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Review Article

A Uniformitarian Solution to the Appearance of Small-Bodied Hominins, Dwarfs, Pathologies, and Self-Domestication: Theories of New Discoveries

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A variety of new finds have produced a new set of species classified within the *Homo* clade. Some of these appear to represent very small hominins with a variety of traits that are often seen in pathologies. The group of traits, however, does not associate with any known suite or any single condition, either genetic or induced by chemicals, radiation, or other means. The first find of a hominin, the Neandertal, was considered a pathological modern human at first. Some claimed hominin finds were fakes that displayed such unusual traits, but whose status was supported by prominent scientists, that only a few questioned their authenticity. The lack of fit into the evolutionary sequence known at a given time has not been considered a single factor in rejecting a find, as the consideration of the Taung fossil eventually proved. Nevertheless, repeated finds of the same kind of fossil in different parts of the world, in different contexts, by the same investigator do seem remarkable. Placing these finds in a phylogenetic setting is in order, but the distance and time frames are as challenging as the problem of coincidence. Reference to pathological conditions producing several types of dwarfism is discussed in the context of these small-bodied finds. This paper proposes a hypothesis that a unique infection in several *Homo erectus* populations could offer a potential explanation for the developmental anomalies seen in small-bodied hominins.

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1. Introduction

A variety of small-bodied hominins have been discovered in recent years and given a variety of species names, including *floresiensis* and *naledi*. Often, they are referred to in the literature as “diminutive” hominins. The dates assigned to their periods also vary (Graph 1). Some scientists also consider them to be either derived from *Homo erectus* or from *Homo habilis* or some australopithecine[1][2][3][4]. They are dispersed over a considerable territory, from Africa to Polynesia. The scientific standing of the fossils has been marred by both passionate debate[5] and poor handling of some crania, sites, and other remains[6] and tools, especially in making casts[7]. Nevertheless, they provide a most important segment to our understanding of human evolution and the process of determining species.

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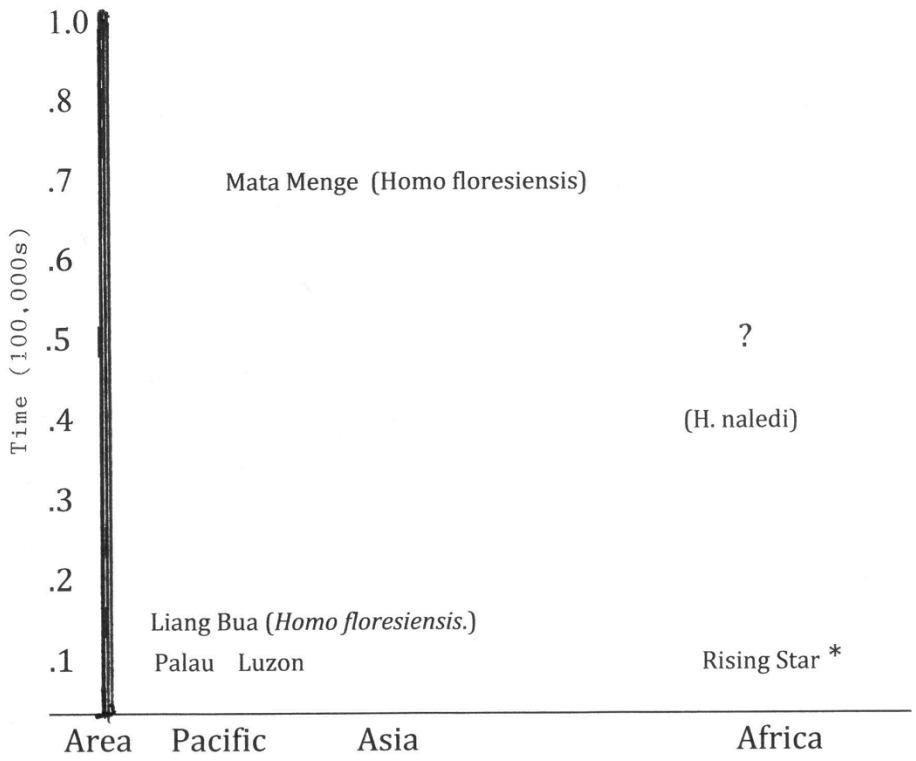

Graph 1. Periods of different small-bodied hominins. New dates for the Rising Star cave for H. Naledi are from Robbins, et al.[8] Mata Menge date from Brumm, et al.[9]. The Dmanisi fossil site, where Homo erectus georgicus was found, is dated to 1.8 mya and would therefore range far outside of the limits of this table[10]

The small-bodied hominins include *Homo naledi, Homo floresienis*, and Berger has not claimed a species designation for the Palauan finds[11]. Some of these remains are not fossilized or are subfossils, though this term is not a definitive one in the literature, often denoting extinct recent flora or fauna but seldom any specific condition of remains (see Jungers[12]; Van Blaricom, et al.[13]; Lucking, et al.[14]). (1) An analysis of body size to stature, including these 3 with samples of hominins from 4.4 mya to the present, found that the small-bodied samples fell outside of the trend of hominin evolution[15]. Though there has been some dispute about whether the Palauan finds were of normal size or not[16][17], and while some researchers using the same methods have produced different brain sizes, body size estimates have also differed, especially when scaling has been considered[18][6]. Yet Pribram[19] demonstrated the more significant aspects of brain organization and connectivity in cognitive adaptability.

However, a study of a larger group of both infant through adult microcephalic and normocephalic subjects compared to H. floresiensis found that the fossil small-bodied hominin fell within the group of microcephalics[20]. Given that they are all small samples of supposed populations that appeared at different times from widely separated locations (*Homo* naledi from South Africa, Homo floresiensis from Indonesia, and Homo *luzonensis* from the Philippines[21], (the sample from Palau is included), this could represent an artifact of sampling. That would assume that if a larger sample of these hominins were found, they would conform with the general trend. More samples do keep appearing, and some of these are even smaller[9]. Caldararo has stressed the need for reference to population genetics and variation over time in the interpretation of hominin evolution[22].

This variation, especially when we look at contemporary populations of humans as well as other primates, is quite overwhelming, as Plavcan[23] has demonstrated.

2. Unusual Finds and Unique Nature in Comparison

One quality of new finds that causes skepticism is unique features that cannot be placed within known species or genera that show general similarity. This was one of the problems with Piltdown Man. In general, all the small-bodied hominins thus far analyzed are placed within existing species or the general genus of *Homo*, falling either within one early *Homo* species (e.g., habilis or erectus) but showing unique characters that cannot be used to assign them to any specific group[24]. While there is significant disagreement over whether the small-bodied finds are pathologically derived as noted below, current theories appear to be unlikely and illogical in explaining the appearance of these fossils not only so widely separated in time but also in space. It should also be kept in mind that some scientists who have analyzed the group of small-bodied fossils[5] have noted evidence of incongruent portions of the skeletons if attributed to one species. But there are also other reports that the context of the finds, all of them, was disturbed before scientific excavation could occur[25] [26]. A new focus in Anthropology has appeared where the relation of pathology to development and evolution is considered[27]. While reference to variation in development goes back to work by Haeckel, it has been largely ignored in recent decades due to criticism by Gould[28].

One aspect of the three that seems common is the deposition of the remains in caves, in Rising Star, the most inaccessible area. Cave use is not unusual for hominins, and one is reminded of the long underground treks necessary to access some of the cave art in parts of southern France and northern Spain[29]. This Rising Star situation could simply relate to cave living in general, burial practice, or denote hiding from extermination as where cultural practices call for abnormal infants to be killed[30]. Escape would be sought if termination was known. While the Rising Star fossils, their fragmentary nature, apparent post-mortem treatment, and other items have indicated to some researchers elements of mortuary ritual[31], the lack of uniform treatment argues against it.

If we consider the general appearance and brain size of the small-bodied hominins and other small hominins and attempt to group them with the micro and nanocephalic samples, it does seem that the small-bodied group clusters with the pathology group. Recent research has shown that viral infections can cause a number of developmental problems in the fetus and neonate; these include inflammatory responses[32]. I will discuss some of these later in this paper. Though perhaps it is a mistake to assume that the pathologic factors, genetic and others, would produce the same features today as in the past. Still, we might assume that if pathological causes are involved in a *Homo erectus* morphology in ontology, all the subjects would display similar features and would not show those more consistent with modern humans. This assumption is undermined by the time factor separating the locales, as well as the spatial distances and the genetic and environmental unknowns affecting most of the pathologies associated with microcephaly. Though there are parallels in some pathological conditions that appear especially in primates, for example, Down Syndrome[33].

While Vannucci, et al.[20] limit this association of *Homo* floresiensis to a sample of microcephalics, there is a more general possible grouping with them all. Yet in some samples, workers have asserted that scanning has produced evidence of brain sizes within the Australopithecine range[34]. Baab, et al.[35] use a number of similar features in comparing fossil hominins with a number of microcephalic types. While their polygons overlap with *Homo floresiensis,* it is almost always on the border of the *Homo erectus* sample, yet also trending to the microcephalic group. Their microcephalic sample, however, is limited. In another study, Baab, et al.[36] show that the *Homo floresiensis* sample does not cluster with a number of Down Syndrome individuals. Further research is necessary. Stringer[37] has discussed the features of early *Homo* fossils and those of Homo erectus to attempt to understand how to fit the small-bodied finds in one group or another in an evolutionary grouping (see Figure 2).

3. Burials, Caching, and Cats

Another claim for one of the small-bodied hominins is that for *Homo naledi*[38] as a species that buried its dead. There is a long history of claims of burials for early hominins, and non-human primates, mammals, and some birds[39]. Often, they are dismissed for a number

of reasons: intrusion of a later *Homo sapiens* burial or disturbance, accidental accumulation due to water, or movement by predators or rodents. In some cases, we might question a possible burial due to the simple need to cover up a smelly rotten mass of organic material, as in how cats bury their feces. The laboratory rat will bury a noxious or threatening object[40].

4. Brains, Size, Speciation, and Tools

Toolmaking and tool-using have long been associated with a meridian of *Homo* fossil cognition and evolution[41]. The brains of *Homo erectus* are bigger than those of early Homo (e.g., H*omo habilis* and Homo *georgicus*), while that of *Homo floresiensis* is much smaller. This theory could justify the idea of a smaller species being represented, as big brains and toolmaking do not seem necessarily linked[42], yet more evidence is necessary to support the contention that *H. floresiensis* is a separate species and not just a pathological example.

The discovery of a new find of early *Homo* at 2.8 ma[43] or the idea that a new small-brained species, *Homo naledi*, has been identified only emphasizes the problem of the evolution of characteristic human behavior, as does the discovery of tools dating from 3.3 ma[44]. *H. naledi*[45][46] could be a version of *H. habilis* or *H. rudolfensis.* Cranial architecture seems to place it at the base of the australopithecine*/ Homo* boundary[47]. The fact that a number of individuals reflect australopithecine traits is not surprising, given the small number of early *Homo* remains heretofore reported. But, species and generic designation for hominids have been in flux for years and continue to be so[48][49].

This problem has surfaced in the debate over the status of the fossils from locations other than the island of Flores. But with those from Flores, the idea that a new small species could be described from the remains led to discussions of potential dwarfism[50][18], pathology, and later the process of island dwarfism after the discovery of the more recent fossils of small individuals discovered by Berger on Palau[11][51][52]. The idea of island dwarfing has been challenged by Stone, et al.[25], whose own excavations on the island and in the caves of the finds dispute isolation, which would be necessary for dwarfing to occur unless extreme forms of contact avoidance were instituted, as among the Andaman Islanders even today. Thus, the question of how unique these cases are may represent pathology or adaptation in the Flores example, or insular dwarfism in the Palau example, as they generally fall within the range of certain local groups of Andaman Islanders (Onge). However, the small brain size in relation to the scaling of body size reduction seen in island dwarfing is too extreme in the small-bodied hominins[53]. This finding is contradicted by that of Gordon, et al.[3], yet in their analysis, the *Homo floresiensis* sample consistently falls either outside the hominin ranges or at the extremities. But the effects of mummification and different conditions of preservation should also be considered, as in the cases of the Alaskan and Aleutian mummies[54], in the case of Palau and the Rising Star Cave finds, or *Homo naledi*[45][21]. Some ideas that the Rising Star Caves had been disturbed or entered from other directions have been reassessed[55][56][57][58][59].

Figure 1. What is considered microcephalic, both behaviorally and morphologically, has differed over the past 200 years. In the above image, the individual on the left was diagnosed as microcephalic. Image from Church & Petterson[60]. Variation in frequency, especially the rate of twins, in Berg & Kirman[61]).

Some paleoanthropologists consider the specimen, now dubbed *Homo floresiensis,* to be a new species[62]; others think it to be a microcephalic dwarf[63]. This idea is of interest to this discussion also due to the small brain and body size yet obvious evidence of considerable cognitive ability. Nanocephalic/microcephalic dwarfs (the term varies in the literature) can learn language and are capable of a number of direction-led actions[64]. But the variation in severity and limitations is considerable[65]. A comprehensive analysis appears in Helmut P.G. Seckel's book Bird-headed Dwarfs[66]. Martin[63] and others chose to identify the H. floresiensis specimen as a microcephalic due to the characteristic mandible

deformation. When you look at the fossil and then the examples in Seckel, you see the point. There is also the issue of rapid ageing, which can be associated with the *Homo floresiensis* specimen as an example of a nanocephalic/microcephalic dwarf.

More interesting is the evidence of other individuals appearing in Smith's Recognizable Patterns of Human Malformation by Kenneth Lyons Jones[67]. Here, we have a number of other features that also show similarity with the *Homo floresiensis*; in one example, two children, brother and sister, are shown side by side. Remember, they are the size of a large *capuchin* monkey as in Sapajus apella. The cerebra of both the boy and the girl are unusual. The cerebrum shows a "simple primitive convolutional pattern resembling that of a chimpanzee," according to Smith. They have only 11 pairs of ribs apiece; they cannot straighten their legs fully; like many "bird-headed dwarfs," they have displaced hips. Others have displaced elbows. Yet, given all this, some have lived to 75 years of age. The newest find reported by Kaifu, et al.,[68] reinforces this theory as the remains are well within the pathological range.

Two studies by paleoneurologist Dean Falk and her colleagues[62][69] rejected the possibility of pathology. Falk's[62] arguments have been rejected by Martin et al.[63] and Jacob et al.[70], and defended by Morwood[71] and Argue et al.[72]. Weston and Lister[73] have also produced comparisons with other mammals and dwarfism with supporting evidence for *Homo floresiensis*. What is most interesting in this find of *Homo floresiensis* are the tools that appear to have been made by these people. While this particular find may be a microcephalic dwarf of a normal H. sapiens population, the idea that an individual with such a small brain could make tools at all, and in this case fairly complex tools, undermines the theoretical frameworks of brain evolution and cognitive requirements for human cultural complexity. Evidence of fire was initially thought to be present, but later this was assigned to the use of the cave by later arriving *Homo sapiens sapiens*[74]. This idea would fit Brown, et al.,[75] that a group of *Homo erectus* lived on the island and were reduced by conditions of scarcity to a dwarf condition, retaining primitive tool-using capacity. Yet the Stone, et al.,[25] criticism of this idea for Palau seems to apply equally to Flores. The lack of any fossil evidence of a transition is a problem. Though this in itself is not key in considering tool-making cognitive capacity or the lack of fire, as some forest-dwelling peoples lack fire[76], and fire is lacking at many hominin sites, including Mousterian sites[77] not perhaps due to an inability to discover or an opportunity to borrow it, but due to cosmological ideas of fire as the enemy of the forest which may be deified. Even art and burial have been claimed to have been produced by *Homo naledi,* though the association may be inconclusive[55][46][78].

A molecular defect of Growth Hormone has been claimed to produce conditions very similar to *Homo floresiensis*[79]. However, Obendorf, et al.,[80] argue that the *Homo floresiensis* fossils are derived from myxoedematous endemic (ME) cretins of a *Homo sapiens sapiens* population and not *Homo erectus*. The features they identify are typical results of congenital hypothyroidism. A convincing analysis of the *Homo floresiensis* skeleton supports this conclusion[81].

In a focus on the dentition, some support for microcephaly was published by Regen et al.[82] though Kaifu, et al.[83] argue from similar analysis for island dwarfing. It must be kept in mind that this condition (ME) is regarded as an autosomal recessive trait, but the fact that there seems to be some variety of outcome has caused some researchers to argue that there are type I and type II forms. In fact, Geoffrey Woods, et al.,[84] consider there to be at least six genes involved in the various contemporary forms. How these genes interact is unknown. The genetic evidence of contemporary examples does not seem to be well characterized as yet, and it seems premature to conjecture about the evolution of the genes involved until we have more precise information on the living varieties. Richardson[85] describes the some 30-odd genes that seem significant in the study of brain evolution and cognition and cautions concerning the difficulties of relating single gene functions to performance. She also critiques some recent interpretations of the function of these genes and potential implications on IQ and some ideas of race in general.

Suggestions have been made that one of the *Homo floresiensis* group was a small-bodied human suffering from Down Syndrome, Henneberg, et al.,[52], but rejected by a number of researchers (e.g., Dembo[86]) due to their character analysis placing the *Homo floresiensis* group as descended from an early *Homo* group possibly derived from *Australopithicus sediba*, yet they did not include pathology characters of Down Syndrome in their analysis. But Brown and Maeda[2] applied character analysis to the fossil and assigned it to also an australopith. In general, character

analysis has been undermined by the disagreement of workers on character, significance, and weighting in analysis[87][86]. Weins[88] has described the problem in coding morphological traits and made suggestions for reducing comparative errors; however, the nature of pathological effects and coding can introduce errors that appear to be simple aspects of variation.

In addition to the gene variants, microcephaly can be induced by prenatal infections and mother's alcohol consumption, mimicking the action of Methylazoxymethanol in mice[89][90][91].

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	Pro	Con
1. New Previously unknown species	a	b
2. Aberrant early *Homo* species	c	d
3. Pathological condition mutations	e	f
4. Pathological condition disease	g	h

Chart 1. Theories about Small-bodied hominins

a. New species often differ from existing fossil samples; the nature of that variation can justify new species designation. *Homo florsesiensis* displays a number of significant differences from existing species.
b. New species are often met with critical attempts to reassign them to existing classifications. Differences between existing fossils and a new find often appear to pattern as population variations or as differences introduced by taphonomy or pathology. But with 3 different locations with such different times, could there be one or 3 species?
c. There is disagreement here on an australopith or early *Homo,* see Dembo, et al.[86] vs. Brown & Maeda[2], but the outcome is similar.
d. How to explain the arrival in Polynesia and Melanesia, as well as South Africa, of forms of different small-bodied hominins separated in time.
e. Pathological agency, either genetic or developmental, seems to be a likely agent, yet the number of cases, unless produced by preferential mating, is curious. Though suites of mutations produced by radiation can have effects in repeated cases.
f. There is no agreement over the unique characters of the small-bodied hominins nor any logical association in time or causative agency.
g. Pathological agency induced by developmental irregularities, as in viral disease, seems to be the most clear and elegant explanation.
h. Uniformity of production of characteristics appears to be variable, as in radiation-induced mutations and developmental outcomes[92]. This could also be a pro.

In fact, brain size variation in modern humans is considerable, yet performance as a human is unclear as related to brain size, weight, region size, and so forth[93] [94]. Holloway[95] also pointed out the arbitrary nature of the size of the brain associated with species designation, especially regarding Neandertals. As he notes, it is difficult to understand why hominid brains evolved after *Homo habilis*, and Caldararo has taken on this problem in a recent book[96].

5. The All At Once, Appearing Full-Blown an "Athena" Phenomenon

As in the myth of the goddess Athena being born fully grown from the head of Zeus, the appearance of combinations of unique features of physiology in advanced characters in a fossil without lineage has been problematic, and much like Piltdown Man, they create concern[97]. Often in the history of fakes and forgeries, an object or work will appear too good, too shaped as would be expected by most philosophers of science. There is, in these cases, no antecedents; the animal or object is found without any tradition or lineage that might provide a provenance in the case of art or an evolutionary sequence for a fossil. In the case of the small-bodied hominins we have been discussing, they fit into this category. There is no evolutionary foundation to support their lineage, and they appear not only with tools but art as well[55]. They are simply protégés of the philosophy of miracles.

Wendt[29] reviews the history of remarkable discoveries that were believed to be fakes and those claims which turned out on investigation to be fabrications. The phenomenon of fake is described by the desire to profit in money or fame and the gullibility of many, as well as the desire to believe despite the evidence. The social milieu has much to do with this aspect, and yet among

learned professionals, we find the effect of authority to be a powerful agency, as with the case of the Piltdown Man. Carl Bishop, et al.,[98] summarized the objections of his American colleagues, pointing out the incongruity of the "completely human skull" in Smith Woodward's terms, as well as the lower jaw being "precisely that of an ape." Smith Woodward should have reacted to the contrast but did not. Hrdlicka's critical assessment (quoted in Bishop) that the case seemed clearly to not belong together, but if so, "the case is totally exceptional." Yet for most of the paleoanthropological community, it took the development of a new analytical technique, fluorine tests in the hands of a geologist, Oakley, to bring a fresh view to the problem. This also relates to how the first Neandertals were regarded by some as diseased, which some were[99]. As Boas had put it in his 1922 book[100], it sometimes takes the passing of one generation of thinkers for a younger one to see things in a more comprehensive fashion. An observation that became a theory Thomas Kuhn[101] made famous in his popular book. Though the thought of a motive has eluded most investigators of the hoax, Alastair Brotchie's[102] biography of Alfred Jarry, the French Symbolist writer of *Ubu Roi* and inventor of the philosophy of Pataphysics, a satire of science and logic, could have provided the incentive. The timing of his writing and the appearance of Piltdown Man are close.

The "Athena" problem is one that has dogged studies in the origins of domestication of plants and animals, as human selection on organisms can produce a variety of characters of benefit to humans in a relatively short period of time with few archaeologically distinct forms[103][104]. Here we can see a number of varieties appear in rapid succession by breeding experiments, especially in the past 500 years, where we have fairly good records. So the "Athena" phenomenon can genuinely apply in this context.

6. Domestication and Some Unappetizing Suggestions

In recent years, attention has been collected around the process of domestication of animals by humans and the great genetic power human-directed selection can produce, from dogs to laboratory rats. But also, focus has been brought to the possibility of self-domestication of humans and other animals, including elephants[105]. While the small-bodied hominins appear to display a significant degree of similarity, some variations are known. The nature of a population of humans to direct selective processes to other animals is well established, and in some cases, sexual selection of mates is argued to be a general feature of many species[106]. However, preferential mating with unique forms is also known among humans, as in the case of albinos among the Hopi[107]. Such directed selection could produce varieties of dwarfs that might suggest the histories of the small-bodied hominins. It could happen by a religious belief; dwarves have had a remarkable history in different cultures, representing a variety of cosmological and magical realms and ideas[108]. Another less developed theory would be the selection of hominins for sport, as in jockeys in horse racing, or for food.

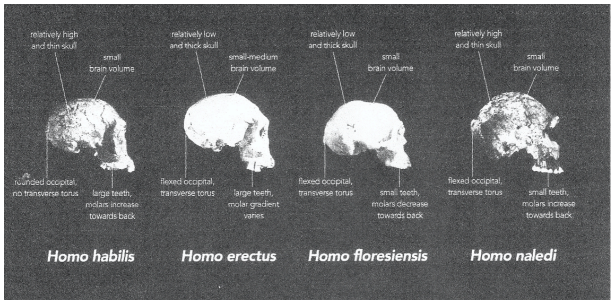

Figure 2. This is Figure 1 from Stringer[37] where he discusses the potential relationships of early *Homo* and *Homo erectus* specimens.

Map 1. #1 location Palau #2 Flores #3 Rising Star Cave #4 Luzon.

This last topic touches on the same problem as in our last section, tracing domestication. Humans raised as slaves underwent a number of selective pressures from their owners. One of the most important, from the

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standpoint of the use of slaves on large plantations or productive services in workshops, is the selection for docility and the ability to train for different operations with varying skills. While some evidence has appeared in genetic studies that selection during slavery has had some effects[109], this evidence is weak, and the study population is too diverse and too mixed (especially with Southern Euroamerican populations) in time to retain any such effects[110]. Since historic evidence indicates that most slave populations interbred with the dominant population, either illicitly or by marriage and adoption, there has never been a distinct captive population in human history (e.g.[111]). Also, it would not explain the small-bodied hominin context where only small-bodied individuals are found without other sized hominins. While this could be an artifact of preservation, it seems unlikely, even though their fossils were always found in caves.

The same problem pertains to the domestication of a population of normal-sized hominins bred for food to become a small-bodied food source. Why one would produce such a variant might be an aspect of control or for entertainment. Positive assortative selection could produce defined differences between groups[112]. This is proposed by some who argue Neandertals were not the same species as Anatomically Modern Humans, no matter the amount of admixture (e.g.[49]). The question of our sample and its relation to the diversity of the original populations they are derived from and how representative they are has been treated by Maxwell, et al.[113] and bears on the idea of species in the hominin lineage. The proliferation of new species based on a number of different methods for species determination (e.g., Biological Species Concept; Ecological Species Concept, etc.) has led some to call a temporary end to new species[114]. This call is reminiscent of some of the discussions at the Wenner-Gren Foundation meeting of paleoanthropologists at Burg Wartenstein in 1962[115]. While many of those present expressed confidence that new methods and materials would produce more clarity, the situation seems unchanged in many ways. While computers and DNA analysis have provided new methods to look at evolution, the complexity of data and how programs and coding are fashioned can introduce new challenges[116][117][118]. This has become clear when considering the relationships of Archaic and modern populations[119].

This leaves us with little potential for the features seen in the small-bodied hominins to be the result of domestication.

7. Conclusions

When searching for explanations, we might be guided by the simplest, least complex, or by the most logical. In this case, it seems that the wide separation of the locations of the small-bodied hominins would argue for some factor that might link them not in time or space but by agency. By this, I mean that it appears rather unlikely that a small-bodied hominin left Africa or even the Caucasus after 2 million years ago to then reach the islands of Flores and Palau millions of years later without leaving other examples of the type in between. Also, the general similarity of the forms does argue for some kind of pathological agency; it could be a suite of mutations as is associated with some forms of dwarfism. The recurrent appearance of small-bodied hominins in different regions raises questions about the evolutionary processes at play. There is no reason to believe that microcephaly has been expressed in all cases over the past 2 million years in the same fashion as today. Chew and Tan[120] have broached this problem recently with disease expression in general. What seems more likely is a causative agent like a virus that produced similar developmental anomalous conditions; yet not so detrimental to survival that maturity could not be reached. Some viral form of congenital rubella syndrome could be such an agent. This was mentioned by Henneberg, et al.[5] previously. There are both brain and body developmental abnormalities as well as relations with other conditions, as in endogenous hypervitaminosis A[121][122][123] that can act as a teratogen with dysmorphogenesis; an example is in Holoprosencephaly, where the two halves of the brain do not develop normally[124]. While it is also possible that the original hominin populations in the three locations could have had different causative agents (e.g., Obendorf, et al.[80]; Oxnard, et al.[81]), it seems likely they represent one pathological systematic event.

Common TORCH infections (toxoplasmosis, syphilis, rubella, cytomegalovirus, and herpes) have been traditionally noted as having significant developmental disturbances; Zika virus was added to the group after a major outbreak producing developmental problems, including microcephaly[125].

One potential hypothesis is that a viral infection may have contributed to the developmental anomalies observed in small-bodied hominins. This would eliminate a need for there to be proximity, as local viral evolution could produce the variations and still need not be in temporal alignment. The placing of the remains in caves in widely separated areas is no

problem for explanation, as it is a common hominin behavior. This also could explain the lack of normal hominins in the burial areas, as it could be representative of the cognitive association of the victims, or fear of contamination or pollution seen in disease avoidance in different contexts and even with other animals[126][127].

Statements and Declarations

This article is the work of one author; there is no conflict of interest, and there is no funding to report.

Footnotes

(1) The precise nature of the process of fossilization is under analysis today, especially regarding soft tissue preservation as in the case of brain tissue[128]. The case of the Ganovce Neandertal “endocast” is an example of soft tissue preservation of a very rare organ[129], which has received long-overdue interest since I put a color image of it on Caldararo's 2017 book cover.

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