioned by international scientific arbiters.

. . . Necessary Facts

The details of documenting the error of the type of *Homo sapiens* are not likely to gain public attention. Systematics and taxonomy are inherently less interesting than the lives and histories of organisms (especially the very popular dinosaurs, in which context this problem has arisen). Given the popularity of Edward Cope among aficionados of dinosaurs, the error and its correction are bound to be met by the public with disappointment rather than interested thanks. It is not to the publisher's advantage, either, to acknowledge such an uninspirational correction because the firm sells books, and exciting stories sell. Scientifically there is no danger of conflict in taxonomy if the problem is ignored, so it plays no role in systematics and applied biology. Most objectively, the means by which the acts were carried out in the first place (as quoted below) reveal such flippant and egregious errors that the conclusions are promptly dismissable. Scientific readers thus may demand to know why this commentary is given space.

This is the predicament: Popular science backed by authoritative statements from professionals is inferred as coming with the high credentials of factual accuracy. Misguided statements from a professional erode the credibility of science if error is uncovered, but they wear more insidiously if they are unknowingly—or blindly—perpetuated. We should be concerned that the information offered up by Psihoyos is essentially not correctable before the public, other than in a revised edition of his book, which is not likely. The uncorrected information is bound to be repeated, if only for its novelty. For example, a random search through the ephemeral postings of the Internet for fallout from Psihoyos's book found the giddy "People Trivia and Useless Facts" list, which with added imprecision and no documented source states: "The type specimen for the human species is the skull of Edward Drinker Cope an American paleontologist of the late 1800s. A type specimen is used in paleontology as the best example of that species" (Internet, 1998). This serves injustice on science and Edward Cope.

Professionals understand that the acts which created this problem are useless, but the public remains entertainingly enlightened by their apparent validity. It is better to pursue historical accuracy. To document these contrasting points reference has to be made alternately to scientific and popular sources, however discomforting it is, because both forums are intimately involved: taxonomic nomenclature does not exclude popular literature from the status of valid publication; public science freely borrows from professional sources.

One might argue that it is better to continue to privately point out the mistake when it is necessary to do so, and to let it go at that—or outrightly ignore the matter as being nothing more than an unflattering comment on journalistic credibility that does not concern biologists. I counter that while a correction is just a statement—perhaps a self-serving one—the lessons it gives are awfully constructive. To not publicize a correction in the scientific community sanctions the undocumented "oral tradition" which created the problem. Correction maintains the integrity of scientific methods and formal protocols. It replaces misinformed hearsay. It repairs a breach of historical accuracy and defends Edward Cope from mischaracterization. To not publicly correct this occludes the written, referable documentation that is needed to understand how the problem arose, to defend the charges of misappropriation and procedural violations, and to specify the errors. Taxonomy is history; both need verifiable sources.

"Master Naturalist" or "Ultimate Man"?

Hunting Dinosaurs (Psihoyos, 1994) is a trade publication by an accomplished photojournalist. The theme of one chapter is Edward Drinker Cope (1840–1897), who left his body to science. Cope, working in the Academy of Natural Sciences of Philadelphia and the University of Pennsylvania, was one of the last of the great pansystemic naturalists (Osborn, 1931; Davidson, 1997). A great deal of his work still stands, principally in vertebrate paleontology and in Recent herpetology and ichthyology. He is one of few naturalists who are recognized in popular literature, although in this context Cope is remembered most readily for the sensational academic feud in paleontology he fought with Yale University's Othniel C. Marsh. But Cope is not mentioned here just for his position as what Osborn (1931) called "Master Naturalist." He was one of the most notable members of the Academy of Natural Sciences, and this institution takes great pride in knowing that it is a caretaker of his legacy.

We could take as much pride in knowing that he is the type specimen for *Homo sapiens*, but this peculiar claim has no merit.

A codicil to Cope's will instructed that his brain be preserved, and that his bones be kept in a "locked case or drawer, and shall not be placed on exhibition, but shall be open to the inspection of students of anthropology" (Osborn, 1931:590). What appears in Psihoyos's (1994) book is contrary to Cope's wishes. His skull was used as an inspirational prop, far from home. The role played by the skull as the putative type specimen for *H. sapiens* was unplanned but, once the scenario was created, it was played to full advantage. It is a poorly researched scientific claim, journalistically embellished and presented to the lay public as scientific process and result.[2]

Psihoyos's (1994) book is a historical collage of dinosaur paleontology—history and science written for the casual reader—but the chapter about Cope stands out. Contributing author John Knoebber and Psihoyos travelled across the United States, taking Cope's skull with them. They met professional paleontologists who work on dinosaurs, and they traveled to some of Cope's great collecting localities. The accompanying illustrations are macabre tableaux featuring Cope's skull, nine times in the book and once on the back cover where Cope is called the "father of American paleontology."[3]

A claim is made by Psihoyos (1994) for the typification of *Homo sapiens*, tacitly made by publicly well-known and media-attracting dinosaur paleontologist, Robert T. Bakker. Surely Psihoyos did not imagine that, procedurally, it is his publication, not Bakker, that now has to be cited for the attempted typification. In the public forum, though, this technicality is not appreciated. All which is noticed is the implied authority of Bakker and Psihoyos's enthusiastic mixing of the seminal event of the chapter with the final point, mistakenly concluding that Cope's desire to be preserved was to serve as the type specimen for *H. sapiens*. Embellishing this supposition Psihoyos adds that to taxonomists "the most coveted trophy is called the type specimen," and he deduces, "By actually becoming the type specimen for man, *Homo sapiens*, Cope arguably would become, taxonomically anyway, the ultimate man . . ." (Psihoyos, 1994:20).

Although Cope's latest biographer testifies that Cope never said that he wished to be the type of *H. sapiens* (Davidson, 1997, and personal communications, 1998), Psihoyos ceremoniously portrayed the execution of Cope's will: "Per his instructions, Cope was prepared for his postmortem career as *Homo sapiens* type specimen [*sic*] and his bones were dedicated to science." In the search for a suitably magnanimous, respectful phrase, a fact was fabricated.

The problem of the erroneous declaration of Cope as a type specimen originates at the main focus of the chapter on Cope—Psihoyos's and Knoebber's visit, with Cope's skull, to Bakker (Psihoyos, 1994:27):

> *Homo sapiens*, he said, one of the best-known primates, quite surprisingly still lacked a type specimen. It seems that Carolus Linnaeus, the father of modern taxonomy who named our species in 1758, was content with a short Latin description which means, translated, simply 'Know thyself.' But the ruling authority on new species, the International Commission on Zoological Nomenclature . . . declared that all species, to be valid, had to have a scientific description and have a registered type specimen at a recognized museum.

The point of invalidity is not true. In 1758 there was no type concept; many provisions of the *International Code of Zoological Nomenclature* (International Commission on Zoological Nomenclature, 1985; "*Code*" hereafter) take this into account for early taxonomic literature. And Bakker could have been alerted to the presence of a type had he examined the comprehensive reference, *Mammalian Species of the World* (Wilson and Reeder, 1993); there the type locality for *H. sapiens* is listed as Uppsala, Sweden. Since a type locality infers also a type specimen, Bakker could have seen there a cue to the existence of a previously designated type; thus Psihoyos (1994) unwittingly adopted Bakker's unresearched statement. The criterion of deposit of type specimens in a museum or similar institution is still only a Recommendation in the *Code* (Rec. 72D); only the deposit of neotypes is mandatory (*Code*, Art. 75(d)(6)).

Finally, Psihoyos recounts Bakker's attempt to designate Cope as the "lectotype" of *Homo sapiens*. Bakker's proposal (which Psihoyos does not summarize) was "submitted . . . to a dignified but amused [and unspecified] review board" (Psihoyos, 1994:29). Without indicating the source, Psihoyos implies that "approval" was received. He concludes (p. 29), "In 1994 . . . Edward Drinker Cope got his wish and was entered into the scientific literature as the type specimen for *Homo sapiens*," adding that Philadelphia "is now the registered type locality for humans" (p. 29). A literature search yields nothing that pertains to this matter, by Bakker or anyone else; the only thing is that which appears in Psihoyos (1994). As if to authenticate Bakker's proclamation, Psihoyos (p. 29) illustrates a brass plaque attached to a velvet-lined mahogany box specially made by Knoebber to hold Cope's skull; it reads, "Edward Drinker Cope (1840-1897) Type Specimen for *Homo sapiens* Described by Robert T. Bakker, 1993."

Setting the Record Straight

Non-scientific literature is not excluded from being validly published for the purposes of taxonomic nomenclature. If physical and procedural criteria are satisfied for the production and distribution of a

publication, taxonomic and nomenclatural acts included in such publications come under the purview of the *Code*. Taxonomic acts first published in popular literature are not common, but neither are they without precedent. Factually, the information from Psihoyos and Bakker is flawed, but it is validly published (*Code*, Arts. 7-9). Their statements are easily dismissed as scientifically meaningless, but only by those who understand the function of types and who are familiar with the terms and provisions of the process of typification. The public at large does not know this. To them—particularly those who search for documentary and authoritative statements, or worse, for sensational or amusing topics—several errors are accepted: Edward Cope, the "father of American paleontology," is the type of *Homo sapiens*; Robert Bakker, a publicly popular paleontologist, "described" Cope as the type of *H. sapiens*; Philadelphia is the type locality; the International Commission on Zoological Nomenclature registers new species, type specimens, and type localities; for a species to be validly recognized type specimens must exist and be placed in a museum; and *H. sapiens* has no further original description than the appellation, "Know thyself."

Linnaeus (1758:20-24) erected the species *Homo sapiens* with five pages of descriptions. It is the generic name, *Homo*, to which the statement (or admonishment) "*nosce Te ipsum*" is appended (pp. 18, 20), thus "Man, know thyself." An asterisk leads to a footnote running over three pages (pp. 20-22) that elaborates on the characteristics of the genus. The name *Homo sapiens* means "wise man" or "knowing man"; and in fact, the two taxa "may be said to presuppose each other" (Broberg, 1994:176), even though taxonomically "*sapiens*" is just an epithet, not a description. In Linnaeus's (1758) description and diagnosis of *H. sapiens* there are five varieties or forms that are synonyms of *H. sapiens*. Some of the diagnoses for both the genus and species deal with aspects of sociology and ethnocentric culture, hence the different forms. Within today's *Code* these criteria are not valid for the description of a taxon. Still, Linnaeus's text (particularly pp. 22-24) has morphological descriptions enough to validate the species and to distinguish the genus from other genera. There is no ambiguity. Subsequent editions of Linnaeus's *Systema Naturae* (Linnaeus, 1760, 1767; Gmelin, 1788, 1792) also nearly faithfully reproduce Linnaeus's (1758) original descriptions, but a later translation (Turton, 1802) emends the descriptions and deletes most of the lengthy cultural diagnoses. (For comments on the editions of *Systema Naturae*, see Sherborn, 1899.)

Edward Cope was not present until after Linnaeus's lifetime (1707–1778); he could not have been among the "specimens" referred to by Linnaeus (1758) for the description of *Homo sapiens*. Bakker had to have made his selection from among the suite of syntypes of *H. sapiens* (*Code*, Art. 74(a)(v)). Many of Linnaeus's reference specimens have been located in museum collections, and many of his plant and animal species were later typified. We do understand his taxonomic concepts (*e.g.*, Cain, 1993, 1994; Frängsmyr, 1994) and we are not oblivious to the huge impact Linnaeus has had on biological classification (*e.g.*, Sandbergs Bokhandel, 1957; Cain, 1959; Stearn, 1959). The matter of *Homo sapiens* is peculiar only in Linnaeus's (and our) "intuitive" understanding of these taxa—that is, knowing ourselves—so not surprisingly none of Linnaeus's "study specimens" of this species were set aside for future reference. One may argue that Bakker had thus selected Cope to be the neotype specimen, in the absence of recognizable original type material. However, the information published by Psihoyos (1994) fails to meet the qualifying conditions needed to designate a neotype (*Code*, Art. 75); these criteria are more rigorous than those needed to select a lectotype (*Code*, Art. 74).

Despite these technicalities, Bakker's proposal is a moot point on one criterion (see *Code*, Art. 74(a)(i)). The lectotype of *Homo sapiens* had previously been selected, by Stearn (1959:4): "Since for nomenclatorial purposes the specimen most carefully studied and recorded by the author is accepted as the type, clearly Linnaeus himself, who was much addicted to autobiography, must stand as the type of his *Homo sapiens!*", which is all that Stearn had to say to select Linnaeus as the type specimen. As for Linnaeus's addiction and his qualification to be a referred specimen, Stearn (written communication, 1995) points out, "it may suffice to say that he wrote his autobiography five times" (see Malmeström & Uggla, 1957). By the selection of Linnaeus as the lectotype of *H. sapiens*, Uppsala, Sweden, simultaneously became the type locality since that was the provenance of the specimen when it was "discovered." The disposition of the type specimen is certainly known; it is not lost. In fact, a description of Linnaeus's body when interred is recalled from contemporary sources in Jackson (1923: 340-341). And Stearn incidentally observes (written communication, 1995) that the vault containing Linnaeus's remains (illustrated in Uggla, 1957), in the cathedral at Uppsala, is inscribed, "'Ossa Caroli a Linné', a remark relevant in a zoological context."

Linnaeus's bones are, of course, not openly available for study, but how any examination of them could advance our understanding (or taxonomic recognition!) of the species is unimaginable. Given this, and the fact that there is no confusion in the taxonomy of this species without a type, the typification of *Homo sapiens* is, frankly, an honorary declaration.

Typification is nevertheless a function of taxonomy, the mechanism of systematics, and this particular act was validly published; the same rules apply to *H.*

sapiens as apply to all other zoological species. Admittedly, the *Code* is only a non-binding convention, but there is broad agreement among zoologists that they will adhere to its arbitrating provisions for the sake of stability in taxonomic nomenclature. Earlier conventions of many kinds comprise a long history of nomenclatural protocols, and the present *Code* continues to evolve, but the underlying objective—to stabilize the procedures and structure of taxonomic nomenclature—has been constantly the guide (Melville, 1995).

To describe *H. sapiens* clinically in taxonomic terms, and to give to it a named individual (Carolus Linnaeus) as the lectotype is an odd situation only because of our familiarity with the subjects. But Stearn supposes (personal communication, 1995), "This conclusion [Linnaeus] would have regarded as satisfactory and just. As he himself said, '*Homo nosce Te ipsum*'."

Conclusion: Conscience or Conciliation

Lest one believe that there is nothing to be gained from the critiques and calls I make, consider first what Ernst Mayr (1982:20) said: "I feel that the history of a field is the best way of acquiring an understanding of its concepts. * * * In science one learns not by one's own mistakes but by the history of mistakes of others." The statement not just trusts the role of history in science but implicitly refers to mistakes that have been recognized. Unfortunately, the gulf between professional and popular science distances one's mistakes from the other; they are easy to overlook or ignore as being the "other party's concern." Frankly, there is no gain in smugly indulging the lay public's misperceptions, taking the attitude that *we* understand what is right and that is "what matters."

It does not matter whether the species *Homo sapiens* has or has not a type specimen. That a type was selected does, however, make it a point of historical accuracy. That mistakes such as the ones discussed here perpetuate is scientifically irrelevant. In the future, however, they could lead to claims of historical propriety, with Psihoyos's book used as a corroborative source. It is for this reason, if for no other, that professionals should consider the consequences of extralimital problems that can arise from placing the matter aside.

The points raised here can be dismissed as having no bearing on the advancement of scientific knowledge, thus no reason to account for them. This is so only if one considers the responsibility of writers of science in the public domain to be different from the accountability to which scientists hold their peers. The way in which Psihoyos used and illustrated Edward Cope's remains is unethical. Such sensational, casual treatment disrespects Cope's final wishes, but this is a matter simply of subjective offense. On the other hand, the statement that *Homo sapiens* has no proper description is objectively wrong; it reveals that not even Linnaeus's original description was read. And Bakker's flamboyant, explicit sanction of Cope as the type specimen for *H. sapiens*, made without documenting a search for an existing type, is nonetheless procedurally incorrect. It misguided Psihoyos and his publisher to create and disseminate a scientific and historical mistake, one which is unfortunately appealing and eagerly recited.

From such morsels the public gets its information, and upon them is built public opinion of science and scientists. Only a few lucky areas of science have prolific, casually versed spokesmen like Hawking and Gould. Scientists who are so fortunate as to gain public prestige must of course always be aware that in public their comments come with high value, which quickly depreciate if the statements are found to be wrong.

Productions presented as fiction or entertainment, such as novels and films, are just that; they may (and do) take liberties with scientific fact. But public productions presented as fact should be accountable. An informed and responsive scientific community at large is the first defense against misstatement. Publishers would do well, too, to be more critical of, and responsible for, the facts they allow into print, regardless of the inherent authority of the source. They should ensure the means by which scientific accuracy is more surely corroborated or challenged before it is published. Nevertheless, it is up to us, the scientific community, not to shrug off misconceptions that enter the public forum as fact. The beneficiaries are the public (present and future), in their right to historical accuracy, and ourselves through ensurance of the integrity of scientific methods and interpretations.

Notes

[1]This Point of View was written after four years of encouraged and discouraged discussion. Some individuals said there must be a formal response to the problems addressed here, some thought it did not matter, and others thought the matter ridiculous—yet all took the time to discuss it because the problems exist. Arthur E. Bogan and Jane Davidson, anonymous readers, and Internet discussion groups provided discussion and critical comments on various points brought up here. A. J. Cain was instrumental in introducing me to William T. Stearn's typification of *Homo sapiens* and leading me to Stearn, who graciously provided some continuing thoughts, 36 years after publishing his essay, on Linnaeus as the type of *H. sapiens*. The International Commission on Zoological Nomenclature remains silent on the matter of a type for *Homo sapiens*, as it has in the past (*teste* E. Yochelson, 1998).

[2]As a matter of record, I corroborate that labelled specimens survive, as follows: Cope's brain is in the study collections of the Wistar Institute, in Philadelphia; his bones are in boxes in the collections of the University Museum of Archaeology and Anthropology, University of Pennsylvania, Philadelphia; and, in accordance with another one of Cope's last requests, the ashes of the rest of his remains are in a bronze urn displayed next to those

of other scientists, in the Wistar Institute. Some controversy still exists as to the authenticity of the surviving skeletal material (see Stewart, 1983, who briefly reviews the subject and provides information on the history of other authentic and posthumously prepared study materials), but all claims still are conjectural. And, in defense of the University Museum, Psihoyos had no further authorization than to photograph Cope's bones.

[3]Historians of paleontology do not identify any one "founder" of American paleontology. In different disciplines within this science several individuals are recognized for being the first significant workers or promoters, most of whom antedate Cope. In vertebrate paleontology specifically, Isaac Wistar and Thomas Jefferson are usually pointed to as inaugurating this discipline in North America, although their work as well as that of American workers for decades afterwards is eclipsed by the broad and influential studies by the dominant "master naturalist," Georges Cuvier, working in France (Scott, 1927; Simpson, 1942; Smith, 1993). Joseph Leidy, the comparative anatomist under whose tutelage Cope worked as a young man in the Academy of Natural Sciences and in the University of Pennsylvania, and with whom Cope worked until Leidy's death in 1892, was the first broadly focused and prolific researcher in American vertebrate paleontology (Warren, 1998).

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