Notes and Documents

SAURON, Mount Doom, and Elvish Moths: The Influence of Tolkien on Modern Science

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J.R.R. Tolkien once explained that Middle-earth was based on his "wonder and delight in the Earth as it is, particularly the natural Earth" (*New York Times* 18). Numerous authors have analyzed the influence of real-world science on Middle-earth, including Flieger, Quiñónez and Raggett, Manning, and Larsen. In turn, Tolkien's works have influenced a number of distinct disciplines, the most obvious being fantasy writing. In 1980, Attebery noted that "No important work of fantasy written After Tolkien is free of his influence, and many are merely halting imitations of his style and substance" (10). Even the most cursory examination of the voluminous Tolkien Music List demonstrates the impact Tolkien's subcreation has had on myriad musical genres. Less well-known is Middle-earth's influence on the teaching of composition, literature, and even astronomy (Stanton; Nelson; Larsen "Teaching"). This paper will examine a surprisingly rich yet largely neglected area of Tolkien's influence, namely that on real-world science and scientists.

It has been documented that Middle-earth caught the attention of students and practitioners of science from the early days of Tolkien fandom. For example, in the 1960s, the Tolkien Society members were said to mainly consist of "students, teachers, scientists or psychologists" (Resnik 94). A decade later, the printer at the Stanford Artificial Intelligence Laboratory (SAIL) was adapted to handle a Tengwar font (Davis 124). Not surprisingly, scientists from such varied disciplines as paleontology and astronomy began honoring their favorite author through the naming of discoveries after Tolkien himself and various characters of Middle-earth. Nowhere has this been more evident and widespread than in the taxonomy of living and extinct species.

Bee specialist Doug Yanega explains that in taxonomy, "most names are descriptive, and a big chunk of the rest of them are honorific" (Milius 330). As Henry Gee notes,

> Given Tolkien's passion for nomenclature, his coinage, over decades, of enormous numbers of euphonious names—not to mention scientists' fondness for Tolkien—it is perhaps inevitable that Tolkien has been accorded formal taxonomic commemoration like no other author (54).

As one of the central characters in the Third Age of Middle-earth, Gollum/Sméagol is an obvious choice for such scientific immortality. In 1973, K. J. Hedqvist named a new species of Swedish wasp *Smeagolia perplexa*, while in 1980 F. M. Climo dubbed a new order of "enigmatic New Zealand slug" Smeagolida (514). The corresponding new genus Smeagol was named for

> the pallid, sometimes subterranean Tolkien character Smeagol (whose alternative name is Gollum), a pitiable humanoid who ultimately played a very important role in saving 'Middle Earth' from evil forces. The slug below is far more significant, phylogenetically, than its drab exterior indicates—hence the analogy. (515)

New Zealand is also home to two other Gollums, the first being *Galaxias gollumoides*, a freshwater fish with large eyes, named after the "dark little fellow with big round eyes who sometimes frequents a swamp, a character in J. R. Tolkien's 'The Hobbit' and 'Lord of the Rings', hence gollumoides meaning Gollum-like" (McDowall and Chadderton 85). The other "Kiwi" Gollum is *Gollum attenuatus*, "a bizarre-looking longnosed deepwater shark" first recognized by L.J.V. Compagno (192) in 1973. This original Gollumshark was recently joined in the subfamily Gollluminae by two other still unnamed species, temporarily dubbed Gollum A and B (Compagno, Dando, and Fowler 258-9).

Hobbits are also honored in the taxonomical system. Terry Erwin named a species of Central American ground-beetle *Pericompsus bilbo* due its short, fat stature and hairy feet (470). *Syconycteris hobbit*, the moss-forest blossom bat indigenous to Indonesia and New Guinea identified by Ziegler in 1982, is currently listed as a vulnerable species. Juan Morrone named three new species of Andean weevils after Tolkien characters (*Macrostyphlus bilbo, Macrostyphlus gandalf*, and *Macrostyphlus Frodo)* in 1994. Other familiar names that appear in the taxonomy of living creatures include *Gwaihiria naumann,* an Australian wasp discovered by I. D. Naumann in 1982 and named after the great eagle; *Sauron,* a genus of spiders from the Saur Mountains of Kazakhstan, discovered by K.Y. Eskov in 1995 (Eskov and Marusik); and *Leucothoe tolkieni*, a new species of crustacean identified by G. Vinogradov in 1990 (Vader 52).

Moths and butterflies make several appearances in Tolkien's world. Wilwarin, the butterfly, was one of the constellations created by Varda in anticipation of the coming of the Elves (*S* 48). While traveling through Mirkwood, Bilbo and the twelve dwarves were troubled by "thousands of dark-grey and black moths, some nearly as big as your hands, flapping and whirring round their ears" (*H,* VIII, 194). After climbing a large oak tree in hopes of spying the end of the forest, Bilbo found the tree

canopy populated by butterflies described as "black emperors" (*H,* VIII, 201). Gee notes in *The Science of Middle-earth* that "there are no fewer that thirteen tiny moths of genus *Elachista* that are named after Elves" (54). However, a careful reading of the original scientific paper by Lauri Kaila (preferably with one's dog-eared copy of Foster's *The Complete Guide to Middle-earth* close at hand) shows that thirty-eight of the forty-six "newly described species are derived from the mythology of J.R.R. Tolkien" (Kaila 4).

Thirteen of these (*E. finarfinella, E. indisella, E. curufinella, E. maglorella, E. caranthirella, E. turgonella, E. celegormella, E. daeronella, E. miriella, E. serindella, E. guilinella, E. amrodella, and E. aredhella*) indeed do arise from "the ancient Elves, which one after the other sailed over the waters to the West, and were later difficult to see with Human eyes" (Kaila 4). Two species are named after dwarves (*E. ibunella and E. telcharella*), and seventeen honor human characters (*E. morwenella, E. marachella, E. haldarella, E. dagnirella, E. aerinella, E. gildorella, E. bregorella, E. arthadella, E. turinella, E. nienorella, E. tuorella, E. rianella, E. neithanella, E. beorella, E. eilinella, E. gorlimella, and E. ragnorella*). *E. olorinella* recognizes Gandalf's name in Valinor, *E. diorella* is named for the son of Beren and Lúthien, and *E. taurnonella* honors the Vala Oromë. *E. telerella* appears to be named for the Teleri, the third kindred of the Eldar, while *E. galadella* derives its name from the Galadrim of Lothlórien (or perhaps Galadriel or Gil-galad). Finally, *E. aranella* seems to owe its name to aran-, the "royal prefix used by the Kings of Arthedain after Malvegil and by the Chieftains of the Dúnedain of the North to indicate their claim to all of Arnor" (Foster 23).

Kaila explained in his seminal paper that "phonetic attributes of the names were emphasized over the actual deeds of the characters in their world" (4). However, it appears that there are several thematic strands present within the paper. One obvious strand is the House of Finwë. Both of his wives, Indis and Miriel, are named among the moths, with Miriel named twice (once under her epithet Serindë). Finarfin, son of Finwë and Indis, appears, as do five of the seven sons of Fëanor, son of Finwë (Curufin, Maglor, Amrod, Celegorm, and Caranthir). A second thematic strand involves the court of Gondolin, with Turgon, his sister Aredhel, son-in-law Tuor, and Tuor's mother, Rían, named among the moth species. Five of the last dozen outlaws to stand with Barahir in Dorthonion are honored (Dagnir, Gildor, Arthad, Ragnor, and Gorlim), along with Gorlim's wife, Eilinel, and Bregor, father of Barahir. Finally, the tragic tale of Túrin is reflected in Kaila's paper, with species named for Túrin (and his pseudonym Neithan), his mother, Morwen, and his sister/wife, Nienor, along with the dwarf Ibun, who was captured by Túrin, and Aerin, wife of Brodda, who aided Morwen and her young son. In addition, three of the species have distinguishing characteristics

reminiscent of the characters after whom they were named. *E. finarfinella* is "characterized by the yellowish head" and *E. indisella* is "characterized in particular by its pale yellow head and neck tuft" (Kaila 30-1). Similarly, Indis and her son Finarfin were known for their blonde hair. *E. olorinella* is a "pale silvery grey species" which can be distinguished "by its shining wings," an apt description for Gandalf as he was in Valinor (Kaila 46).

Fossil species have also afforded ample opportunities for honoring Tolkien and his works. In 1964, Kenneth Cooper identified the first fossil species of tardigrade from Canadian amber dating to the late Cretaceous Period (60-80 million years ago). Commonly referred to as water-bears, tardigrades are tiny invertebrates commonly 1 mm in size. Cooper named his extinct species *Beorn leggi*, after what he explained is "the now storied magical bear of the Wilderland in the Third Age of Middle-earth" (44). Simon Conway Morris named a genus of fossil priapulid worm from the Cambrian Period (circa 500-570 million years ago) *Ancalagon* in 1977, while Peter Wagner reclassified a genus of extinct Silurian gastropod mollusks (dating 421-428 million years ago) and named them *Frodospira*. Naming the genus after a hobbit is especially fitting, as "all known species are known only from very small shells" (Wagner 31). In 1969, Webb identified a new species of fossil canid from Florida dating to the Pliocene epoch (5-9 million years ago) and named it *Osteoborus orc*. It was reclassified by Wang, Tedford, and Taylor in 1999 to *Borophagus orc* (278).

Gee has opined that "the prize for Tolkien-related obsession in taxonomy must go to paleontologist Leigh Van Valen, who in a single paper named virtually an entire fauna of fossil mammals after Tolkien characters" (55). In the aforementioned 1978 paper in *Evolutionary Theory*, Van Valen named twenty three new species of primitive mammals (most of a type known as condylarths). In addition, ten new genera or subgenera honor Middle-earth. One such new genus, Ancalagon, was renamed Ankalagon by Van Valen in 1980 when he became aware that Conway Morris had already used the name for his new priapulid genus in 1977 (Van Valen "Ankalagon" 266).

Unlike Kaili, Van Valen openly tied the names chosen for his new species and genera to the properties of Tolkien's characters. Mithrandir became the name of a subgenus of *Anisonchus,* named for the "wisest of the Istari." Van Valen chose the name in reference to "the subtleness of the differences between the subgenera" (Van Valen "Beginning" 64). Two of the new species of *Anisonchus* Van Valen identified were named *A. athelas* and *A. eowynae*, noting that Eowyn was cured of the poison of the Witch King with the aid of the athelas plant (64). *Earendil undomiel*, a new species of the genus Earendil, was named for the Quenya term for the "evening star, which Eärendil with his Silmaril became" (63). The new genus *Fimbrethil* was named for the "entwife loved by Fangorn" due to the

"partly primate-like morphology" of the genus and "the disappearance of both Fimbrethils" (62). *F. ambaronae* was named for one of "Fangorn's shorter names for his forest," relating the "dimness of the forest and of the affinities of this species" (62). *Protoselene bombadili* was named for the "simple, powerful, and very old being," whose traits Van Valen believed relevant to the new species (60).

Van Valen designated several of the species in reference to their appearance. The new genus Bomburia, was named for the "fat dwarf" in *The Hobbit*, which Van Valen felt reflected the "size and morphology" of this particular genus (59). *Arctocyonides mumak* was named after the "large elephant" because it was the largest known species in its genus (55). Likewise, *Deltatherium durini* was named after the dwarf king because this new species was "two thirds the size of *D. fundaminis*" (53). *Thangorodrim thalion*, a new species of the new genus Thangorodrim, was named for the Sindarin word for strong, in reference to the species' "massive morphology" (55).

Other species were named after terms in Sindarin and Quenya. *Chriacus calenancus* received its name from the Sindarin for green jaws, a reference to the species' "inferred herbivory" (53). *Litaletes ondolinde* was named for Gondolin, the hidden city carved from rock, a reference to the fossil collection site Rock Bench, whose specimens "were formerly as hidden (and unsorted)" (59). *Litomylus alphamon* was named in Sindarin for Swan Hill, the location of this species' fossils (60). *Deuterogondon noletil* owes its name to the Quenya for knowledge and horn, referring to the "apparent relationship of *D. noletil* to Uintatheres," a horned fossil mammal (57). *Platymastus palantir* related the palantírs' ability to give "visions through spacetime" to the "long duration of the genus" (56). *P. mellon* was named for the Elvish password to Khazad-dûm due to the species' "similarity to *P. palantir*, presumptive diet of plants, and obliquely to the English word melon" (56).

Van Valen therefore sometimes mixed Elvish with words from other traditions in crafting his new genus and species names. The new genus Mimatuta owes its name to mir, the Sindarin term for jewel, combined with the name of the Roman dawn goddess, Matuta, and was also a reference to the dwarf Mîm (62). The new species *Mimatuta minuial* was named after the Sindarin word for "the time at dawn when the stars fade," referring to the "dawn of the Cenezoic [era] and the fading of the Mesozoic stars," namely the dinosaurs (62). *Tinuviel eurydice*, a new species of the new genus Tinuviel, was named in honor of both Tinúviel and the Greek mythological character Eurydice, and referenced Lúthien's rescue of her husband from the Hades-like subterranean domains of both Morgoth and Sauron (61). Other examples that require no further explanation are the new genera Niphredil and Maiorana, and the new species

Mimatuta morgoth, Niphredil radagasti, Oxyprimus galadrielae, Mimotricentes mirielae, Protungulatum gorgun, and *Desmatoclaenus mearae*.

Clearly the most important example of an extinct species bearing a Middle-earth name (albeit an unofficial one) is the so-called Hobbit of Indonesia. In 2004, Peter Brown and colleagues published what they believed to be evidence of a new and radically small human species. The 18,000 year old fossils were named *Homo floresiensis*, after the Indonesian island on which they were found (Brown et al. 1055). When it became known that Michael Morwood, one of the scientists on the discovery team, had nicknamed the original skeleton "Hobbit," the press ran with the side story, and the term became synonymous with the new species in most media reports (Fullagar 68). For example, *Time* announced the proposed species as the "Hobbits of the South Pacific" (Lemonick et al., 2004). The name began to appear in more scientific outlets, as in the 2005 article "Bone Collection Backs Up 'Hobbit' Theory" in *New Scientist*. Even the august journal *Science* succumbed to the nickname in its coverage of the continuing controversy surrounding whether or not the fossils represent a separate species of humans. In "How the Hobbit Shrugged: Tiny Hominid's Story Takes New Turn," it was revealed that a newly found fossil foot was quite large, leading to the pithy comment that "Indonesia's hobbits, like J.R.R. Tolkien's fictional creatures, may have trekked about on big hairy feet" (Culotta 984). If it is finally determined that *H. floresiensis* does indeed represent a new species of humans, it appears that "hobbits" will become firmly entrenched in archaeology textbooks.

The personal impact of Tolkien and his subcreation on biologists and paleontologists has clearly resulted in a respectful repayment through the naming of numerous species and genera. But Middle-earth has also played an important role in the imagination of geologists and astronomers as well. In 1972-3, a team of geologists working for the Australian government first mapped an area near Alice Springs dubbed Spring Pound by the locals. Based on his observations of the area's geology and geography, team member Alan Langworthy proposed the official name Mordor Pound, which he spearheaded by utilizing it in scientific publications (Langworthy and Black). Also termed the Mordor Igneous Complex, the roughly rectangular plane was formed when its relatively soft rocks eroded more quickly than those comprising the ring of surrounding cliffs (Huston). Like its Middle-earth equivalent, Mordor Pound is only accessible through a small gap in the surrounding ridge, called Wild Dog Pass, compared to "Cirith Gorgor in Tolkien's tale" (*Aus Geo News*, 15). Within Mordor Pound are a number of "dark conical hills of ultramafic intrusive rocks" (Hoatson and Stewart, 41), with one of the largest now bearing the name Mount Doom, courtesy of Alan Langworthy.

The rocks which form the floor of Mordor Pound contain phlogopite, a type of mica rich in magnesium which has a "bronze, shimmering effect." Huston further explained that "the combination of the dark colour along with the shimmering effect gives the rocks of Mordor Pound the feel of a 'dark land where the shadows lie'." Although no economically feasible mineral resources have so-far been mined from Mordor Pound, private companies have successfully developed other mineral resources in Australia. One such company, Mithril Resources Ltd, was first listed on the Australian Stock Exchange in 2002 and "is committed to creating shareholder value through the discovery and development of nickel-copper sulphide deposits in Australia" (Mithril Resources).

In the astronomical community, one of the most common expressions of respect and admiration is the naming of asteroids. Asteroid 2675 was discovered by M. Watt on April 14, 1982, and asteroid 2991 was first seen by the same observer on April 21, 1982. Watt suggested "Tolkien" as the official name for his first discovery, with G. V. Williams proposing "Bilbo" for the second (Schmadel 346, 388). To date, these are the only two asteroids officially named for Tolkien or his works. Radegast (asteroid 2581) is named for the Slavic fertility god, while Underhill (asteroid 2581) is named for woman astronomer Anne B. Underhill (Schmadel 333, 277).

Astronomers have continually made a game out of creating experiment names with humorous acronyms. A well-known example is the series of experiments which searched for microlensing events bearing acronyms of MACHO, EROS, DUO, and OGLE. In 2001, Roger Bacon and colleagues published the first results of their study of the motion of gas and dust in galaxies utilizing a special spectrograph named the Spectroscopic Areal Unit for Research on Optical Nebulae, or SAURON (24). The team also developed a special computer system for analyzing the data, which they named Palantir (33).

An area of ongoing theoretical and observational research in astronomy is the so-called dark energy, a mysterious, pervasive background that currently appears to be dominating the expansion of the universe. Various models of dark energy have been proposed, each in turn making testable predictions for the values of a number of cosmological parameters (when coupled with the standard inflationary big bang scenario). Likewise, observations of various cosmological parameters (such as the rate of change of the expansion of the universe and the fine structure in the cosmic microwave background) put constraints on viable dark energy candidates. Analysis of these constraints and their predictions for future experiments is the goal of the Analysis and Resolution of Dark-sector Attributes project, or ARDA, introduced in a preprint by Greg Huey in 2005 (1). Interested scientists were directed to contact the program at

the University of Illinois through email, with the address located on the server isildur.astro.uiuc.edu (Huey 11).

Astronomers have also borrowed lines from *The Lord of the Rings* and even the title of the work itself in describing astronomical phenomena. For example, a 2006 preprint on rings and disks of material surrounding hot Be-type stars, entitled "Be Stars: One Ring to Rule Them All?" described a project to "probe whether the ring scenario is the one to rule the Be phenomenon" (Meilland et al. 1). In February 2002, several articles on Saturn appeared on popular astronomy websites in connection with the anniversary of Galileo's birth and Saturn's occultation by the moon. The Astronomy Picture of the Day site picture for February 15 was entitled "Saturn: Lord of the Rings" (Nemiroff and Bonnell), while the February 12 Science@NASA page proclaimed Saturn to be "The Real Lord of the Rings" (Phillips, "Real")

Not even the mighty fire-demon of Khazad-dûm is safe from appropriation by imaginative astronomers. On April 30, 2006, a particularly striking bipolar sunspot and magnetic filament was visible to backyard observers using hydrogen alpha filters on their telescopes. A photograph taken by Jeff Barton of the Texas Astronomical Society was afterwards featured on the SpaceWeather website. Barton drew a connection between the sunspot and the Balrog, stating "I can see the monster's terrible eyes and flaming whip curling over its right shoulder as it readies to strike Gandalf from the rock bridge in the Mines of Moria" (Phillips, "Beware").

In a draft to a letter to Carole Batten-Phelps from 1971, Tolkien acknowledged that *The Lord of the Rings* "does not belong to me. It has been brought forth and must now go its appointed way in the world" (*Letters* 413). From spectrographs to sea slugs, sunspots to spiders, scientists from varied disciplines have, in their own small way, gladly taken ownership of Middle-earth and brought it a little closer to reality. A 1978 note in *Chemical and Engineering News* (Reese 52) even pondered the sagacity of officially adopting the Shire Calendar (*RK*, Appendix D, 384). It appears that Tolkien was most certainly correct when he asserted that "the theatre of my tale is this earth," but he could not possible have predicted to the extent to which scientists are continuing in the telling of the tale (*Letters* 239).

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