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Zombie Science & Geoscience

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"In science, conventional wisdom is difficult to overturn...some implications of plate tectonics have yet to be fully appreciated by isotope geochemists...and by geologists and geophysicists who have followed their lead"—Armstrong, 1991

Zombies are reanimated, shambling and catatonic corpses of voodoo and video that know not when they are dead. Zombies have analogs in obsolete conjectures—propped up as conventional wisdom—in science and maintained for reasons and methods outside of science (Charlton, 2008). Zombie hypotheses are unproductive (they do not produce useful results) but are not completely sterile (uncreative). They need to evolve and morph to keep up with the facts that threaten to bury them; they spawn rationalization, exceptions, paradoxes, adjectives and other zombies, often in creative ways that diverge from real science. Aether, phlogiston, and Lamarckian inheritance of acquired characteristics are among examples of zombie science that are now extinct. Phlogiston, the magic elixir of alchemy, became endowed with many mysterious qualities but when it was discovered that adding phlogiston to burning solids added to their weight, a small group of alchemists defected and founded chemistry. Aether was similarly discarded when it was required to be rigid, fluid, weightless and invisible. Ptolomaic motions of Sun and the planets around a fixed Earth survived generations of complications with epicycles, eccentrics, and equants, but were demoted from science centuries before they were rejected by the Vatican. Even before better models were fully in place the Ptolomaic system became so complicated with gears-within-gears, and spheres-within-spheres that some astrologers looked elsewhere for solutions and became astronomers. Fixity (of aether, Earth, Euler poles, geographic poles, "hot spots", continents, species) is a simple and testable hypothesis that can make numerous predictions. If every observation requires an adjustment, or a new parameter, then the hypothesis is no longer simple or elegant and it cannot make predictions. But it is hard to recognize the final straw, the smoking gun, or the nail in the coffin—so dead things stick around.

Editors, reviewers and funding agencies unwittingly perpetuate zombie science, which differs from simply bad science in that it is immune to evidence. As a result, zombie science becomes entrenched as conventional wisdom, and even mainstream science. Speculations that may have been reasonable when proposed become cemented by constant repetition to dogma, impervious to disproof and defended passionately by committed advocates.

In real science, assumptions are formulated clearly, tested rigorously, and applied to as many situations as possible. The assumptions self-destruct if nature resists. Assumptions and hypotheses are not laws of nature, but are made to be tested and, when broken, abandoned. Controversial science, ideas that conflict with our own, and wrong hypotheses can all be good science. Zombie science, in contrast, cannot be falsified or killed, and instead exists in a nether world of dogma and superstition that lies between paradigm shifts. Contradicting facts are ignored and added as new, unpredicted properties or adjustments to earlier speculations. The underlying assumptions, which are no longer believed by anyone, are forgotten in the process.

A well-known geoscience example was the "permanent continents–rigid mantle" ideology, retained by most geologists and geophysicists long after continental drift and a flowing mantle, with no fixed points, were established by empirical evidence. We look with disbelief on 20th century scientists who believed that gigantic continents were fixed to the mantle. However, the view is now adopted that small islands are tethered to the deep, rigid mantle by narrow umbilical cords. We accept the views that while oceanic crust recycles to the lowermost mantle, continental crust is permanent. Future scientists may regard present-day belief in absolute reference systems, fertile fixed points, narrow 3000-km-tall mantle jets, and one-way continental growth from "the convecting mantle" as persistent myths (Armstrong, 1991).

Geologists had long since given up on the young Earth hypothesis before the news filtered up to physicists. Mineral physicists and petrologists dismiss the geochemical dogma that low seismic velocity and large magma volumes are unique proxies for high absolute temperature. Geodynamicists no longer believe that convection implies chaotic stirring and homogeneity, or that plates are passive passengers on the backs of convection cells driven by core heat. Geologists do not believe that the upper mantle is homogeneous or that oceanic crust, delivered up by plumes from the lower mantle, is the only contaminating material. Planetary scientists do not believe that Earth accreted cold and homogeneous and only later warmed up and differentiated. Yet these old ideas are still entrenched in dependent disciplines. Complex conjectures are built on the assumption that early Earth was cold, the lower mantle "unfractionated" and "undegassed", that the crust grew gradually and, once formed, was permanent and that there was no recycling. Because the model required two "reservoirs", the mantle was early thought by geochemists to be two-layered. Later it was thought to be one-layered based on suggestive visual chromotomography wherein the assumption that "red is hot and blue is not" was unconsciously accepted. Continuous recycling of oceanic crust from the surface to the core-mantle boundary and back was presumed. Geodynamicists supported these speculations with modeling.

Sometimes in science it is hard to know when to "put the last nail in the coffin" of an attractive hypothesis that has failed all tests. "...before we nail any more coffins, let's first be sure that there is a body to be buried" (Hofmann & Hart, 2007). The temptation is to add more assumptions and parameters to prop up dead theories. Just like munchkins in the Wizard of Oz, we often wait and see if it is truly dead; "Let the joyous news be spread, The Wicked Old Witch at last is dead!...not only merely dead...she's really most sincerely dead." Specialists are often unaware when developments in other fields have falsified the assumptions on which their work relies.

The fixed "hot spot" postulate was based on the southeastward younging of Hawaiian volcanoes, previously attributed to fissures and propagating cracks that were also able to account for the age progression. Many modern advocates say that the plume concept is validated by the fit of Hawaii and other "hot spot tracks" to fixed-hot-spot predictions, a circular rationale. Speculation expanded to include myriad features of magmatism, geochemistry and dynamics that had previously been explained by top-down processes such as plate tectonics, continental dynamics and crustal stoping.

Rationalizations of the observed characteristics of hypothetical plumes have generated continuously changing predictions regarding fixity, hot-spot motion, age progressions of island chains, heatflow, style of mantle convection, uplift prior to magmatism, temperatures of magmas, and geochemistry. These predictions are rarely successful, so the concepts have been modified to allow as many exceptions, and as many kinds of plumes, as there are "hot spots". The guiding principles are non-physical. The products of plumes are whatever is observed where plumes are postulated. Amendments to the fixed "hot spot" hypothesis now include mantle winds, polar wander, mantle roll, lithosphere drift, lateral flow, magma tunnels, group motions of "hot spots", plume head decapitation and superplumes. Mantle winds are used to explain non-fixity of "hot spots". "Fixed hot spots" may be large regions or long "hot lines" within which volcanoes can pop up anywhere and in any sequence. Plumes are postulated to feed volcanoes

thousands of kilometers distant, and they no longer need fit Euler geometry or global reference frames. If age progressions are non-uniform, new co-linear plumes are added. Most “plume tracks” are missing a “plume head”, and most “plume heads” are missing a track. The lack of evidence for “plume heads”, “plume tracks”, high heatflow and precursory uplift is ignored or rationalized. Evidence for the uplift predicted to precede the Siberian flood basalt is assumed to be hidden beneath the west Siberian lowlands, whereas that for Hawaii is assumed to have been subducted. Findings that defy such ad hoc adjustments became official paradoxes: the Lead Paradox, the Helium Paradox, and the Heat Flow Paradox. New observations are labeled surprising, unexpected, counter-intuitive or anomalous. All of this signals a failed hypothesis—zombie science—but the conjecture is sustained outside the domain of science. A simple, elegant, satisfyingly neat, concise, falsifiable hypothesis has become a complicated, awkward, messy, unfalsifiable monster that refuses to lie down and die. According to the more cynical philosophers of science, failed hypotheses, heaped high with anomalies, paradoxes and auxiliary conjectures, are perpetuated by repetition and self-referencing because too many adherents have invested their careers in them. Although many scientists have moved on, plumeology remains entrenched conventional wisdom, supported by the publishing industry, with alternative opinions discouraged and made to jump a higher bar. Young scientists who should be encouraged to question dogma are kept in line via hiring, promotion, grant proposal and publication decisions. Zombie research programs defy burial.

References

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