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Wolf-Ekkehard Lönnig

31 March to 13 June 2024 (PRELIMINARY VERSION) [Some very small additions/corrections after 13 June in square brackets.]

The Panda's Thumb: Striking Imperfection Or Masterpiece of Engineering?

PART 1

Jiao Qing at Zoo Berlin (May 2020)
https://de.wikipedia.org/wiki/Gro%C3%9Fer_Panda#/media/Datei:Berlin_-_Jiao_Qing_-_2020.jpg Autor Avda (3 May 2020)

https://commons.wikimedia.org/wiki/File:Giant_Panda_Eating.jpg (retrieved 3 April 2024)
Author Chen Wu from Shanghai, China (2008)
See additionally the video Pandas eating, standing, and playing https://en.wikipedia.org/wiki/Giant_panda (retrieved 7 March 2024)
Panda Mother Teaches Cub How to Eat Bamboo | 4KUHD | China: Natures Ancient Kingdom | BBC Earth
https://www.youtube.com/watch?v=YdP2fFyjBWQ (retrieved 8 March 2024)

Picture detail from https://www.zoo-berlin.de/de/tiere/grosser-panda (Retrieved 3 April 2024).
'False thumbs' clearly to be seen on the left and right inner site below its five digits with claws to hold the bamboo stick.
See **more on their additional "thumbs"** by Xiaoming Wang, Denise F. Su, Nina G. Jablonski, Xueping Ji, Jay Kelley, Lawrence J. Flynn & Tao Deng (2022) with many fine figures at https://www.nature.com/articles/s41598-022-13402-y (From the abstract: "Of the many peculiarities that enable the giant panda (*Ailuropoda melanoleuca*), a member of the order Carnivora, to adapt to life as a dedicated bamboo feeder, its extra "thumb" is arguably the most celebrated yet enigmatic. In addition to the normal five digits in the hands of most mammals, the giant panda has a **greatly enlarged wrist bone, the radial sesamoid, that acts as a sixth digit, an opposable "thumb"** for manipulating bamboo.")

Some Key Points on a Long-Lasting Controversy

"We can know that evolution has happened by the **imperfections and oddities** that life shows."
"The panda must use parts on hand and settle for an enlarged wrist bone and a **somewhat clumsy** but quite workable solution.
The sesamoid thumb wins no prize in an engineer's derby. … **The panda's "thumb" demonstrates evolution because it is clumsy and built from an odd part, the radial sesamoid bone of the wrist**."[1] The panda's thumb is "**highly inefficient**"[2]
"If God had designed a beautiful machine to reflect his wisdom and power, surely he would not have used a collection of parts generally fashioned for other purposes." [3]

Stephen Jay Gould

(His theological argument)

"How did he [Gould] know that this structure [the Panda's thumb] was suboptimal. […] So, I asked Gould one on one sitting in his office what's the evidence that the thumb is actually suboptimal and he said "Paul, just look at it, just look at it, it's obvious."
Well, the fact is, it's not just obvious."[4] - "Every direct reference from the panda natural history literature that I've found […] praised the structure in the highest terms: "**like a forceps**" (Schaller et al.), "**with the utmost precision**" (Perry), etc."[5]
[Richard Perry points out that] "Pandas can hold **a single piece of sugarcane or a slice of bread**. They can pick up a tin dish like a dog dish in their fore limps. **Ming**, a female, **could hold a spoon and eat soup with it or she could pick up as small as little Necco candy wafers**."[6]

Paul Nelson

"The way in which the giant panda…uses the radial sesamoid bone — its 'pseudo-thumb' — for grasping makes it **one of the most extraordinary manipulation systems in mammalian evolution**. …The radial sesamoid bone and the accessory carpal bone form a **double pincer-like apparatus** in the medial and lateral sides of the hand, respectively, **enabling the panda to manipulate objects with great dexterity**."[7]

Hideki Endo, Daishiro Yamagiwa, Yoshihiro Hayashi, Hiroshi Koie, Yoshiki Yamaya & Junpei Kimura in *Nature*

"When watching a panda eat leaves, stem or new shoots
we were always impressed by its dexterity. **Forepaws and mouth work together with great precision**, with great economy of motion, as the food is grasped, plucked, peeled, stripped, bitten and otherwise prepared for being swallowed. **Actions are fluid and rapid**.[8]

George B. Schaller, Hu Jinchu, Pan Wenshi, and Zhu Jing

Now back to Gould on the two pandas shipped to the Washington Zoo (1972): "I went and watched in appropriate awe.
They yawned, stretched, and ambled a bit, but they spent nearly all their time feeding on their beloved bamboo. They sat upright and manipulated the stalks with their forepaws, shedding the leaves and consuming only the shoots.
I was amazed by their dexterity and wondered how the scion of a stock adapted for running **could use its hands so adroitly.**
…Darwin's metaphor for organic form reflects his sense of wonder that evolution can fashion such a world of diversity and **adequate design with such limited raw material**."[9]

Stephen Jay Gould (similarly D. Dwight Davis) (as for panda's dexterity, see also W.-E. L. 2024 below)

(According to his direct Panda observations, apart from his presupposed ideas what evolution can do and God "would surely not do" As for Davis see the main text below)

In fact, it seems possible that **a single event of quantum speciation** accomplished the transition [from *Ursus* to *Ailuropoda*]
Again: The "basic shift could easily have been achieved by **a quantum speciation event**"[10]

Steven M. Stanley

"**None of these people, however earnest they may be, have any deep grasp of the principles of design and development underlying sesamoid bones or thumbs**, to say nothing of pandas. Indeed, none of us do[11]. Search the world's top research centers and you'll find no skeletal engineers—no one who has the faintest idea how to encase earthworms in exoskeletons or how to endow leeches with backbones. Surely, then, our total inability to answer these how questions categorically disqualifies us from serious engagement of the higher why questions. We're free to form opinions on these matters, but they're nothing more than that. My opinion, for those interested, is that **the giant panda is yet another example of something perfect**—something that is exactly as it should be."[12]

Douglas Axe

W.-E. L: As a general **background** for this article, I would suggest to check the discussion between Stuart Burgess and Nathan Lents **on the wrist**.
As we have just cited, the giant panda has **a greatly enlarged wrist bone, the radial sesamoid**. **S. Burgess** quotes the assertion of N. Lents that "…**the wrist has 8 bones like a useless pile of rocks**" in contrast to what has been ascribed to Newton: "The thumb alone would convince me of a Creator". **Burgess**: "Newton was right **the wrist thumb is a masterpiece of engineering** and Nathan Lents is catastrophically wrong. **But sadly**, **that is harming students and harming science**. Who is right and who is wrong? [Burgess subsequently cites Richard Dawkins (see context there)]: "Maybe Burgess and McIntosh are right and all the rest of us – biologists, geologists, archaeologists, …and respectable theologians, … Fellows of the Royal Society and of the National Academies of the world – are wrong. Not just slightly wrong but catastrophically, appallingly, devastatingly wrong. …if Burgess and McIntosh are right, the scientific establishment has fallen. "Burgess comments: "I basically agree [with] what he's just said."[13]

Stuart Burgess

(See please below in the text the connection to the radial sesamoid of the panda bear)

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[1] Stephen Jay Gould. (1980): The Panda's Thumb. New York: W.W. Norton
[2] Stephen Jay Gould. (1986): "Evolution and the Triumph of Homology, Or Why History Matters." American Scientist 74: 60-69, esp. p. 63 (
[3] Again Stephen Jay Gould. (1980): The Panda's Thumb. New York: W.W. Norton
[4] Full quote. Paul Nelson (2007): https://www.youtube.com/watch?v=j0s3CYIRtdY "How did he know that this structure was suboptimal. After all a claim of suboptimality or imperfection is something that you have to support with evidence. If I tell you that a formula race car is better a load of groceries home than my Honda minivan that's something we can evaluate, in fact it's false. A Hona minivan is much better for getting a load of groceries home from the store than a Formula One race car, which is optimized to go around a track. So, I asked Gould one on one sitting in his office what's the evidence that the thumb is actually suboptimal and he said "Paul just look at it, just look at it, it's obvious. Well, the fact is, it's not just obvious."
[5] Full quote. Paul Nelson (1995) "Every direct reference from the panda natural history literature that I've found [as opposed to the theological arguments for evolution literature, e.g., Gould's 1980 panda's thumb essay] praised the structure in the highest terms: "like a forceps" (Schaller et al.), "with the utmost precision" (Perry), etc. More to the point, ***it is unclear how one would do the optimality analysis required by the theological argument***. **The argument compares actual pseudothumbs with the structure God or an optimal designer would have made**. Good luck with getting a fix on the latter structure." http://www.arn.org/docs/asa795rpt.htm
[6] Again https://www.youtube.com/watch?v=j0s3CYIRtdY
[7] Hideki Endo, Daishiro Yamagiwa, Yoshihiro Hayashi, Hiroshi Koie, Yoshiki Yamaya & Junpei Kimura (1999): Role of the giant panda's 'pseudo-thumb'. *Nature* **397**, 309–310. https://www.nature.com/articles/16830
[8] George B Schaller, Hu Jinchu, Pan Wenshi, and Zhu Jing (1985): The Giant Pandas of Wolong. Chicago: University of Chicago Press. Quotations according to Stephen Dilley (2023): God, Gould, and the Panda's Thumb. Religions 14: 1006. https://doi.org/10.3390/rel14081006. "…Gould, like Davis, concludes that "***very few genetic mechanisms—perhaps no more than half a dozen—were involved in the primary adaptive shift from Ursus* [bear] *to Ailuropoda* [panda]**" (S. Dilley p. 6). [After a correction of "I could not find anything…" so far in April 2024, *cf.* now however PART 2 (in preparation).]
[9] Stephen Jay Gould (1980): The Panda's Thumb. WW Norton & Co; Reissue Edition (1. August 1992)
[10] Steven M. Stanley (1979/1998, p. 138): Macroevolution. Pattern and Process. W.H. Freeman and Company. San Francisco. Second edition John Hopkins University Press 1998.
"…a **single speciation event**" (1981, p. 129). The New Evolutionary Time Table. Basic Books. New York.
[11] See, however, in the interim for some approaches for concerning design of, for example, human feet, wrists and thumbs and further bones were made by by Stuart Burgess (2022): https://www.youtube.com/watch?v=EmXjK4HiM4M and on the human foot (2022): Why the Ankle-Foot Complex Is a Masterpiece of Engineering and a Rebuttal of "Bad Design" Arguments. Bio-Complexity Vol (13) 2022: 1 – 10 https://bio-complexity.org/ojs/index.php/main/article/view/BIO-C.2022.3/BIO-C.2022.3. (2021): A review of linkage mechanisms in animal joints and related bioinspired designs. *Bioinspiration & Biomimetics*, Volume 16.
[12] Douglas Axe (2017): Undeniable: How Biology Confirms Our Intuition That Life Is Designed. https://www.amazon.de/Undeniable-Biology-Confirms-Intuition-Designed/dp/0062349597 https://dokumen.pub/undeniable-how-biology-confirms-our-intuition-that-life-is-designed.html
[13] Stuart Burgess: Talk (2022): This presentation was taped at the 2022: Why Human Skeletal Joints Are Masterpieces of Engineering. Westminster Conference on Science and Faith in the greater Philadelphia area, which was jointly sponsored by Discovery Institute's Center for Science and Westminster Theological Seminary. https://www.youtube.com/watch?v=EmXjK4HiM4M (By the way Dawkins' implicit appeal to authority (so many scientists and academies cannot err) is unconvincing (see again below).

Abstract: Key Points of the Contents

Before I move on to the abstract, a brief note on the synonyms that I'm using here like the "Double/Dual/Complementary Function" of the panda's thumb. Well, each of the synonyms has its own subtly different overtones so that the basic points discussed may be, I hope, better understood and can be easier memorized.

1. Above: Some Key Points on a Long-Lasting Controversy: Different views of evolutionary biologists on the skill of the panda's thumb. Some assessments of the panda's dexterity by intelligent design theorists.
2. Introduction: the panda's thumb has become a paradigm for evolution in general, links to the topics and articles of Stephen Dilley, notes on the recent controversy between Nathan Lents and Stuart Burgess.
3. If the panda's thumb is an embodiment of bad design – where are the evolutionist's proposals how they could have done better?
4. Some citations from the public talk of Stuart Burgess on the ingenious design of the wrist.
5. A massive contradiction within the theory of evolution itself.
6. Double/dual/complementary function often overlooked.
7. "What makes the modern human thumb myology special within the primate clade is … [the appearance of] two extrinsic muscles, extensor pollicis brevis and flexor pollicis longus.
8. It is a fundamental mistake to use the human thumb as a yardstick for the perfection or imperfection of the panda's thumb.
9. A closer look at the differences of the radial sesamoid in a basal ursoid in comparison to that of the panda (*Ailuropoda*) for gripping and walking and the grasping hand of *Homo sapiens* according to Xiaoming Wang et al. (2022).
10. In comparison to other bear species "only in *A. melanoleuca* it can be considered to be hyper-developed, reaching a similar size to that of the first metacarpal".
11. Doubts concerning a simple homology of different sesamoid bones in various species.
12. Radial sesamoid as ideal starting point to develop a thumb-like digit in pandas.
13. Natural selection of the radial sesamoid according to Wang et al. as well as Barrette in contrast to Stanley.
14. The implications of the ruling neo-Darwinian paradigm (gradualism plus natural selection) for the origin of the panda's thumb.
15. Further discussion of Barrette's points as "the length of the radial sesamoid, and therefore that of the false thumb, is limited firstly by its location under the hand" etc.
16. Less efficient feeding would emphasize the enormous problem involved in the theory of natural selection.
17. The panda's ecological impact and the "Optimal Panda Principle" in contrast to evolutionary the "Panda Principle" of Gould and his followers.
18. How to pick little Necco candy wafers with thumbless mittens?
19. Gould and Davis have marveled at the dexterity/competence/virtuosity of the panda's hand when directly observing pandas at zoos (as I have too). The panda's hand is not "clumsy" at all.
20. Key question of two PhD students at the Max Planck Institute of Plant Breeding Research (Cologne) who came to my office and asked: Wouldn't [it] be much more economic for an intelligent designer to modify, as far as possible, an already existing structure for some new functions than to create a totally new structure for similar roles/purposes/tasks from scratch?
21. Some comments on Barette's statement that "we owe this metaphor [of approximate tinkering/bricolage] to Francois Jacob, a French biologist and recipient of the Nobel Prize. Far from being perfect, such approximate tinkering are traces left by evolutionary history" – thus being a proof of it.
22. Davis on the enlarged radial sesamoid as "unquestionably" a direct product of natural selection.
23. Possible number of genes involved in the origin of pandas according to Davis and some others.
24. Starting to the answer the question, what do we know in the interim about panda genetics?
25. *SNP*s in the Ursidae including our beloved pandas.

Emphasis: As already mentioned for other articles of mine (for example: https://www.weloennig.de/Hippo.pdf): Note please that **virtually all highlighting/emphasis in the typeface by W.-E. L.** (except italics for ***genera*** and ***species*** names as well as adding a note when the cited authors themselves emphasized certain points). **Why so often**? Well, *since many people do not have the time to study a more extensive work in detail, these highlights can serve as* **keywords to get a first impression of what is being discussed** in the respective paragraphs.

Concerning the key points enumerated above: ***Page numbers may change in a future update, so not presented here***.

Incidentally, citations do not imply consent of the authors quoted with my overall views nor *vice versa*. Moreover, I alone am responsible for any mistakes.

On some questions concerning absolute dating methods, see http://www.weloennig.de/HumanEvolution.pdf, p. 28.

Introduction

In the Wikipedia[14] — which "averages more than 18 billion page views per month, making it one of the most visited websites in the world"[15] — the public is correctly informed that *The Panda's Thumb* refers to at least three topics;

- "The **sesamoid bone of the Giant Panda**, used similarly to a human thumb, ***cited as evidence of evolution*** and the main feature of an essay by Stephen Jay Gould
- *The Panda's Thumb* (book), also known as *The Panda's Thumb: More Reflections in Natural History*, a 1980 book by Stephen Jay Gould featuring an essay on the Panda's thumb [and additionally the essay by Gould, originally titled "the panda's peculiar thumb" of 1978]
- **The Panda's Thumb** (blog), **a blog** that discusses evolutionary biology and the creation-evolution controversy from a scientific perspective"

Now, the blog discussing evolutionary biology "…from a scientific perspective" means *de facto* discussing it exclusively from a ***philosophically materialistic perspective***.[16] It is presupposed, i.e. absolutely taken for granted, that "The sesamoid bone of the Giant Panda, used similarly to a human thumb", is ***evidence of evolution by imperfectly formed structures*** (being "clumsy" and "inefficient", so "…just look at it, it's obvious") – thus a structure, which no intelligent designer would ever have created this way – or, in the words of Gould cited above – "*we can know that evolution has happened by the imperfections and oddities that life shows*." And "*if God had designed a beautiful machine to reflect his wisdom and power, surely he would not have used a collection of parts generally fashioned for other purposes*."

However, it should be added that the authors of *The Panda Blog* also remain absolutely materialistic (now applying Todd's word on them) "even if all the data point to an intelligent designer", for "such a hypothesis is excluded from science because it is not naturalistic"[17] – a basic attitude that characterizes almost all contemporary evolutionary biologists.

Now, if *The Blog* remains totally *materialistic even if all the data point to an intelligent designer*, what then is to be expected in the case of putative imperfections, defects, flaws and oddities – especially if something appears to be "clumsy" and "inefficient"?

So, ***the panda's thumb has become a paradigm for evolution in general***, most certainly "proved" by "the imperfections and oddities that life shows" – like so many other assumed examples (see my recent discussion on Haeckel's "*Biogenetic Law*" *and Vestigialty*: *Is Man "a Veritable Walking Museum of Antiquities"? Discussing One of the Most Egregious Contradictions Within the Theory of Evolution* (Plus "*Breaking News" on Kidney Development*): http://www.weloennig.de/Kidney1x.pdf)

Stephen Dilley of the *Discovery Institute* has recently published an in-depth analysis of several of the key aspects of that long-lasting controversy on that sympathetic, peaceful, amiable, tranquil vegan bear[18] in his peer reviewed essay *God,*

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[14] See, for example, some comments on p. 21 of http://www.weloennig.de/AngiospermsLivingFossils.pdf
[15] https://www.pewresearch.org/short-reads/2016/01/14/wikipedia-at-15/
[16] Concerning the topic of materialism, see for example: http://www.weloennig.de/KutscheraPortner.pdf p. 3.
[17] Scott C. Todd (1999): A view from Kansas on that evolution debate. *Nature* 401: 423: https://www.nature.com/articles/46661
[18] "Giant pandas are solitary and peaceful animals, which will usually avoid confrontation, but if escape is impossible, they will certainly fight back. And as cuddly as they may look, pandas can protect themselves as well as most other bears by using their physical strength, and powerful jaws and teeth. Pandas can grow up to 1.5m long and weigh as much as 150kg. And while their large molar teeth and strong jaw muscles are designed for crushing bamboo, they can deliver a very nasty bite." [Panda.org – note added 17 June 2024] [More exactly "almost vegan": 99%]

Gould, and the Panda's Thumb[19] and he posted the main points accordingly at *Evolution News & Science Today* – all together a series of excellent/superb discussions:

> 4 April 2024: Is the Panda's Thumb Suboptimal? https://evolutionnews.org/2024/04/is-the-pandas-thumb-suboptimal/
>
> 5 April 2024: Gould's God-Talk: Is the Panda's Thumb Incompatible with ID? https://evolutionnews.org/2024/04/goulds-god-talk-is-the-pandas-thumb-incompatible-with-id/
>
> 8 April 2024: Does a Suboptimal Panda's Thumb Fit Better with Evolution than with Intelligent Design? https://evolutionnews.org/2024/04/does-a-suboptimal-pandas-thumb-fit-better-with- evolution-than-with-intelligent-design/
>
> 10 April 2024: Does the Panda Argument Hurt the Case for Evolution? https://evolutionnews.org/2024/04/does-the-panda-argument-hurt-the-case-for-evolution/
>
> 15 April 2024: Gould's Panda Argument Is a Problem for Atheistic and Agnostic Views https://evolutionnews.org/2024/04/goulds-panda-argument-is-a-problem-for-atheistic-and-agnostic-views/

If you are further interested in that topic, you are invited to see – or better to listen to – the interview of Stephen Dilley by Casey Luskin: *The Panda's Thumb: An Extraordinary Instance of Design*? https://idthefuture.com/1878/ (20 March 2024).

Also, Dr. C. Luskin himself has written illuminating comments at the IDEA Center (founded 2001) and in the time prior to that *Is the Panda's Thumb a "Clumsy" Adaptation that Refutes Intelligent Design*? (1999[?])[20] and later *Good Theology and Bad Design or Bad Theology and Good Design*? *A scientific and philosophical assessment of supposed "poor design" examples in the natural realm* (2004)[21].

As a larger framework/background for the present article, I have chosen the recent controversy between **Nathan H. Lents** (*Professor of Biology on the faculty of John Jay College of Criminal Justice, City University of New York*[22]), and **Stuart Burgess** (*Professor of Engineering Design at the University of Bristol, UK*[23]) on the construction

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https://wwf.panda.org/discover/knowledge_hub/endangered_species/giant_panda/panda/kung_fu_panda_enemies_defences/ Retrieved 9 April 2024.

[19] **Stephen Dilley** (2023): God, Gould. And the Panda's Thumb. Religions 14: 1006. https://www.mdpi.com/2077-1444/14/8/1006

[20] http://www.ideacenter.org/contentmgr/showdetails.php/id/1477 (However, no exact date of first publication of that article is given there)

[21] http://www.ideacenter.org/contentmgr/showdetails.php/id/722

[22] "**Nathan H. Lents**: **66 scientific papers** according to https://scholar.google.com/citations?user=ajuWegQAAAAJ&hl=en (retrieved 13 April 2024) "[He] is an American scientist, author, and university professor. He has been on the faculty of John Jay College since 2006 and is **currently the director of the Cell and Molecular Biology program** and the former head of the honors program and the campus Macaulay Honors College program. … In 2018, Houghton Mifflin Harcourt published his second book, ***Human Errors: A Panorama of Our Glitches, from Pointless Bones to Broken Genes***, which was listed by Publishers Weekly as a "Big Title" for spring 2018 in the Science category. … Human Errors received **many favorable reviews and was included on recommended summer reading lists in *The Wall Street Journal*, *Discover Magazine*, *EndPoints*, the *Financial Times*, and was "*Book of the Month*" for August 2018 in *Geographical Magazine***. … Lents' book Human Errors elicited much criticism from supporters of Intelligent Design. Even though the book was intended for an audience that accepted the scientific consensus on evolution, ***it does argue that the quirks of evolution, not an intelligent designer, account for the flaws in the human body***" (https://en.wikipedia.org/wiki/Nathan_H._Lents; retrieved 13 April 2024).

[23] **Stuart C. Burgess**: **206 scientific papers** according to https://scholar.google.com/citations?user=chAFNQgAAAAJ&hl=en (retrieved 13 April 2023). Appointments: 1994-1997 Cambridge University, Assistant Director of Research; **1997-present Bristol University, Professor of Engineering Design**; **2021 Visiting Fellow at Clare Hall College, Cambridge University**.

Awards:

2021 Fellowship, Clare Hall College, Cambridge University
2021 Designer of the transmission for Team GB bikes, Tokyo Olympics
2019 IMechE James Clayton Prize
(Biggest contribution to mechanical engineering science in UK)
2019 Designer of the SA deployment mechanism, ESA's Metop C satellite
2017 Royal Society Summer Science Exhibition – Olympic bike design
2017 IEOM Global Engineering Education Award
2009 Royal Society Summer Science Exhibition – Biomimetics design
2008 Wessex Institute Scientific Medal (for bio-inspired design)
2002 Designer of the SA deployment mechanism, ESA's ENVISAT satellite
1997 Turner's Bronze Medal (for spacecraft design)
1993 Turner's Gold Medal (for spacecraft design)
(Presented by Prof R. N. Franklin, Vice Chancellor of City University)
1993 UK Mitutoyo Design Prize (for spacecraft design)
1986 UK Design Council Molins Prize (for mechanisms design)
(Presented by Peter Morrison, Minister of State for Trade & Industry)
1985 UK IMechE Queen's Silver Jubilee Prize

of the human ancle and wrist, – extrapolating and integrating from these so closely related research topics[24] (yet having generated radically different viewpoints, tensions and discussions) the optimal place of the panda's thumb in the evolution/ID debate.

Part 1: Apart from some recollections (*repetitio est mater studiorum*) of the "great dexterity" of the panda's thumb, in the present article I'm going to focus on (1) that neglected question how exactly the evolutionary biologists could have done better, (2) the dual/double function of the panda's thumb, (3) a discussion of evolutionary and genetical points according to Xiaoming Wang et al. (2022) in www.nature.com/scientificreports, the viewpoint of Cyrille Barrette in his panda book of 2023, and mention several further papers including that of Yisi Hu et al. (2024). For Part 2: (4) Additional points on panda genetics, (5) the fossil record of the pandas and their relatives in the bear family (Ursidae), showing the enormous constancy/stasis of the genera according to the present geological timescale. Here in Part 1 we are also briefly mentioning the question whether our Darwinian friends can really have both, omnipotent *natural selection eliminating all imperfections* (from Darwin to present authors) and *at the same time masses of imperfect structures on all biological levels*.

If the Panda's Thumb is an Embodiment of Bad Design – Where are the Evolutionist's Proposals How They Could Have Done Better?

"Crude"[25], "built from an odd part", clumsy", "highly inefficient", "imperfect", "suboptimal", "bad design": Although the evolutionists at the *Future Agriculture* site raise the question *Can we improve Nature*?[26] — concerning the panda's thumb we are only informed that it displays "bad design", but absolutely no suggestion has been presented how the evolutionary critics could have done it better, i. e. ***how they could have designed it elegantly, efficiently, perfectly, and really well*** starting from the normal foot of the bear family (Ursidae). We are only informed as follows:

> "The panda's thumb is perhaps **one of the most famous examples of such bad design**: the thumb is constructed by enlarging a few bones that usually form the wrist in other species. ***Pandas have been eating bamboo for so long, that the small wrist bone called radial sesamoid (highlighted in red) has slowly become an extra "thumb," assisting the panda in grasping and stripping bamboo stalks***[27]. The panda's true thumb is committed to another role, too specialized for a different function to become an opposable, manipulating digit. So, the panda could only use parts on hand and settle for a **clumsy solution**, far from an ideal design.

Nevertheless, as we have seen above, there are also many evolutionary biologists who appear to be rather happy with the panda's thumb as it is – to recall:

> "The way in which the giant panda…uses the radial sesamoid bone — its 'pseudo-thumb' — for grasping makes it one of the most extraordinary manipulation systems in mammalian evolution. …The radial sesamoid bone and the accessory carpal bone form a double pincer-like apparatus in the medial and lateral sides of the hand, respectively, enabling the panda to manipulate objects with great dexterity" (Endo et al.)
>
> "When watching a panda eat leaves, stem or new shoots we were always impressed by its dexterity. Forepaws and mouth work together with great precision, with great economy of motion, as the food is grasped, plucked, peeled, stripped, bitten and otherwise prepared for being swallowed. Actions are fluid and rapid" (Schaller et al.)

And, as we have seen, even Gould remarked in contradiction to his other assertions after his direct Panda observations at the Washington Zoo:

> "I went and watched in appropriate awe. They yawned, stretched, and ambled a bit, but they spent nearly all their time feeding on their beloved bamboo. They sat upright and manipulated the stalks with their forepaws, shedding the leaves and consuming only the shoots. I was amazed by their dexterity and wondered how the scion of a stock adapted for running could use its hands so adroitly. …Darwin's metaphor for organic form reflects his sense of wonder that evolution can fashion such a world of diversity and adequate design with such limited raw material."

But if the panda's thumb were so "crude", "clumsy", "highly inefficient", "imperfect", "suboptimal", "badly designed" – the evolutionist should take the ***Bauplan*** of a bear species displaying the normal forefoot as found in the Asian Black bear (*Ursus tibetanus*), the Brown bear (*Ursus arctos*), Sun bear (*Ursus malayanus*) – all living or having lived in the vicinity of the pandas in China – and now redesign it elegantly, efficiently, perfectly, and really well (genetically, physiologically, anatomically and ethologically).

See also PAPER PRIZES and APPOINTMENTS & FELLOWSHIPS (https://profstuartburgess.com/academic/ retrieved 13 April 2024). Books on Design and Creation: https://www.amazon.com/Design-Origin-Man-Stuart-Burgess/dp/1846253926

[24] **Double sense**: Construction of foot and hand are closely related and both are also closely related to Bauplan of the Panda's hand and *sensu lato* the question on the Panda's Thumb: Striking Imperfection or Masterpiece of Engineering?

[25] See Xiaoming Wang et al. below.

[26] http://www.futureagriculture.eu/synthetic-biology/can-we-improve-nature/

[27] Wolves and dogs, for example, have tried to catch birds for so long that they will grow wings (perhaps from the Spina scapulae) - really?

Trying to do so, the evolutionary biologist would also have to clearly keep in mind the **double/dual/complementary function** of the panda's thumb *as* ***part of the forefoot to walk on regularly*** **and** ***'to manipulate objects with great dexterity'****, 'to grasp, pluck, peel, strip, bite and otherwise prepare the bamboo stems for being swallowed'.*

We'll see whether they can do better than ***Nathan H. Lents*** in his assertions on the human ankle and foot displaying a "massive scholarly fail on Lents's part" (Klinghoffer) – ***as has been systematically proven by Stuart C. Burgess*** in his paper (2022; see link below) and public talk of 2022 on these topics: ***Why Human Skeletal Joints Are Masterpieces of Engineering. And a rebuttal of 'bad design' arguments***[28]: https://www.youtube.com/watch?v=EmXjK4HiM4Min: S. Burgess: Professor of ***Engineering Design*** at the University of Bristol, UK (**all emphasis by W.-E. L.**) – just to give you a foretaste:

Starting some quotations from the lecture's second point: (2) **The wrist joint** at 40:23 being relevant also for our discussion of the panda's thumb (yet, ***to fully understand the ensuing text, one should really look also at the fine/clear figures, which he presented all along in that talk***):

"…well, that was the ankle joint. And **the wrist joint**, I can promise you, is just as enlightening as the ankle joint. This time I have a quote from Isaac Newton ("the thumb alone would convince of a Creator"[29]). The reason I have included this is because one of the things that makes the thumb very special is the way it joints with the wrist. At the joint with the wrist there is a special saddle joint and it's one of the keys to the incredible flexibility of the thumb. Hence this is legitimate to include for the wrist joint so as before one of these people is correct and one of them is catastrophically wrong. Either we put our faith in Isaac Newton (to emphasize "**the thumb alone would convince of a Creator**") or we're going to put our faith in Nathan Lents (stating in his book that "**the wrist has eight bones like a useless pile of rocks**"). And I'm going to explain which one you should put your faith in. So, the wrist joint, yes, it's another complicated joint but complication doesn't mean bad design. Sometimes complexity means ingenious design and that's what I'm going to explain with the wrist: **Every bone has a purpose**. There are eight bones. They all have names, you don't need to remember them. Just remember there's two rows, there is a row of four at the top and the row of four at the bottom. On the bottom there are four there – one of them is on top of the other, the Pisiform is on top of the Triquetrum; so, on the top the Hamate, the Capitate, Trapezoid, Trapezium and on the bottom Pisiform, Triquetrum, Lunate and Scaphoid. But just remember two rows, top row of four, bottom row of four. ***Eight bones with precise functions***, with this one if you remember Nathan Lents said, this is *eight bones like a useless pile of rocks*. Well, I'm going to show you, they are not a useless pile of rocks, ***there is precision engineering in the wrist joint***. So, like with the ankle we have this **multifunctioning wrist joint**. **Function one**: Flexion for going up and down function. **Function two**: abduction, very important if you're a table tennis player, but actually important for lots of things. Then strength, **Function [3]**: a lot of load goes through a small joint. Then there is a carpal tunnel. **Function [4]:** you might know that the wrist forms this arch, a protective arch to allow tendons, blood vessels to safely go through that arch in your hand. And then a **rotation-Function [5]** and like the ankle joint, ***an engineer is so impressed with that incredible functionality in small place and great performance in terms of efficiency, compactness and endurance***. **No engineer has built a prosthetic wrist joint with that kind of functionality**. As I said with the ankle, there's got to be something clever to do all those things and there are very clever things, **so one ingenious design again**: three integrated arches just like the foot, three integrated arches. Two of the arches are shown here the red, the row of four bones make an arch. In the other direction the four green bones make a complementary arch. They snugly fit, so you have two arches incredibly with the wrist you have an arch in the transverse direction. This is the carpel arch. Notice that the carpel arch is made of the four red bones, the top arch and it also includes two of the green bones, the Pisiform and the Triquetrum. And if you look carefully, we can see on the blue in that middle diagram very, very clever to have two arches in the plane of the hand and then to built an arch in the transverse perpendicular direction using the same bones that is so, so clever. I have never seen an engineer do that kind of thing before. **So, three integrated arches, very strong, all eight bones needed for those three arches**. But then we have a number of ingenious design features, one is a biaxial joint. Now what I mean by that is the hand can not only abduct and adduct but it can extend and flex as well. And it does that because the joint goes in two directions, that's a very difficult thing to do. **Engineers can do it but it's a really difficult thing to do**. But then there are other ingenious features on top of that if we first of all look at the first function, the flexion extension function, what we notice here is a double joint so it's the wrist is not only a biaxial joint, it is a biaxial double, double joint because in both, abduction and flexion there's a double joint, so a lot of joints in the wrist that work so smoothly together by having two joints the mid carpal and the radiocarpel joint it gives extra movement that's why our wrists are so flexible and supple because we get this double joint. But on top of that there is one incredible ingenious design feature and that is the radius of those two joints are fine-tuned to be a unique solution that gives a common center of rotation. There is only one ratio of the radius of the radiocarpal joint to radius of the mid carpal joint there's only one unique ratio that will give a common center of rotation shown by these two circles on the right takes a bit of thinking about but there is only one unique ratio that gives a common center. **That is why our wrists move so smoothly because you have this one center of rotation you think there is only one joint in the wrist, but there is actually two but they're so finely tuned with that precision engineering of every small bone it works like a singe joint**. And incredibly the same thing happens in abduction you have the radius of those two joints in the perpendicular direction you also have the one unique ratio of the radius of the one joint to the radius of the other joint **being so finely tuned it gives you a common center of rotation** shown on the black and white circle on the righthand site. So, when you start to look into the details of these bone you see **this precision engineering**. … [You are invited to continue to listen from 47:20 ff. onwards] … [51: 30] **Nathan Lents**…: "**Wrist bones [and ankle bones] are the most obnoxious example of bones for which we have no use**" … I have explained they have multiple critical functions. Here is my table. **There are eight wrist bones and there are 26 subfunctions**." … [At 52:08 continued.]

[W.-E. L.: To emphasize the last point from above:] "**Newton was right the wrist thumb is a masterpiece of engineering and Nathan Lents is catastrophically wrong**. But sadly that is harming students and harming science. Who is right and who is wrong? [Burgess subsequently cites] Richard Dawkins: "Maybe Burgess and McIntosh are right and all the rest of us – biologists, geologists, archaeologists, …and respectable theologians, … Fellows of the Royal Society and of the National Academies of the world – are wrong. Not just slightly wrong but catastrophically, appallingly, devastatingly wrong. …if Burgess and McIntosh are right, the scientific establishment has fallen." Burgess comments: "I basically agree what he's just said."[30]

Dr. David Klinghoffer from the *Discovery Institute* commented (2023):

> "As Lents wrote in his book, the human ankle ***suffers from the same clutter of bones that we find in the wrist***. The ankle contains seven bones [the wrist eight], most of them pointless." These are some of the supposedly "pointless"

[28] To repeat: Westminster Conference on Science and Faith in the greater Philadelphia area, which was jointly sponsored by Discovery Institute's Center for Science and Westminster Theological Seminary: https://www.youtube.com/watch?v=EmXjK4HiM4Min

[29] There is some quarrel about this quotation – in the present situation I would prefer to say "ascribed to Isaac Newton".

[30] Well, in my view certainly true for the theory of intelligent design and the second law of thermodynamics (see on the latter also mathematician Granville Sewell https://www.youtube.com/watch?v=NEyFUB7vtJw https://www.youtube.com/watch?v=JpQWjvYE6Fw), but hardly for their theology (literal 24 hours creation days and many of the dogmata of church history; check, in contrast, for example Isaac Newton's arguments against the doctrine of the trinity: *cf.*, for instance several articles at **The Newton Project** https://www.newtonproject.ox.ac.uk/). Also interesting https://en.wikipedia.org/wiki/Religious_views_of_Isaac_Newton (whether he was a strict Arian is a matter of further discussions).

bones showcased in Lents's book title. If you watch this video with Burgess, or read his article in *BIO-Complexity*[31], you'll know that ***that assertion is a massive scholarly fail on Lents's part.*** And it's representative of the larger argument for evolution based on "poor design," of which Professor Lents has sought out the role of leading spokesman. From an engineering perspective, the bones of the ankle [as well as the wrist], in their complex and functional artistry, are very far from "pointless." In no way has Lents rebutted Burgess. If he could do so, I suppose he would. Poor Lents."[32]

Now concerning evolutionary suggestions to possibly redesign the panda's thumb, starting from the normal foot of the bear family (Ursidae) – always keeping in mind its double/dual/complementary[33] functions: In case of another evolutionary ***'massive scholarly fail'***, someone with the biological and engineering knowledge of Stuart Burgess could expose/uncover/reveal such things in detail.[34]

A Massive Contradiction Within the Theory of Evolution Itself

On the other hand, I would like to emphasize that – in utter contrast to all the assertions on the panda's imperfection cited above – now ***according to the evolutionist's own presuppositions on the limitless powers of natural selection***, the panda's thumb should already be the best solution possible, i.e. it cannot be designed more elegantly, more efficiently and perfectly, so that any redesign would be entirely superfluous – representing a massive contradiction/conflict/inconsistency/incongruity within the theory of evolution itself, for example (just a few keywords):

> "…natural selection is daily and hourly scrutinizing, throughout the world, every variation, even the slightest; ***rejecting that which is bad, preserving and adding up all that is good***; silently and insensibly working, whenever and wherever opportunity offers, at the improvement of each organic being in relation to its organic and in organic conditions of life" … "**I can see no limit to this power**" … "natural selection … always ***intently watching*** each slight alteration in the transparent layers [of the eye]; and carefully preserving each which … in any way or in any degree, tends to produce a distincter image" – Darwin).
>
> Prof. John Avise: "Natural selection comes ***close to omnipotence***". Prof. Christopher Exley is, indeed, convinced that "both the beauty and the brilliance of natural selection are reflected in ***its omnipotence*** to explain the myriad observations of life" (virtually/vitally in agreement with Dawkins, Coyne, Futuyma, Todd, Ayala, Mayr and many other renowned evolutionary authors)
>
> "The genetic message, the program of the present-day organism...resembles a text without an author, that a proof-reader has been correcting for more than two billion years, ***continually improving, refining and completing it, gradually eliminating all imperfections***." (Nobel laureate Francois Jacob")[35]

And as result of this limitless, omniscient and omnipotent natural selection "gradually eliminating all imperfections" now this "crude", "clumsy", "highly inefficient", "imperfect", "suboptimal" and "bad design" of the panda's thumb?

So, you can choose: Imperfect or perfect, bad design or excellent design? There are evolutionists on both sides. Whatever the case – Evolution is always right.

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[31] Stuart Burgess (2022): Why the Ankle-Foot Complex Is a Masterpiece of Engineering and a Rebuttal of "Bad Design" Arguments https://bio-complexity.org/ojs/index.php/main/article/view/BIO-C.2022.3

[32] David Klinghoffer (2023): "Pointless Bones"? Nathan Lents Bites at Stuart Burgess's Ankle. https://evolutionnews.org/2023/03/nathan-lents-bites-at-stuart-burgesss-ankle/ See also Klinghoffer (2022): Stuart Burgess Informs Evolutionist Nathan Lents on the Design Genius of the Ankle and Wrist. ("…Professor **Lents** is a proponent of the "unintelligent design" hypothesis. He looks at engineering marvels like the human wrist and ankle and **sees only "blunders," "pointless bones," "anatomical errors**." Burgess has studied those wonders of biology more closely than Lents has and explains in detail why ***they are, in fact, "ingenious" solutions to engineering problems that leave the genius of human engineers far behind***. Burgess is simply on fire. You've got to watch this: https://www.youtube.com/watch?v=EmXjK4HiM4Min … Lents is like fellow evolutionist Jerry Coyne in that there's a certain generosity to him: ***Coyne and Lent are so profuse in their blunders that they have both provided years of material for Darwin skeptics to work over***. For example, in his book, Lents writes: "Humans have way too many bones." **Of the wrist, he says that "it is way more complicated than it needs to be….The small area that is just the wrist itself has eight fully formed and distinct bones tucked in there like a pile of rocks — which is about how useful they are to anyone**." Burgess tells exactly what functions depend on every one of those useless "rocks." **The design is supremely intelligent. And the same goes for ankle**.")

[33] Oxford Languages: "***combining in such a way as to enhance or emphasize the qualities of each other or another***. "they had different but complementary skills."" Or: https://www.vocabulary.com/dictionary/complementary "The adjective "complementary" … means ***serving to complete or supply mutual needs***. Two or more parts that come together to make a better whole are called complementary.03.04.2020

[34] Jonathan McLatchie (2024): "There are always alternative ways that one can envision in which an engineered system might have been designed differently. Having no experience of designing living organisms ourselves, **we should exercise tremendous caution about asserting what a designer should or should not have done**. https://evolutionnews.org/2024/03/is-complexity-an-argument-against-design/

[35] *Cf.* the references and larger documentation including many more details in https://www.weloennig.de/OmnipotentImpotentNaturalSelection.pdf

Double/Dual/Complementary Function Often Overlooked

Although still citing approvingly Gould's comment on the panda's thumb as "a ***somewhat clumsy***, but quite workable, solution"[36], in contrast to most popular commentators and many other evolutionary biologists, a group of Chinese and American researchers have made a great step forward into the scientifically correct direction by becoming clearly aware of the ***key significance of the dual function*** of the panda's thumb and correspondingly considered it adequately in their publication on this question: Xiaoming Wang, Denise F. Su, Nina G. Jablonski, Xueping Ji, Jay Kelley, Lawrence J. Flynn & Tao Deng (2022): *Earliest giant panda false thumb suggests conflicting demands for locomotion and feeding*. www. nature.com/Scientific Reports 12: Article number 10538 1-13. Directly available here: Open access: https://www.nature.com/articles/s41598-022-13402-y. In their abstract they report:

> "Of the many peculiarities that enable the giant panda (*Ailuropoda melanoleuca*), a member of the order Carnivora, to adapt to life as a dedicated bamboo feeder, **its extra "thumb" is arguably the most celebrated yet enigmatic**. In addition to the normal five digits in the hands of most mammals, ***the giant panda has a greatly enlarged wrist bone, the radial sesamoid***, that acts as a sixth digit, an opposable "thumb" for manipulating bamboo. We report the earliest enlarged radial sesamoid, already a functional opposable "thumb," in the ancestral[37] panda ***Ailurarctos* from the late Miocene** site of Shuitangba in Yunnan Province, China. However, **since the late Miocene, the "thumb" has not enlarged further <u>because it must be balanced with the constraints of weight bearing while walking in a plantigrade posture</u>**. This morphological adaptation in panda evolution thus reflects ***a dual function of the radial sesamoid for both bamboo manipulation and weight distribution***. The latter constraint could be the main reason why the panda's false thumb never evolved into a full digit. This **crude** "thumb" suggests that the origin of the panda's dedicated bamboo diet goes back to as early as 6–7 Ma.

Concerning the dual functions of the panda's thumb, the authors state introductorily:

> "Endo et al. demonstrated that grasping in pandas is fundamentally different from that in humans."

That grasping would be "fundamentally different" in pandas and humans is exactly what could have been expected on the background of their extreme biological differences: (a) "thumb" due to enlarged radial sesamoid, (b) totally different modes of nutrition – literally including a thousand different kinds of nutriments and food preparations in humans all over the globe, but food and its preparation ('to grasp, pluck, peel, strip, bite' bamboo stems) severely restricted in pandas –, (c) dual function of the thumb (grasping and walking) as well as (d) the enormous anatomical and physiological gaps between these so widely different species, especially of the (e) ***brain***, and correspondingly (f) their so totally diverse modes of life and environments. Generally (according to the Encyclopedia Britannica[38]): "***The major function*** of the ***hand in all vertebrates except human beings*** is **<u>locomotion</u>**" – being a key point including the pandas but often overlooked there. And "bipedal locomotion in humans frees the hands for a largely manipulative function" – more than any panda will ever need and can make use of[39]. Moreover, in clear contrast to the pandas and almost all other vertebrates, we humans display even special thumb muscles involved in our

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[36] "Steven J. Gould's insightful remarks still stand: "the panda's true thumb is committed to another role, too specialized for a different function to become an opposable, manipulating digit. So the panda must use parts on hand and settle for an enlarged wrist bone and a somewhat clumsy, but quite workable, solution". However, he would probably have been delighted to learn that the historic contingency of the panda's false thumb requires that while being a better finger was favored by selection, it also had to bear the burden of considerable body weight." https://www.nature.com/articles/s41598-022-13402-y

[37] Whether it was "ancestral" may be another question.

[38] https://www.britannica.com/science/hand-anatomy – As for some points on human exceptionalism, see https://evolutionnews.org/tag/human-exceptionalism/

[39] In contrast to our pandas with their usually rather limited use of their thumbs (walking and fine bamboo handling): Thumbs in humans are **often essentially involved** in **different types of Crafts**: "Basket Weaving, Candle Making, Ceramics, Crochet. Decoupage, Doll Making, Embroidery, Felting, Ikebana, Knitting, Lace Making, Latch Hook Rugs, Leatherwork, Macrame, Make Miniature Models, Make Beaded Jewelry, Mosaics, Origami, Paper Making, Printmaking, Quilting, Soap making, stained Glass, Weaving, Wood Carving" (according to https://craftsbliss.com/types-of-crafts-you-can-try/) as well as **different forms of Art**: "Painting, Sculpture, Architecture, Literature, Music, Theater, Cinema" (https://proactivecreative.com/different-types-of-art/). **Technology**: "20 Types of Technology: Definition and Examples: See https://www.indeed.com/career-advice/finding-a-job/types-of-technology https://en.wikipedia.org/wiki/Category:Technology_by_type and List of **Building Types** https://en.wikipedia.org/wiki/List_of_building_types https://stoneclaims.com/13-popular-and-common-types-of-buildings/ List of **Weapons** (unfortunately): https://www.britannica.com/topic/list-of-weapons-2058724 Etc. Some points also here: https://www.youtube.com/watch?v=RWcEYYj_-rg
Now, as to the use of bamboo itself – humans in contrast to pandas – display a really enormous **amount of various applications of these plants**: see https://en.wikipedia.org/wiki/Bamboo

nearly infinite potential for manual dexterity[40]: "What makes the modern human thumb myology special within the primate clade is … [the appearance of] ***two extrinsic muscles, extensor pollicis brevis and flexor pollicis longus***[41]…"[42]

As for our pandas, they appear to be absolutely happy with their thumbs without these muscles and without many more features of the totally differently designed human thumb. In one word: **It is a fundamental mistake to use the human thumb as a yardstick for the perfection or imperfection of the panda's thumb**.

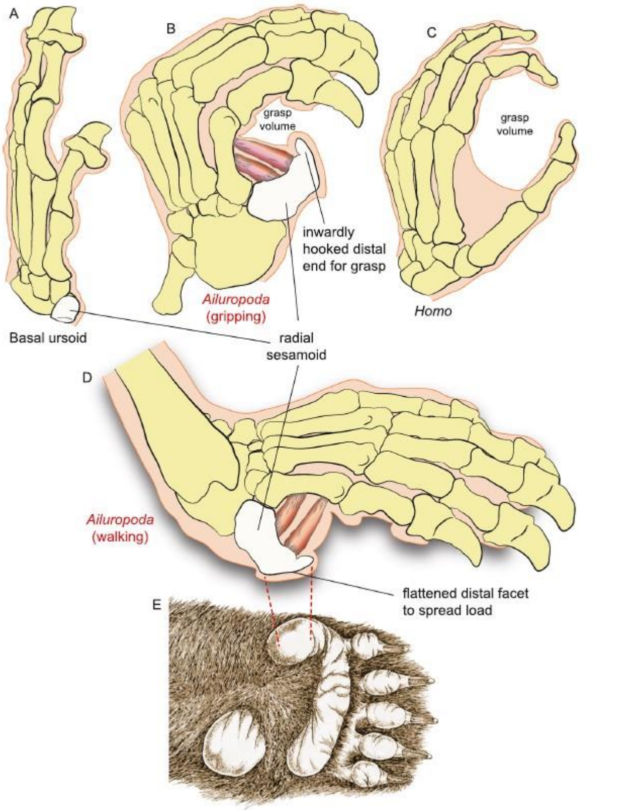

Figure 5. Comparison of the radial sesamoid in the basal ursoid, *Ailuropoda*, and *Homo* and the positioning of the radial sesamoid. Illustrations are of left hands. (A) A basal ursoid from the early Oligocene of North Dakota (USNM 637,259) showing the primitive condition of an unenlarged radial sesamoid; (B) grasping hand in extant *Ailuropoda*; (C) grasping hand of modern human; (D) walking hand of extant *Ailuropoda* in a plantigrade posture; (E) external ventral surface of the hand of *Ailuropoda* showing a fleshy, plantar pad that corresponds to the radial sesamoid (red dash lines), modified from Davis[8]. Muscles (dark red bundles) between the radial sesamoid and first metacarpal are *abductor pollicis brevis* and *opponens pollicis*, following Endo et al.[30]. Note the small distal hook and flat ventral surface of the radial sesamoid in extant *Ailuropoda*, which are derived features that function for better grasping (small hook) as well as walking (flattened palm surface) in contrast to the primitive conditions seen in *Ailurarctos* (Fig. 3).

Now, let's take a closer look at the differences of the radial sesamoid in a basal ursoid in comparison to that of the panda (*Ailuropoda*) gripping and walking and the grasping hand of *Homo sapiens* according to **Xiaoming Wang et al**. (2022, LEFT: **their Figure 5**)[43]:

In the basal ursoid (here a specimen taken from the early Oligocene of North Dakota: *cf.* the text) the radial sesamoid is, apart from *Ailuropoda* – as expected – relatively small, which is true for all the species of the bear family (Ursidae) with perhaps the hardly noteworthy exception in the case of the ***very slightly*** larger radial sesamoid of the bear species *Tremarctos ornatus* (the spectacled bear of South America/Andes): "…its **size is much smaller than that of *A. melanoleuca***, its distal tip being

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[40] https://dictionary.cambridge.org/de/worterbuch/englisch/manual-dexterity#google_vignette: "someone's ability to use the hands to perform a difficult action skillfully and quickly so that it looks easy".

[41]See more at https://upload.wikimedia.org/wikipedia/commons/f/f7/Gray_%E2%80%94_musculus_extensor_pollicis_brevis.png **as well as**:
Below left: https://flexikon.doccheck.com/de/Musculus_extensor_pollicis_brevis "Der Musculus extensor pollicis brevis gehört zur tiefen Schicht der Extensoren des Unterarms."
Below right: https://flexikon.doccheck.com/de/Musculus_extensor_pollicis_longus "Der Musculus extensor pollicis longus gehört zur tiefen Schicht der Extensoren des Unterarms. Er ist der kräftigste Strecker des Daumens." (*Cf.* please there much more detailed explanations and animations on Verlauf, Ansatz, Topographie, Innervation, Blutversorgung, Funktion, Klinik; for a translation into English see https://www.deepl.com/de/translator)

[42] https://www.weloennig.de/HumanEvolution.pdf https://pubmed.ncbi.nlm.nih.gov/22640954/ (Diogo, Richmond & Wood 2012: "What makes the **modern human thumb myology special within the primate clade is not so much its intrinsic musculature but two extrinsic muscles**, ***extensor pollicis brevis*** and ***flexor pollicis longus***, that are otherwise only found in hylobatids [not closely related to humans – convergence?] ***It is likely that these two forearm muscles play different functional roles in hylobatids and modern humans***. In the former, the thumb is separated from elongated digits by a deep cleft and there is no pulp-to-pulp opposition, whereas ***modern humans exhibit powerful thumb flexion and greater manipulative abilities, such as those involved in the manufacture and use of tools***.")
T. Harrison (2016) on Hylobatids: "Based on molecular clock estimates, hylobatids diverged from other hominoids during the early Miocene , at ~19 Ma, and crown hylobatids originated at ~8 Ma. The oldest fossil hylobatid is *Yuanmoupithecus* from the late Miocene of China, dating to ~7–9 Ma, which represents the primitive sister taxon of crown hylobatids. The molecular and paleontological evidence indicates that there was a ***ghost lineage for the initial 10 myrs of hylobatid evolutionary history, with no trace of a fossil record***." https://link.springer.com/chapter/10.1007/978-1-4939-5614-2_4 See also: https://en.wikipedia.org/wiki/Gibbon

[43]The large **scapholunar**, a.o. under the radial sesamoid, is shown, but its name is not especially stated in Fig. 5. See, however, their Fig. 4 reproduced below.

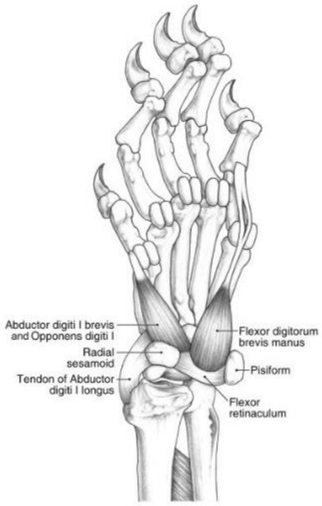
just scarcely developed, remaining as a small and blunt protuberance ([the author's] fig. 2)." Salesa et al. continue:

> "The two radial sesamoid morphologies would be thus reflecting the independent evolution of this structure in Ailuridae[44] and Ursidae. Concerning the relative size of this bone, **only** in ***A. melanoleuca*** **it can be considered to be hyper-developed, reaching a similar size to that of the first metacarpal**. In *A. fulgens*, *S. batalleri* and *T. ornatus*, this bone is just slightly larger than any other sesamoid of the carpus."[45]

Similarly, Colin Groves in his book (second edition 2022) about the Red Panda (*Ailurus fulgens*)[46] "…the radial sesamoid is most developed in the [giant] pandas."

In context:

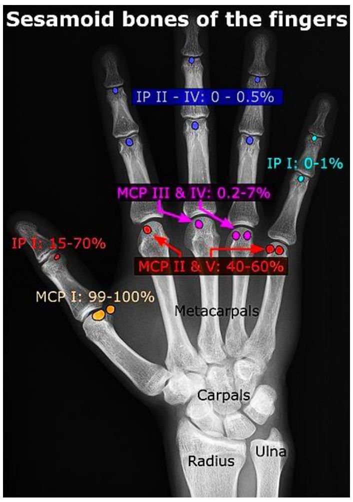
> "A feature that has received a great deal of scrutiny is the enlarged radial sesamoid of the forepaw (Figure 6.5). **The radial sesamoid of the giant panda**, ***and to a lesser extent, the red panda***, **is believed to increase forepaw dexterity**. In fact, both pandas utilize this structure when grasping bamboo stems. However, myological differences may be even more important in determining dexterity, especially if the osteology of the manus is conserved throughout evolution. A radial sesamoid is not uncommon in carnivores. A small sesamoid is present on the radial side of the carpus in the caniforms and the felids, and the male kinkajou is known to use its enlarged radial sesamoid to stimulate the female during mating [24]. However, ***the radial sesamoid is most developed in the pandas***. [47]



Left: Figure 6.5 by Collin Groves (2022): "*The radial sesamoid apparatus in the forepaw of the red panda*." In comparison to that of the giant panda (*Ailuoropoda*), the radial sesamoid is obviously rather small there.

Now, on the radial[48] sesamoid bone of the thumb in humans (*Os sesamoideum radialis pollicis*) Civan et al. report (2020, p. 68):

> "Metacarpophalengeal (MCP) joint of the thumb (MCP 1) ***had sesamoid in all subjects (100%)*** and it was seen bilaterally. The prevalence of the SB [sesamoid bones] was 42.8% in the second MCP joint (MCP 2) in 772 subjects and 36.6% in 1,444 hands, 1.6% in the third MCP joint (MCP 3) for the subjects and 1.1% for the hands, 0.1% in the fourth MCP joint (MCP 4) for the subjects and 0.1% for the hands, and 72.5% in the fifth MCP joint (MCP 5) for the subjects and 62.5% for the hands."[49]



The figure on the LEFT (again) by Mikael Häggström (2017) on the "*Prevalence, structure, and locations of sesamoid bones of the [human] hand*"[50] shows that in humans the radial sesamoid appears to be not only much smaller but also clearly "**displaced**" compared to that of basal ursoid as well as that of *Ailuropoda*, our giant panda bear (see above).

Such differences seem to have led several researchers to doubt a simple homology of different sesamoid bones in various species:

Abdalla et al. (2019, pp. 16/17): "It has frequently been considered that the '**false-thumb**' or '**prepollex**' of ursids and ailurids (Davis, 1964; Endo *et al.,* 1996; Antón *et al.,* 2006; Salesa *et al.,* 2006), talpids, (Sánchez-Villagra & Menke, 2005; Mitgutsch *et al.,* 2011), proboscideans (Hutchinson *et al.,* 2011), sigmodontine rodents (Abella *et al.,* 2016) and ctenomyd rodents (Echeverría *et al.,* in press) is in fact a modified sesamoid, identified as the **radial sesamoid** (e.g. Wood-Jones, 1939; Antón *et al.,* 2006; Salesa *et al.,* 2006; Abella *et al.,* 2016; Echeverría *et al.,* in press). This sesamoid is served by several of the same muscles as digit I (e.g. the m. abductor pollicis longus and m.

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[44] "Ailuridae is a family in the mammal order Carnivora. The family consists of the **red panda** ([***Ailurus fulgens***] the sole living representative) and its extinct relatives." https://en.wikipedia.org/wiki/Ailuridae (retrieved 9 April 2024)
[45] Salesa et al. (2006, pp. 390/391)
[46] https://www.sciencedirect.com/book/9780128237533/red-panda
[47] https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/ailurus (retrieved 9 April 2024)
[48] Although rather late: I should perhaps add a brief definition here: At https://bracelab.com/clinicians-classroom/thumb-terminology-**confusion** Judy Colditz mentions among other points (2017): "**Radial**: on the side of the thumb away from the hand at a right angle to the plane of the thumbnail." (Retrieved 11 May 2024)
[49] Osman Civan, Rahime Şekerci, Nurcan Ercıktı, Şule Özer, İnanç Güvenç, Nigar Keleş Çevik, Haluk Özcanlı (2020): Sesamoid bones of the hand: A multicenter study.
[50] https://en.wikipedia.org/wiki/Sesamoid_bone#/media/File:Sesamoid_bones_of_the_fingers.jpg (retrieved 11 April 2024)

abductor pollicis brevis). …. **Several different hypotheses have been proposed in relation to the false prepollex**: (i) **the false thumb is a real digit**, whose origin requires further research (e.g. Hayashi et al., 2015); (ii) **the false thumb is a modified sesamoid** (e.g. Galis, van Alphen & Metz, 2001; Hutchinson et al., 2011; Abella et al., 2016); (iii) **the false thumb is in fact a modified canonical carpal bone** (Vickaryous & Olson, 2007). Some others simply conclude that **the false thumb is not a true digit, but do not propose an alternative explanation** (e.g. Fabrezi, 2001; Tokita & Iwai, 2010). For talpids, Mitgutsch et al. (2011) found that developmental peculiarities facilitate the inclusion of the radial sesamoid into the digit series: it is co-opted by digit-inducing molecules but does not follow the same developmental pattern as the other digits. ***One important point that emerges from these texts is that we need to have a clearer definition not only for a sesamoid*[51]*, but also for a digit***. **Describing the prepollex as a 'digit' may imply an atavism, parallel evolution, reversal, or a neomorphic evo-devo mechanism**. As with sesamoids, digit identification should follow strict, explicit criteria and be phylogenetically tested for homology."

Subsequently the authors emphasize that "the **identity** of the **pisiform also remains unclear**" (2019, p. 17):

> "The identity of the pisiform also remains unclear. Some authors consider it **a canonical carpal bone** (Bardeleben, 1885; Gillies, 1929; Haines & Hughes, 1944; Harris, 1944; Vickaryous & Olson, 2007; Diaz & Trainor, 2015; Molnar *et al.,* 2017), while **others describe it as a vestigial post minimus** (Gillies, 1929), and **discussions of its origins remain unresolved** (Moojen *et al.,* 2001). Several comparative anatomy studies label **the pisiform as a sesamoid** (Fabrezi, Abdala & Oliver, 2007; Jerez *et al.,* 2010; Fontanarrosa & Abdala, 2014, 2016; Amador *et al.,* 2018), **due to its large size, late ossification, intimate relationship with the flexor carpi ulnaris tendon, and ventral location relative to the carpal bones** (Haines, 1969). Fabrezi *et al.* (2007) identify it as **a sesamoid because it does not arise from the branching and segmentation of the digital arc**."

Other data seem to deny the vestigial *post minimus* interpretation:

> "However, recent data (Diaz & Trainor, 2015; see also Molnar *et al.,* 2017) showed that in three chameleon species, the pisiform arises from segmentation of the ulnare. Comparative studies on the size of the carpal bones in Squamata show that the pisiform is of a similar size to other carpal bones, shares their location plane, and it is present even in taxa with a highly reduced number of carpal bones (Fontanarrosa, 2018). Studies in humans and primates, also support a carpal bone identity for the pisiform (Kjosness *et al.,* 2014; Reno, Kjosness & Hines, 2016)."

Then Abdalla et al. suggest a possible route to solve the questions as follows (still p. 17):

> "The identity of the predigits (prepollex, prehallux) and the pisiform as sesamoids probably could be established by analysing the cell lineages that give rise to these complex structures, since sesamoids develop from different cell lineages to bones of the primary skeleton (Blitz et al., 2013; Eyal et al., 2015). If these super-structures are indeed co-opted sesamoids acting as false digits (Hutchinson et al., 2011; Mitgutsch et al., 2011), their radical transformation illustrates impressive plastic possibilities, and adds considerable support to the dynamic model[52] proposed herein."[53]

So, there are still some basic doubts within a strictly evolutionary world view – simple homologies have led to more questions than answers.

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[51] In this context perhaps some additional points on sesamoids: Juan Abella et al. (2015, p. 35): "By definition, a sesamoid is a small and more or less rounded mass embedded in certain tendons and usually related to joint surfaces. Their functions probably are to modify pressure, to diminish friction, and occasionally to alter the direction of a muscle pull (Gray 1977; Barone 2000). However, **the radial sesamoid can be considered a special kind of sesamoid, with a completely different role and therefore subjected to different anatomical strictures**. In most instances, this bone is of similar size to other sesamoids, or even vestigial, but in some mammals, such as talpids (Krause and Jenkins 1983; Sánchez-Villagra and Menke 2005), many tenrecids (Salton and Sargis 2008) and elephants (Hutchinson et al. 2011), it constitutes a digit-like element that is variously called 'os falciforme', 'prepollex' or 'predigit'. Furthermore, ***a truly hypertrophied radial sesamoid, constituting a functional 'false thumb', is considered to be present in the giant panda, Ailuropoda melanoleuca*** (Lankester and Lydekker 1901; Wood-Jones 1939a, b; Davis 1964; Gould 1978; Chorn and Hoffmann 1978; Endo et al. 1996, 1999a, b, 2001a; Antón, et al. 2006; Salesa et al. 2006a, b) and, to a lesser extent, in the red panda, Ailurus fulgens (Roberts and Gittleman 1984; Endo et al. 2001b, 2007; Antón et al. 2006; Salesa et al. 2006b)." See more by the eight authors here: https://core.ac.uk/download/pdf/36212769.pdf

Salesa et al (2006, p. 390) after pointing out that "sharing of this structure ["false thumps" in Ursidae and Ailuridae] is one of the most remarkable cases of evolutionary **convergence** among mammals (Salesa et al., 2006)", they continue: "The "false thumb" is a small bone of the carpus, the radial sesamoid, which has enlarged, protruding posteriorly and thus acting partly as an opposable thumb: **in association to the pisiform and when the fingers flex over the palm, it defines a pincer mechanism** that allows the hand to manipulate food, basically bamboo branches (Endo et al., 1999a; Roberts and Gittleman, 1984; Chorn and Hoffman, 1978)." https://digital.csic.es/bitstream/10261/22444/1/32.pdf

Anton et al. 2006, p. 757: On some differences between the red panda and the giant panda: "Previous interpretations of the radial sesamoid in *Ailurus* as a rod-like structure without direct articulation to the wrist bones are inaccurate. There are various important differences between the red panda and the giant panda. ***In the former, the lesser development of the radial sesamoid, its connection with the flexor retinaculum, the presence of an insertion of the muscle abductor pollicis longus in the first metacarpal, which enhances its supinatory action, and the presence of a muscle flexor brevis digitorum manus*** point to thin-branch climbing features serving as an exaptation to the more recent role of the red panda hand in the manipulation of bamboo."
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2049003/

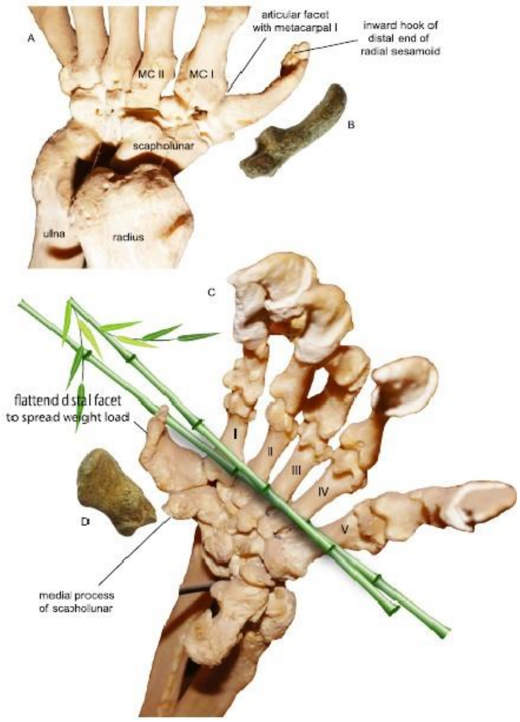
Wikipedia (2024): "In anatomy, a sesamoid bone … is a **bone embedded within a tendon or a muscle**. Its name is derived from the Greek word for **'sesame seed'**, indicating the **small size of most sesamoids**. Often, these bones form in response to strain, or can be present as a normal variant. The patella is the largest sesamoid bone in the body. ***Sesamoids act like pulleys, providing a smooth surface for tendons to slide over, increasing the tendon's ability to transmit muscular forces***." In humans and other organisms several **common variants have been found**: "One or both of the sesamoid bones under the first metatarsophalangeal joint (of the great toe) can be multipartite – in two or three parts (mostly bipartite – in two parts). The fabella is a small sesamoid bone found in some mammals embedded in the tendon of the lateral head of the gastrocnemius muscle behind the lateral condyle of the femur. It is a variant of normal anatomy and present in humans in **10% to 30% of individuals**. The fabella can also be mutipartite or bipartite. The cyamella is a small sesamoid bone embedded in the tendon of the popliteus muscle. It is a variant of normal anatomy. It is rarely seen in humans, but has been described more often in other primates and certain other animals. (https://en.wikipedia.org/wiki/Sesamoid_bone (retrieved 14 May 2024)

[52] "*Sesamoids are periarticular skeletal elements, which initially form in juxtaposition to or independently of bones and joints. They are commonly related to tendons and ligaments, have a genetic basis and, once they are formed, epigenetic stimuli drive their growth and development to the acquisition of their definitive tissue composition, which can be diverse, for example, cartilage, fibrocartilage, or bone*." (Italics by the authors)-

[53] Virginia Abdala, Miriam C. Vera, Lucila I. Amador, Gabriela Fontanarrosa, Jessica Fratani and María L. Ponssa (2019): Sesamoids in tetrapods: the origin of new skeletal morphologies. *Biological Reviews* 2019 (21 pp.) https://ibn.conicet.gov.ar/wp-content/uploads/sites/113/2019/07/Abdala-et-al-2019.pdf

Radial Sesamoid as Ideal Starting Point to Develop a Thumb-like Digit in Pandas

Studying the bones of the panda's thumb more closely (*always keeping in mind its dual function for walking and grasping*), the radial sesamoid of the basal ursoid (see Fig. 5 and Fig. 4 of Xiaoming Wang et al. (2022) above and below left) appears to be ***the ideal starting point to form an additional thumb-like digit***. In both figures the starkly/ the enormously developed **scapholunar** is striking in the illustrations[54]. As D. Dwight Davis already put it in his study of 1964, p. 99 (being according to Gould "probably the greatest work of modern evolutionary comparative anatomy"[55]):



"The **carpus** [wrist joint] is dominated by the **scapholunar**. This bone greatly exceeds any of the other carpals in size, and articulates with all the other carpal bones except the pisiform, and with the **radius** and the **radial sesamoid**."

And just before this statement:

"The carpus (figs. 52, 53) is very similar to that of bears, *except for the tremendous development of* ***the radial sesamoid and the modifications of the scapholunar*** *associated therewith*. **The carpus-forearm articulation is largely between the scapholunar** and **the radius**, which form an almost ball-and-socket joint permitting very extensive excursion."

And on pp. 99/100:

"*The* ***radial sesamoid*** *articulates extensively with the enlarged medial process of* ***the scapholunar***, and is in contact with the medial border of the first metacarpal. … A large depression on the **outer surface of the radial sesamoid near the base** marks the attachment of the tendon of the **abductor pollicis longus**. The **abductor pollicis brevis** and **opponens pollicis** arise from its medial surface. A sizable ***radial sesamoid articulating with the scapholunar is present in all the other arctoid carnivores***, and a corresponding bone exists in many other mammals. **In no other arctoid does it approach the proportions seen in *Ailuropoda*, however**. … The radial sesamoid is also relatively small in *Ursus* but provides attachment for a part of the long abductor and opponens (fig. 54)."

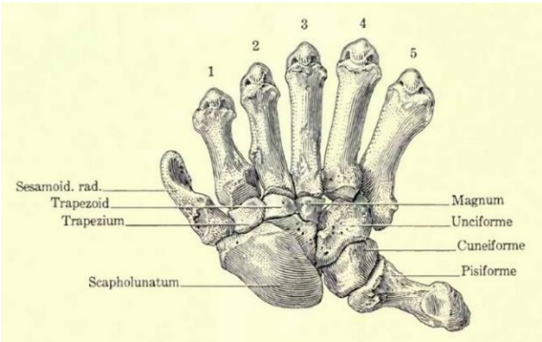


Fig. 52. Right carpus and metacarpus of *Ailuropoda*, dorsal view.

Tamela S. Smart (2009, p. 22):

"**The scapho-lunar is the largest carpal found in the** [black] **bear** and **also one of the most distinctive** (Figure 4). Its overall shape is rectangular with a large inferior

[54] **Above: Text for Figure 4 of Wang et al.** (2022): "Giant panda's false thumb. Dorsal (**A**) and ventral (**C**) views of the modern giant panda left hand, as compared with an isolated left radial sesamoid *Ailuarctos* cf. *A. lufengensis* (**B** and **D**, ZT-2015-0056) at a similar angle and relative size. Mounted skeleton of the giant panda on display at KIZ exhibition hall, probably a zoo specimen." **Below**: **Figure 52 of D. Dwight Davis** (1964).

[55] Stephen Jay Gould (1980): The Pandas Thumb. (And he adds: "…and it contains more than anyone would ever want to know about pandas. Davis had the answer, of course." Joseph Curtis Moore (1965): "The memoir on the giant panda, completed after **25 years of study, thought, and toil**, and published 2 months before his death, represents Dwight Davis' maturest work and the ultimate expression of his personal perfectionism." https://www.abebooks.com/signed-first-edition/Giant-Panda-Morphological-Study-Evolutionary-Mechanisms/31578510434/bd. Steven M. Stanley (1979, p. 157 in MACROEVOLTION) called it "**a remarkable**, but seldom-cited **pioneering study**" (**in he interim it has, in fact, been regularly and often cited**) and (1981, p. 128 in THE NEW EVOLUTOARX TIMETAVBE) "a **definite anatomical monograph on the giant panda**." Concerning Stanley (born 1941, professor of paleontology John Hopkins University 1969-2005), see comments and some of his publications including extensive volumes in https://de.wikipedia.org/wiki/Steven_M._Stanley (retrieved 18 May 2024). Davis' book has also been republished in 2010 by Benediction Books and 2019 Benediction Classics. As for Davis, see: https://en.wikipedia.org/wiki/Delbert_Dwight_Davis ("...in literature, usually just D. Dwight Davis), (30 December 1908 – 6 February 1965). …. Davis married Charlotte and they had a **son, Charles Darwin Davis**." Frédéric Morneau-Guérin (2023): speaks of the "remarquable monographie du spécialiste de l'anatomie comparée D. Dwight Davis consacrée au panda géant": https://r-libre.teluq.ca/3081/1/L%27e%CC%81tonnant%20Panda%20-%20Recension.pdf Prof. Cyrille Barrette in L'Étonnant Panda (2023): "Cette monographie … **demeure LA référence sur tout les aspects de l'anatomie du panda**."

projection extending from its medial corner. The scapho-lunar articulates with six elements, including the trapezium, trapezoid, capitate, hamate, triquetral (anteriorly), and radius (posteriorly)."[56]

Now let's imagine for a moment that an ingenious genetic engineer[57] had had the task of transforming a small population of one of China's so far known bear species like *Ursus arctos* or *Ursus malayanus* in order to inhabit in and living from the extraordinary large bamboo forests[58], including several important ecological tasks[59] by eating as many soft bamboo shoots, stems and leaves as possible (Steven M. Stanley 1981, p. 129: "*The giant pant is **essentially a machine for eating bamboo***"[60]; Cyrille Barrette 2023, p. 107: "*Que se soit des feuilles ou des tiges, il exécute ce travail avec énormément de concentration, d'ardeur, d'attention, de facon systématique et répétitive, **comme une machine***" – see English translation below[61]).

"Panda trio Sichuan China autumn 2011 Chengdu Research Base of Giant Panda Breeding"
Source and author: chensiyuan
https://commons.wikimedia.org/wiki/File:1_panda_trio_sichuan_china_2011.jpg (retrieved 22 May 2024)

[56] Incidentally "American and Asian black bears are considered sister taxa and are more closely related to each other than to the other modern species of bears." https://en.wikipedia.org/wiki/American_black_bear

[57] Fortunately, there is no such individual who could do such things as given in the following illustration – I say "fortunately" because I'm not sure what some well-meaning but otherwise imperfect individual could do wrong in such cases with incalculable consequences for the ecological balance of a biocoenosis and perhaps even nature in general.

[58] Google please China's reforestation program, perhaps including Xiaowei Tong et al. (2023) https://www.nature.com/articles/s43247-023-00923-1

[59] "Pandas play an important role in the forest ecosystem where they live. **Seeds and plant matter collects on their fur**, which is then deposited as they move throughout their habitat. They also climb trees and swim, which further helps disperse the seeds." https://www.nature.org/en-us/get-involved/how-to-help/animals-we-protect/giant-panda/ "Giant pandas help to keep their mountain forests healthy by **spreading seeds in their droppings**, which helps vegetation to thrive. The Giant panda's forested habitat is also important for local people – for food, income and fuel for cooking and heating. They also **play a crucial role in regulating water flow**. The pandas live in the mountain catchment areas of the Yangtze and Yellow rivers. The forests act as natural watersheds, helping to control water runoff, reduce soil erosion and maintain water quality, which over a half a billion people depend on." https://www.wwf.org.uk/learn/wildlife/giant-pandas "**If pandas were to go extinct, China's bamboo forests would greatly suffer since pandas help spread bamboo seeds that they pass in their feces**. By spreading these seeds, they help bamboo plants to spread and grow." https://homework.study.com/explanation/how-would-the-local-ecology-be-affected-if-pandas-were-to-go-extinct.html

[60] The new Evolutionary Timetable, p. 129.

[61] "Whether it is leaves or stems, he carries out this work with ***enormous concentration, eagerness and attention, systematically and repetitively, like a machine***." Cyrille Barrette (2023) L'Étonnant Panda. Erreur de la nature ou merveille d'adaptation? Editions MaultiMondes https://editionsmultimondes.com/livre/l-etonnant-panda/ see perhaps also on the autor https://fr.wikipedia.org/wiki/ Cyrille Barrette (Professor of biology at the Université Laval à Québec: 1975-2007).

Now, what would our ingenious genetic engineer do?

But perhaps we should first raise the question, what he would absolutely not do?

Assuming for a moment that he would really be able to accomplish such things, he would definitely not reprogram DNA as well as corresponding cytoplasmatic systems and additional cell structurers of that small bear population to enable them the development of a *human thumb* (including its distinct musculus extensor pollicis brevis and musculus extensor pollicis longus): These animals could neither walk properly, for such a thumb would be a painful major obstacle (and permanently get in the way) when walking or running – nor allow a durable tight and firm grip (hardly without getting problems of overuse) in the 12 to 15[62] hours a day of eating bamboo.[63]

> "Perhaps **the most demanding function of the false thumb is *to maintain a tight grip on bamboo stems*** while the panda uses its teeth to tear and shred stems into bite size portions for consumption. The high strength of bamboo, especially the woody stems during the winter months, ***requires considerable grip strength by the hands to twist and jerk***, **countering the powerful biting and tearing by the jaws** (see, for example, a panda cam (2 hours and 22 minutes) at the San Diego Zoo[64]). Therefore, it seems likely that a ***tight grip*** is more critical to panda's feeding ability than the volume of their grasp."[65]

This key requirement of a tight grip: time and again/intermittently/at short intervals for 12 to 15 hours a day of our bamboo eating "machine" explains why the ingenious genetic engineer in our illustration developed DNA and further programs solidly linking the movements of panda's thumb with other fingers in a ***functional complex*** – this being not a sign of imperfection but an example of well thought through and highly efficient intelligent design.

> "**Instead of a human thumb that is capable of independent movements against other fingers**, the ***panda's radial sesamoid forms a functional complex in rigid articulation with the first metacarpal and* scapholunar**, which collectively rotate with other metacarpals fully flexed, the radial sesamoid functional complex couples with the pisiform on the lateral side of the hand to function as a double stop against the pincer-like actions of the bending phalanges (*but see Fig. 6, which shows only the radial sesamoid is used in the pincer action and **the pisiform is not***[66]). Small muscles (such as abductor pollicis brevis and opponens pollicis) between the radial sesamoid and first metacarpal serve as a cushion for the bamboo stems grasped between the radial sesamoid and phalanges (Fig. 5)."[67]

Moreover, all the extraordinarily rich projects/actions/labors/enterprises humans use their thumbs for working with, just focusing on bamboo[68], not to mention a thousand further activities humans utilize their thumbs for (see previous footnote on *Crafts* etc.), most of which are principally not available for the panda so that such a human-like thumb would constitute a potential that would never be realizable for a bear and thus be superfluous[69].

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[62] „Un panda adulte der 100 kilos consacre de **12 à 15 heures par jour** á manger due bambou…" Cyrille Barrette (2023, p. 96): L'Étonnant Panda.

[63] "As it turns out, however, **the human opposable thumb is not at all well designed to accommodate 12 hours/day of scraping leaves from bamboo branches** (which is what Pandas do) however **the panda's thumb can accomplish this function without a problem**. … If pandas had to use humanlike opposable thumbs to strip bamboo for 12 hours per day and were American evolutionist lawyers, they'd probably sue the designer for negligent design. It looks like pandas have weak grounds for such a lawsuit. Is this poor design?" C. Luskin 2004 http://www.ideacenter.org/contentmgr/showdetails.php/id/722

[64] https://www.facebook.com/SanDiegoZoo/videos/562351354170625/

[65] Xiaoming Wang, Denise F. Su, Nina G. Jablonski, Xueping Ji, Jay Kelley, Lawrence J. Flynn & Tao Deng (2022): https://www.nature.com/articles/s41598-022-13402-y

[66] See also the third photograph of panda from Zoo Berlin above as well as the enlargement of the right paw below.

[67] Again Wang et al. 2022.

[68] "Bamboo has many uses, mainly in construction (flooring, roofing designing, and scaffolding), furniture, food, biofuel, fabrics, cloth, paper, pulp, charcoal, ornamental garden planting, and environmental characteristics, such as a large carbon sink and good phytoremediation option, improving soil structure and soil erosion. 2020: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7555460/ See perhaps also 2008-2024: https://econation.one/bamboo/ and (2023) The Culture and History of Chinese Bamboo https://studycli.org/chinese-culture/chinese-bamboo/

[69] As for the general differences between humans and animals, see again perhaps several articles in https://evolutionnews.org/tag/human-exceptionalism/ as well some keywords here (each could be a topic of its own, from different publications not listed here in detail) – see footnote continued next page.

However, why did our ingenious genetic engineer choose the radial sesamoid at all?

To generate a bear that would be "essentially a machine for eating bamboo" over 12 to 15 hours per day, the engineer's highest goal would have been an animal that was able to get along with the demanding function of a kind of thumb "to maintain a tight grip on bamboo stems while …[using] its teeth to tear and shred stems into bite size portions for consumption" as well as ***simultaneously*** employing his large bear forefeet for walking as ever. So, a significant limit: "*Panda's false thumb must walk and 'chew'*," says Wang. "*Such a dual function serves as the limit on how big this 'thumb' can become*."[70] But would that suffice within such limits? We already know that it does – not only as any extant panda vividly demonstrates but also ***as the fossil record reveals for some 7 million years*** according to the geological time scale (see again Wang et al. 2022). So, the present solution has already proven itself ***the best and most durable***.

Now we have already heard D. Dwight Davis stating that "The carpus is very similar to that of bears, except for the tremendous development of the **radial sesamoid** and the modifications of the **scapholunar** associated therewith. The carpus-forearm articulation is largely **between the scapholunar and the radius**…"

Hence, in retrospect our ingenious engineer did the best possible thing he could do: Taking an already existing bone – the **radial sesamoid** – "tell it" to develop tremendously within the limits of the double/dual/complementary function of grasping and walking, taking the also already existing **large scapholunar** as its further basis in order to link the carpus-forearm articulation "largely between the **scapholunar and the radius**". Just some functions of the human radius – modifications in bears see below:

> "The radius permits the forearm and hand to pronate and supinate, flex and extend at the elbow, and adduct, abduct, extend, flex, and circumduct the wrist. Pronation and supination occur through complex articulation with the cylindrical shaped radial head, which is stabilized to the ulnar notch by the annular ligament"[71].

Absolutely ideal starting points and solutions! Taking into account the overall context: ***This is elegant, efficient, perfect intelligent design*** (genetically, physiologically, anatomically and ethologically). I would like to hear how any evolutionary biologist of the "crude", "clumsy", "highly inefficient", "imperfect", "suboptimal", "badly designed" party could have really done better.[72]

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(1) **Language** (for a definition see perhaps https://www.britannica.com/topic/language; "*Language, as described above, is species-specific to human beings*.")
(2) **Broca's area**. Though evolutionary biologists have tried hard to detect and assert Broca homologies in primates, there are many clear/deep differences as well as wide open problems even between humans and chimps. Applying the **Optimal Panda Principle** here, further "old" and **especially entirely new structures, control loops, and cybernetic systems** embedded in the overall human entity as a whole might be detected. Just one link: https://academic.oup.com/cercor/article-abstract/34/2/bhaa202/5918479
(3) In contrast to humans, "The chimp language experiments actually prove that chimps are incapable of even the most rudimentary forms of human language" (Chomsky to Restak).
(4) "The normal human brain …is endowed with **considerably more potential** than is realizable in the course of one person's lifetime" (Encyclopedia Britannica). However, let's keep in mind that "evolution does not plan for the future".
(5) Abstract thinking.
(6) Contemplating and Setting Future New goals.
(7) Humans are equipped/provided with "an eye for beauty, an ear for music, a flair for art, an urge to learn, an insatiable curiosity, and an imagination that invents and creates" (Anonymus).
(8) Love (Human: Agape, Philia, Storge, Eros), patience, goodness, faith, self-control (and more).
(9) Search for Meaning in Life.
(10) Also, in contrast: Natural selection "has no mind and no mind's eye. It does not plan for the future. It has no vision, no foresight, no sight at all…" (Dawkins)

[70] https://nhm.org/stories/eating-bamboo-its-all-wrist

[71] Michael M. Bair and Anoosh Zafar Gondal (2023): Anatomy, Shoulder and Upper Limb, Forearm Radius. https://www.ncbi.nlm.nih.gov/books/NBK544512/ Somewhat modified in bears. Smart 2009, pp. 17, 21, 31: "The radius and ulna are long bones positioned side by side in the lower arm. In humans these elements are relatively similar in overall size and robusticity, however **in most non-human mammals the radius is generally the more robust of the two** (Flower 1885). … the [bear] articular surface on the posterior side of the bear scapho-lunar is rectangular in shape and exhibits a single facet where it articulates with the radius. … the proximal surface on the human scaphoid has a single facet for the radius (2), which is convex. Whereas the posterior surface of the bear element has two facets (c and d) and both are concave.

[72] For Nathan Lents even one of the two long bones of the forearm (radius or ulna) would be superfluous (belonging to his "pointless bones" and "blunders of nature" 2018, pp. 28, 31, to say nothing of his view on the ingeniously designed and functioning eight wrist bones) – see the complete refutation of Lents by Stuart Burgess). **Now the special development/shaping of the radial sesamoid and scapholunar belong to the basic elements of the panda's very existence**. Reminds me of the "principle of variable proportions" – so, the far-sighted ingenious genetic engineer appears to have been responsible also for the basic ***bauplan*** of the hand and consequently for its enormous potential to vary it according to further goals – see the details above for the panda's many ecological tasks. Recall please Burgess: "Eight bones with precise functions, with this one if you remember Nathan Lents said, this is eight bones like a useless pile of rocks. Well, I'm going to show you, they are not a useless pile of rocks, there is precision engineering in the wrist joint. So, like with the ankle **we have this multifunctioning wrist joint**." – **Including a vast potential for future 'modifications' as seen in the panda's hand and in further animals at that**. So, a far-sighted engineer looking far into the future.

We always have to keep in mind that the panda's hands have a **dual function**: To walk (as shown **above**) and to skillfully process bamboo over up to 15 hours a day (see photo **below**). As for the its excellent **skill and precision – the panda's dexterity** – my observations are full agreement with the many authors (friends and foes of Gould's 'panda principle' alike) when carefully studying and filming the two pandas at Rhenen Zoo in the Netherlands (Wednesday 5 June 2024). As for the zoo and its panda project, see https://blooloop.com/animals/in-depth/giant-pandas-ouwehands-zoo/ and history of the zoo https://en.wikipedia.org/wiki/Ouwehands_Dierenpark and https://www.ouwehand.nl/

Photographs by W.-E. L.

Interestingly, Xiaoming Wang, Denise F. Su, Nina G. Jablonski, Xueping Ji, Jay Kelley, Lawrence J. Flynn & Tao Deng (2022) explain natural selection of the radial sesamoid as follows:

> "Furthermore, from an evolutionary point of view, such a simple passive mechanism of grasping can be functionally useful even with a slight initial enlargement of the radial sesamoid. **Natural selection would be effective from the early stages of enlargement**, i.e., ***even a small, protruding lump at the wrist can be a modest help in preventing bamboo from slipping off bent fingers***."[73]

First, I would like to point out that according this group of seven highly qualified evolutionary biologists the origin of the panda's thumb was also starting from the radial sesamoid – hence even for our Darwinian friends this bone seems to be a real asset for the onset of evolution by natural selection of the panda's thumb.[74]

However, "functionally useful even with a *slight initial enlargement* of the radial sesamoid"? Well, "a slight initial enlargement of the radial sesamoid" would functionally be entirely useless: The poor panda could not hold the bamboo stems properly, for (not only "perhaps" but) "the most demanding function of the false thumb is to maintain a ***tight grip on bamboo stems*** while the panda uses its teeth to tear and shred stems into bite size portions for consumption. The high strength of bamboo, especially the woody stems during the winter months, requires ***considerable grip strength*** by the hands to twist and jerk countering the powerful biting and tearing by the jaws" and that, recall also please, perfectly/accurately up to 12 to 15 hours a day ("Il ne pourrait accomplir rien de tout cela sans son pouce"/ "He couldn't accomplish any of this without his thumb" – C. Barrette 2023, p. 107).

In contrast to gradualism or the Synthetic Theory/neo-Darwinism (see footnote below), Steven M. Stanley (1981/1998, p. 158) argued for a quantum speciation event:

> "These genetic similarities [between *Ursus* and *Ailuropoda*][75] suggest that the basic shift could easily have been achieved by ***a quantum speciation event***. I find it **difficult to imagine** that the drastic structural and ecologic changes could have come about by **slow, sequential fixation of the few genetic changes or that an entire species occupying a large geographic area could have made such a remarkable phenotypic transition**. Far more likely would have been origin by way of a very small population occupying a local bamboo forest."[76]

P. 155: "Pleiotropy ['control of two or more features of the phenotype by single genetic components'] may have introduced some important features that had little initial adaptive value." Thus, there would hardly be any selective advantage of the first steps.

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[73] Just before that quotation, the authors state that "…Such a passive system of gripping, far less effective than that of humans, nonetheless offers the panda the tightness of grip it needs for bamboo feeding." As to "far less than that of humans" – this would be a comparison which would ignore the entire context in which humans and pandas use their real and false thumbs.

[74] With their statement that "Natural selection would be effective from the early stages of enlargement" etc. the authors are in agreement with "today's dominant theory of evolution – **neo-Darwinism**, also called "the synthetic theory of evolution" and "modern synthesis" – all life forms have evolved gradually from earlier life forms by natural selection of an almost endless array of **mutations with** "**slight or even invisible effects on the phenotype**" (in the words of Mayr, one of the architects of the modern synthesis) or *phenotypically* exactly as in Darwin's formulations of his theory between 1859 and 1882 by "…innumerable slight variations", "extremely slight variations" and "infinitesimally small inherited variations".

And since this key point of the theory, its bottom line, core and essence, even "the same yesterday, and today and forever" – gradualism in combination with omnipotent natural selection – can hardly be overemphasized, I would like to continue to point out that Darwin correspondingly imagined the origin of species (and, in fact, of all life forms) by selection of "infinitesimally small changes", "infinitesimally slight variations" and "slow degrees" and hence imagined "steps not greater than those separating fine varieties", "insensibly fine steps" and "insensibly fine gradations", "for natural selection can act only by taking advantage of slight successive variations; ***she can never take a leap***, but must advance by the shortest and slowest steps" or "the transition [between species] could, according to my theory, be effected only by numberless small gradations" (All emphasis added).

In the 1st edition of Darwin's *Origin* (1859) we find his assertion that "**Natura non facit saltum**" ("nature doesn't jump") eight times and in the 6th edition (1872) twelve times, so even four times more. See more here: http://www.weloennig.de/Rhinoceros.pdf

[75] Referring to Davis' assertion of a few gene effects (see below) and the "very small" transferrin immunological distance "between a giant panda and a bear" according to Sarich (1971).

[76] However, he cautioned in *The New Evolutionary Timetable* (1979, p. 166) "… distinctive new species are **not literally born or hatched in final form**. It is virtually inconceivable that the first bird emerged full blown, from a dinosaur egg, **or that the modern giant panda entered the world as a monstrous bear cub**. Certainly, however, a partial step in such a direction can be taken in a single generation. As we have seen, a small group of siblings may, for example, share certain features that set the stage for rapid divergence. For speciation to be achieved, however, it is required that such features be fixed within an interbreeding population and that they be blended with other adaptations to yield a successfully functioning unit of life. This may require **several generations — or several hundred or several thousand**. Such intervals are nonetheless brief instants in geological time, and this is the fundamental point of the punctuational model of evolution. Once established, an average species survives, as a slowly evolving lineage, for at least a million years (as in mammals, birds, and insects) and for more than ten million years in some groups (snails, clams, and corals, for example)."

Concerning the adaptive value of incipient characters Stanley surmises (p. 157): "My guess … is that pleiotropy may have induced much important raw material for evolution in the form of ***initially nonadaptive features***. The evolution of the **giant panda** … offers support for this notion" and most importantly:

> "Here we may find ***a way around the traditional problem of the adaptive value of incipient features*** – a problem with which Darwin and others have grappled unsuccessfully in the context of gradualism."

However, *inter alia* there is the problem of *co-adapted* initial features[77]. So much here on a non-Darwinian theory of the origin of the panda's thumb, according to which at least the incipient thump could have arisen without any involvement of natural selection.

Now back to the Synthetic Theory and natural selection: Following Wang et al. 2022 the neo-Darwinian evolutionary biologist Cyrille Barrette hypothesizes that the origin of the panda's thumb also started with the development of the radial sesamoid and he implicitly tells us that its evolution took place over many intermediate stages (2023, p. 99) – although he never tells us how many such steps were probably involved and what their selective values could have been (title of his Chapter 8: "*Sauvé par son deuxième pouce*"/So, the panda was "*Saved by his second thumb*"[78]):

> "It is ***natural selection that cobbled together this false thumb*** from a small, insignificant bone of its ancestors, which other current bears also have: the radial sesamoid. That of the Panda has become longer and mobile thanks to the development of the associated muscles (figure 18). This bone measures 35 millimeters in length. Those of other bears do not exceed 10 millimeters (figure 19)."

"…cobbled together … from a small, insignificant bone of its ancestors"? According to the neo-Darwinian theory/gradualism this has happened over thousands of intermediate steps. To recall these salient facts from my Giraffe book (2011, p. 129):

> "For the elongation of the giraffe's neck, the evolutionary biologists Badlangana et al. (2009) stipulated for the many steps according to the microevolutionary scenario of the neo-Darwinian theory an average between **0.72 and 1.19 µm each per generation**. And I asked:
>
> "Thus, are there really decisive selective advantages for the survival of giraffe populations of ***about 1 millionth of 1 meter or 1 thousandth of 1 mm higher in each generation***? And that for about 500,000 or so generations each reaching 1 thousandth of 1 mm higher than their ancestors into the canopy of the last leaves during a dearth? (Not to mention the smaller females, juveniles and Haldane's dilemma)."

(P. 131): Ernst Mayr on the meaning of gradual evolution of the teeth of horses (1967, p. 193): "…actually the extent of its increase amounted to only some **1mm per million years** (Simpson 1944)." Also, in this context recall please Robert Nachtwey on the genetical basis of gradualism: "The theory only says that something survived in the struggle for existence, but to our question as to how this something actually came into being, it always has only one answer: "By an accidental hereditary variation!""

Although some would probably argue that different anatomical features may have had different evolutionary tempos, for an **approximate calculation of the magnitude of the number of evolutionary steps and the time involved in gradualism**, let's apply these hypotheses and calculations (giraffe's neck and horse's teeth) of neo-Darwinian biologists to the elongation of the radial sesamoid of *Ailuropoda* that is about 21 mm longer than that of the brown bear:

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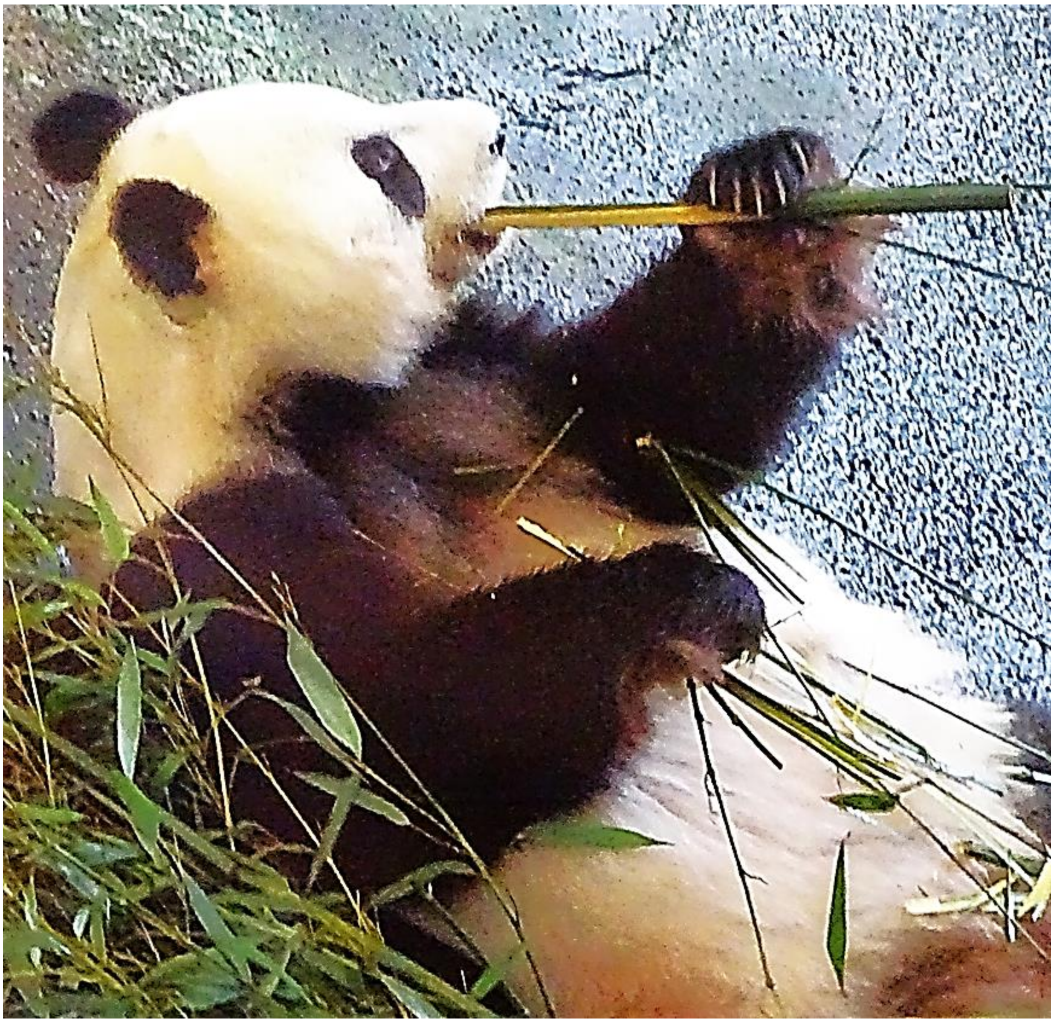
[77] It would not help say a grizzly bear to just grow a larger radial sesamoid without ***co-adapted further structures and a corresponding 'intelligent' behavior how to use it*** – all just due to a pleiotropic mutation? As for regulatory genes (also deployed by him) – they are largely impotent without target genes.

[78] Translated by Google and/or DeepL



Above: Panda resting at Rhenen Zoo in the Netherlands: Ouwehands Dierenpark. Note please the panda's thumb here shown on his right foot (somewhat magnified a few pages further down);
incidentally, above in that photograph: an example of the feces they usually produce – interesting for scientific investigations.
Below: Panda is grasping and eating bamboo: **The animal could not hold it without a regularly developed thumb** (or, as we have heard: "He couldn't accomplish any of this without his thumb" – see further context above).
Photographs W.-E. L.: 5 June 2024

1 thousandth of 1 mm higher in each generation would mean a gradual evolution over **21 000** (**twenty one thousand**) **transitional steps**. And Simpson's one million years for 1 mm would mean **21 million years** (ca. 3 x longer than pandas are known from the fossil record) until the radial sesamoid of *Ailuropoda* achieved its present length. Thus, the question: are there really decisive selective advantages for the survival of *Ailuropoda* populations each about 1 thousandth of 1 mm higher in some 21 million years? Moreover:

> "***Even a new mutation that is slightly favorable will usually be lost in the first few generations after it appears in the population***, a victim of **genetic drift**. If a new mutation has a selective advantage of *S* in the heterozygote in which it appears, then the chance is only 2*S* that the mutation will ever succeed in taking over the population. So, a mutation that is 1 percent better in fitness than the standard allele in the population will be lost 98 percent of the time by genetic drift."
>
> Also, let's not forget that **each new successful evolutionary step implied the substitution of the entire panda population**.[79]

Gradualism plus natural selection: Very improbable scenario indeed![80] Conversely, in combination with Occam's razor, the intelligent design theory offers a much more economic and definitely scientific alternative to such evolutionary suggestions. "We know from our own experience that such things as books and art only come from one source, a mind. So, when we see intentionally designed systems, ***purposeful arrangement of parts***, we know that at an intelligent agent, a mind, must be the cause. The theory of intelligent design simply says that certain features of the universe and of living things are best explained by an intelligent cause, not an undirected process such as natural selection."[81]

Cyrille Barrette continues (2023, p. 99):

> "In a remarkable study recently published, the team of paleontologist Xiaoming Wang from the Natural History Museum of Los Angeles County showed that ***the length of the radial sesamoid***, and therefore that of the false thumb, ***is limited firstly by its location under the hand***. To grasp food, the thumb must emerge from the edge of the palm. Now in this position, **if it were longer, it would harm the plantigrade gait of the animal, just as a Pebble in our shoe causes us great discomfort**."

Clear illustration: "…just as a pebble in our shoe causes us great discomfort."

> "To minimize this presumed inconvenience, the Panda may have a tendency to walk slightly on the outer side of the hand, unless the bump caused by the pisiform (figures 18 and 20) serves to straighten the palm of the hand otherwise unbalanced by the presence of the false thumb. These two hypotheses remain to be verified."

Could be – we'll see.

> "Secondly, the length of the sesamoid and the thumb results from a **compromise between two aspects of its gripping capacity**. ***If the false thumb were shorter, the amplitude of its opening would be reduced and would limit the size of the bamboo stems handled, making feeding less efficient***."

Correct: "…the amplitude of its opening would be reduced" so that our pandas couldn't eat enough bamboo distributed over 12 to 15 hours a day to prosper and survive. Yet *Ailuropoda* exhibits exactly the optimal grasp volume necessary to fulfill its tasks – the *Homo* grasp volume, on the other hand (including the *abductor pollicis brevis* and *opponens pollicis*[82]) – would, among other points, be ***far too large*** *to cope with* its dual tasks of **grasping and walking**, not only for up to 15 hours a day but a whole life long – some 20 years in the wild and up to 30 years in captivity.

So again: Optimally/splendidly/superbly carried out by our ingenious genetic engineer!

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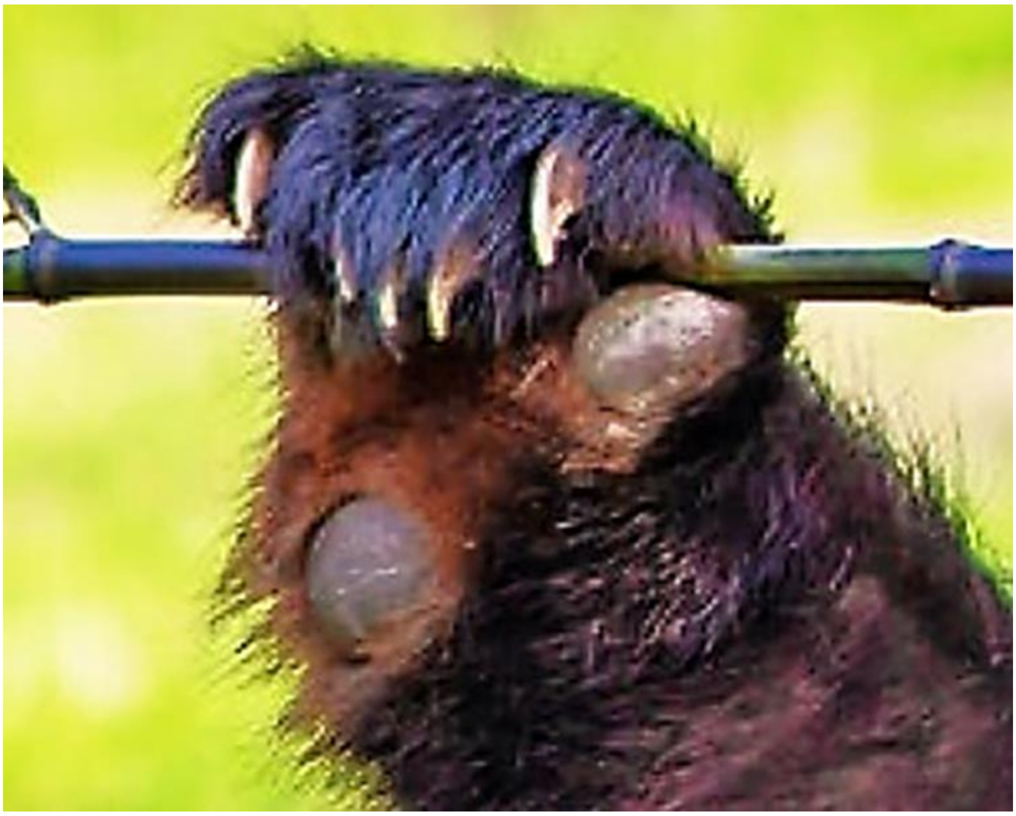
[79] See http://www.weloennig.de/Hummingbirds.pdf
[80] As for the history of punctuated equilibrium, *cf.* Stephen C. Meyer (2014): Darwin's Doubt. HarperOne. (Chapter 7: Punk Eek! Yet, even Gould returned neo-Darwinism.)
[81] Fort the reference, see https://www.weloennig.de/Rhinoceros.pdf p. 48, see also pp. 8, 19, 51
[82] Not shown in Figure 5 of Wang et al. for *Homo*. For *Ailuropoda* they note; "Small muscles (such as *abductor pollicis brevis* and *opponens pollicis*) between the radial sesamoid and first metacarpal **serve as a cushion** for the bamboo stems grasped between the radial sesamoid and phalanges."



Above: Photo from previous page somewhat enlarged to note and realize the panda's thumb a bit better.
Below: Picture detail from https://www.zoo-berlin.de/de/tiere/grosser-panda:
Now the right panda paw strongly enlarged. Compare it please with Figure 5 by Wang et al. (2022)
as shown and discussed above. **Ideal solution for grasping _and_ walking!**
'Striking Imperfection or Masterpiece of Engineering?'

However, ***less efficient feeding*** would emphasize the enormous problem involved in the theory of natural selection, the problem of the adaptive value of incipient and thus not adequately functioning features, which Stanley tried to bypass by pleiotropic mutations and, as he correctly stressed concerning incipient structures – they present "a problem with which Darwin and others have grappled unsuccessfully in the context of gradualism."

> (Pp. 99/100) "If, on the contrary, it [the thumb] were longer, the gripping force of its tip would be unduly limited. The length of the false thumb is therefore a compromise between two contradictory needs: those of promoting both its degree of opening and its gripping force. ***Its length is therefore neither minimum nor maximum, but optimal***, **like most natural selection products**."

Well, not only the length is optimal but also the entire "panda system" for grasping, walking and climbing as well as to inhabit in and living from large bamboo forests, fulfilling major/weighty/serious ecological tasks.

Just to repeat the importance of **panda's ecological impact**: "Seeds and plant matter collects on their fur, which is then deposited as they move throughout their habitat. They also climb trees and swim, which further helps disperse the seeds." … "Giant pandas help to keep their mountain forests healthy by spreading seeds in their droppings, which helps vegetation to thrive. The Giant panda's forested habitat is also important for local people – for food, income and fuel for cooking and heating. They also play a crucial role in regulating water flow. The pandas live in the mountain catchment areas of the Yangtze and Yellow rivers. The forests act as natural watersheds, helping to control water runoff, reduce soil erosion and maintain water quality, which over a half a billion people depend on." … "If pandas were to go extinct, China's bamboo forests would greatly suffer since pandas help spread bamboo seeds that they pass in their feces. By spreading these seeds, they help bamboo plants to spread and grow by eating as many soft bamboo shoots, stems and leaves as possible."

– Considering all the different aspects of the panda's biology, I would call it the "optimal intelligently designed panda system" (or in brief the "***Optimal Panda Principle***" – see also the points below) – exactly as a far-sighted ingenious genetic engineer would have considered and implemented it on all biological levels – in contrast to Gould's evolutionary "*Panda Principle*" implying, "highly inefficient", "imperfect", "suboptimal", "bad design" etc., while exclusively focusing on the isolated radial sesamoid.

However, "…like most natural selection products"? Why then are there so many evolutionists who call the panda's thumb not only "imperfect", "suboptimal", "badly designed" but also "crude", "clumsy" and "highly inefficient"? – Not to speak of many further biological examples (see, for instance http://www.weloennig.de/Kidney1x.pdf)

On p. 99 of his book C. Barrette also mentions the opinion of D. Dwight Davis (just before citing Wang et al. 2022):

> "According to researcher Dwight Davis, using this thumb would be like grasping an object with a thumbless mitten [Fausthandschuh], an impotent manipulation. Despite this, the thumb is sufficient for the task, as it enables the panda to handle food properly.[83]

Although Davis states (p. 5) that "observations on living carnivores were made at both the Chicago Zoological Park and the Lincoln Park Zoo" [84], Barrette's mention of Davis' comparison to "thumbless mitten" could perhaps imply for us a "suboptimal" comment of the latter author in clear contradiction to all the observers who have looked and studied the panda's eating habits more closely – *cf*. the quotations at the beginning of this article as:

> "Every direct reference from the panda natural history literature that I've found […] praised the structure in the highest terms: "like a forceps" (Schaller et al.), "with the utmost precision" (Perry), etc." [Richard Perry points out that] "Pandas can hold a single piece of sugarcane or a slice of bread. They can pick up a tin dish like a dog dish in their fore limps. Ming, a female, could hold a spoon and eat soup with it or she could pick up as small as little Necco candy wafers[85]" (Nelson).

How to pick little Necco candy wafers with thumbless mittens?

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[83] Original French: "Selon le chercheur Dwight Davis, agir avec ce pouce serait comme saisir un objet avec une mitaine sans pouce, une manipulaton empotee. Malgre tout, il suffit a la tache, puisqu'il permet au Panda de manipuler habiliment la nourriture."

[84] In 1937 the first "living baby giant panda" was brought to the US. "This individual, named Su Lin, lived for 16 months in the Chicago Zoological Park. It formed the basis for the present monograp***h***" (Davis p. 15). "…it takes female pandas roughly five years to reach adulthood" … "a panda may spend up to 12 hours a day resting or napping." Greg Hayes at Kensington Tours, 2023): https://www.kensingtontours.com/stories/asia/6-facts-about-pandas-that-will-make-your-day

[85] https://en.wikipedia.org/wiki/Necco_Wafers

"The way in which the giant panda…uses the radial sesamoid bone — its 'pseudo-thumb' — for grasping makes it one of the most extraordinary manipulation systems in mammalian evolution. …The radial sesamoid bone and the accessory carpal bone form a double pincer-like apparatus in the medial and lateral sides of the hand, respectively, enabling the panda to manipulate objects with great dexterity" (Endo et al.)

Again: How to manipulate objects with great dexterity with thumbless mittens?

> "When watching a panda eat leaves, stem or new shoots we were always impressed by its dexterity. Forepaws and mouth work together with great precision, with great economy of motion, as the food is grasped, plucked, peeled, stripped, bitten and otherwise prepared for being swallowed. Actions are fluid and rapid" (Schaller et al.).

How is the food grasped, plucked, peeled, stripped, bitten and otherwise prepared for being swallowed with thumbless mittens?

Even Gould:

> "I was amazed by their dexterity and wondered how the scion of a stock adapted for running could use its hands so adroitly."

How could any animal equipped with thumbless mittens use its hands so adroitly for grasping and walking?

And how can that thumbless mitten like thumb be "sufficient for [its] task" "to enable the panda to handle food properly" for 12 to 15 hours a day?

Admirable as the anatomical studies of Davis are – is his comparison of the panda's thumb with a thumbless mitten not just doubtful but simply wrong?

However, despite of this misleading comparison with thumbless mittens, the original quotation of Davis's comment reads so much more differentiated that he himself has almost refuted/falsified this juxtaposition and illustration, for he admits (p. 23):

> "***The skill and precision with which objects are grasped and manipulated by the fore feet is astonishing***. I have observed animals in the Chicago Zoological Park pick up small items **like single straws and handle them with the greatest precision**. ***Small disks of candy less than an inch in diameter were handled deftly and placed in the mouth***. Objects are grasped between the radial pad and the palmar pad and are held in the shallow furrow that separates these two pads."[86]

This is followed by the comparison with a thumbless mitten, but he puts this comparison immediately into perspective again:

> "The actions of the fore paw ***suggest a human hand grasping through a thumbless mitten*** but are less clumsy than this comparison would indicate."[87]

If anything, the astonishingly skilled and precise actions of the fore paw ***do not suggest a human hand grasping through a thumbless mitten***. No human hand would achieve the panda's dexterity/mastery/competence under such circumstances. So, the relativization "less clumsy" is definitely not sufficient, for ***it is not "clumsy" at all!*** Yet, for the unwary reader the notion of clumsiness remains – including, of course, its aim: producing a weighty argument, a proof, for an evolutionary interpretation.

Cyrille Barrette states on p. 104 after pointing out to Gould's "*principe du Panda*" – being a "*principe fondamental de la sélection naturelle*":

> "This thumb of the Panda indeed illustrates wonderfully that natural selection cannot make something new out of something new ("ne peut pas faire du neuf avec du neuf") **as an intelligent engineer**

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[86] As for the panda's dexterity – I would like to emphasize again that I am in ***full agreement with all the positive statements of so many authors when carefully observing and filming the two pandas at Rhenen Zoo in the Netherlands*** (Wednesday 5 June 2024). https://blooloop.com/animals/in-depth/giant-pandas-ouwehands-zoo/

[87] Interestingly, Davis continuous: "Bears and raccoons, of course, can grasp objects with their fore paws. In this action the digits, aligned side by side, are closed over the object, which is thus held between the digital pads and the transverse palmar pad. ***This is a quite different mechanism from the grasp of the giant panda***." In this context I would like to emphasize that not only the anatomy of the pandas is clearly quite different from that of other bears (Ursidae), but also their overall behavior, here this **new mechanism** for grasping – how to derive it from *Ursus*?

or architect would do, but that it ***can only tinker with adaptations from material inherited from previous generations***."

However, the author does not tell us how an intelligent engineer or architect could really have done basically better as well as entirely different to derive a panda from *Ursus*, keeping in mind the double/dual/complementary function of the panda's thumb as part of the forefoot to walk on regularly and 'to manipulate objects with great dexterity', and like a "machine" 'grasp, pluck, peel, strip, bite' bamboo stems all day long, including the bear's complex ethological instincts (organized into a behavior system) and all the essential ecological tasks mentioned above, not to speak of its ***system of tightly linked anatomical parts*** (the functional complex with other fingers, tremendous development of radial sesamoid, modified scapholunar, carpus-forearm articulation largely between the scapholunar and the radius etc. and a network of correspondingly coordinated physiological setups), so considering the entire synorganized wholeness it may, in fact, best be called "the optimal intelligently designed panda system" (or the "***Optimal Panda Principle***"[88]).

If natural selection can never make anything entirely new from some already existing structures, it is not only totally impotent to explain all the starkly different basic animal *baupläne* appearing abruptly in Cambrian strata (the "Cambrian explosion")[89] but also equally absolutely unable to elucidate the hundreds of abruptly appearing new animal and plant forms[90] during earth's history: See, for example, the presently 40 articles[91] by paleontologist Günter Bechly[92] and furthermore the authors mentioned in https://www.weloennig.de/Hummingbirds.pdf, footnote p. 21[93].

Also, natural selection would be (or perhaps better *is*) incapable to explain – to dare a look into future research – the probably thousands of biological instances of irreducible complexity.

Thus, if "this thumb of the Panda indeed illustrates wonderfully that natural selection cannot make something new out of something new" ("*ne peut pas faire du neuf avec du neuf*") then it is neither limitless (Darwin) nor omnipotent (J. C. Avise, C. Exley, and many other evolutionary biologists)[94] and natural selection is definitely unable to explain large parts of the living world.

Another point on Barrette's comment "*as an intelligent engineer or architect would do*": I remember vividly the objection of two PhD students at the Max Planck Institute of Plant Breeding Research (Cologne) who came to my office and asked: Wouldn't be much more economic for an intelligent designer to modify, as far as possible, an already existing structure for some new functions than to create a totally new structure for similar

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[88] Which may imply losses of Genes/DNA (and further) functions as well as **gain of entirely new information on several biological levels**.

[89] See Stephen C. Meyer (2014): Darwin's Doubt: The Explosive Origin of Animal Life and the Case for Intelligent Design https://www.amazon.de/Darwins-Doubt-Explosive-Origin-Intelligent/dp/0062071483 as well as David Klinghoffer (2015): Debating Darwin's Doubt: A Scientific Controversy that Can No Longer Be Denied https://www.amazon.com/-/de/dp/1936599287/ref=sr_1_3?_

[90] Although the authors presuppose a coherent phylogenetic tree for the plant kingdom and are eager to interpret all the botanical facts with this in mind, they admit the following: "Fossil taxa populate many of the branches on the phylogeny within morphospace, ***but some branches remain conspicuously depauperate, including stem-angiosperms, stem-conifers and stem-embryophytes (fossil species are known that might occupy some of these branches, but there are few credible candidates for the embryophyte stem)***." … "Our analysis of disparity through time bears out a pattern of **episodically increasing disparity** for the plant kingdom. The **sharp increases in disparity** that occur in the early Palaeozoic and mid Mesozoic coincide broadly with the transitions between the recognized three or four major evolutionary floras—early tracheophytes, Devonian seedless plants, Mesozoic gymnosperms and early seed plants, and the rise of angiosperms during the Jurassic/Cretaceous—***which have been associated with a succession of evolutionary novelties, viz. vascular tissue, true leaves, the seed and the flower, respectively.***" Clark et al. (2023) https://www.nature.com/articles/s41477-023-01513-x. However, many of the deeper evolutionary problems are not addressed in this article. From an intelligent design view point see please: https://x.com/RJABuggs/status/1699369829424054284?+7C= https://evolutionnews.org/tag/angiosperms/ https://www.weloennig.de/Utricularia2011Buch.pdf, http://www.weloennig.de/AngiospermsLivingFossils.pdf, https://www.weloennig.de/Staatsexamensarbeit.pdf (p. 93 still largely up-to-date), https://www.weloennig.de/Gesetz_Rekurrente_Variation.html https://www.weloennig.de/Loennig-Long-Version-of-Law-of-Recurrent-Variation.pdf

[91] As of 29 May 2024 – more can be expected.

[92] https://evolutionnews.org/author/gbechly (*cf.* the discussion in https://www.weloennig.de/CorCat.html (Darwin zum Thema "neue Organe selten oder nie?)

[93] The articles and books by Douglas Axe, Günter Bechly, Michael J. Behe, David Berlinski, Tom Bethell, William A. Dembski, Michael Denton, Marcos Eberlin, Phillip E. Johnson, Matti Leisola, Wolf Ekkehard Lönnig, Casey Luskin, Stephen C. Meyer, J. P. Moreland et al. (eds.),Walter James ReMine, Paul Nelson, John C. Sanford, Siegfried Scherer, Granville Sewell, David W. Swift, James Tour, Jonathan Wells, and many others. See also https://evolutionnews.org/ on intelligent design.

[94] See references and details at https://www.weloennig.de/OmnipotentImpotentNaturalSelection.pdf

roles/purposes/tasks from scratch? So why are there examples of things done from scratch/anew/ab initio when it would have been so much easier to produce new structures by reformulating/amending/modifying old ones? Example: Glycolysis.[95]

Well, according to these two molecular biologists (in the interim doctors of genetics and longtime genetic engineers) there was no intelligent design because a designer should have been much more thrifty doing his work surely/decidedly/undeniably more parsimoniously.

Hence, for most evolutionary biologist intelligent design is always wrong, either because it derives new structures from former ones or because entirely new ones are made from scratch.

By the way, architects – apart from designing endless things from scratch/de novo/in a different new way – they also use modifications, renovations, refurbishments and expansions of already existing plans and structures ***en masse***. So, for an intelligent engineer or architect both procedures are possible – it depends on so many factors that an essay on this topic of its own could be written on the ***different contexts*** possible for his/her decisions – similarly in biology.

Professor Cyrille Barrette goes on to state:

> "We owe this metaphor to Francois Jacob, a French biologist and recipient of the Nobel Prize. Far from being perfect, such approximate tinkering are traces left by evolutionary history [*Loin d'etre parfaits, de tells bricolages approximatifs sont des traces laissees par l'histoire evolutive*][96]. Their existence constitutes proof of evolution or proof that life has a history. The Panda's second thumb is a wonderful illustration."

Regarding his assertion "*Far from being perfect, such approximate tinkering are traces left by evolutionary history*": Apart from the fact that neither this author nor any other has produced any definite proof of "approximate tinkering" in the panda's thumb, see the links on the question of suboptimality as discussed by Stephen Dilley above.

To reformulate Barrette's the last two sentences just cited, I would say that traces of approximate tinkering, which were evolutionarily postulated but unproven and nonexistent, cannot constitute evolution in the sense of the ruling paradigm that:

> "…**all organisms** have descended from common ancestors [i.e. "all organisms are **related by common ancestry from a single living organism**"] **through unguided, unintelligent, purposeless, material processes such as natural selection acting on random variations or mutations**; the idea that the Darwinian mechanism of natural selection acting on random variation, and other similarly naturalistic mechanisms, **completely suffice** to explain the origin of novel biological forms and the appearance of design in complex organisms."[97]

Instead of providing evidence for the theory of general descent from a single organism, the panda's second thumb appears to be nothing but "a wonderful illustration" of enthusiastic evolutionary philosophy without any real biological basis.

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[95] *Cf.* p. 40 of https://www.weloennig.de/10Paradebeispiele.pdf ("...die ADH von *Drosophila* ist nicht homolog zu der aus Hefe und Säugetieren." "...the ADH of *Drosophila* is not homologous to that of yeast and mammals" and there several more such examples.)

[96] John Marks (2020): François Jacob: Bricolage and the Possible. ("Although Jacob was initially attracted to the metaphor of genetic material as a computer program, he ultimately moved away from the mechanistic model of reproduction and evolution favoured by Monod. In a short paper published in the journal Science in 1977, he used the metaphor of bricolage as a way of conveying that biology evolution is a process of 'tinkering' with pre-existing materials rather than an elegant process of design. This conceptualization of the evolutionary process of building the new from the old has been highly influential in thinking on biology.") https://www.researchgate.net/publication/347315485_Francois_Jacob_Bricolage_and_the_Possible.
More, for instance, here by Valerie Racine (2014): https://embryo.asu.edu/items/172791 (For example: "In section six, "Evolution and Tinkering," Jacob dismisses a comparison between natural selection and engineering for three reasons. First, unlike natural selection, an engineer works according to a pre-conceived plan of the final product. Second, an engineer actively chooses her materials and has access to the best tools designed for accomplishing the task at hand. Natural selection, in contrast, affects the structurally and functionally imperfect parts of the biotic world and reconfigures existing systems into novel ones. Third, if the engineer is successful, the final product achieves a level of perfection. Evolution by natural selection, however, yields imperfect products."

[97] Stephen C. Meyer and Michael Newton Keas (2011): https://www.researchgate.net/publication/238529368_The_Meanings_of_Evolution

Thus, in his book of 2023: *L'Étonnant Panda. Erreur de la nature ou merveille d'adaptation*? (*The Amazing Panda. Error of nature or marvel of adaptation*?) Cyrille Barrette argues – like Gould, Wang et al., probably all of the authors of the blog *The Panda's Thumb* and many others, for a neo-Darwinian explanation of the Panda's marvelously coordinated ingenious adaptations, especially for its 'false thumb' (see above).

In his "definite anatomical monograph on the giant panda" (Stanley)[98], D. Dwight Davis also asserts his readers (1964, p. 102) that the enlarged radial sesamoid is "*unquestionably*" a direct product of natural selection:

> "The enlarged, maneuverable[99] radial sesamoid in the giant panda is the most notable departure from the ursid pattern. This remarkable mechanism is unquestionably ***a direct product of natural selection***. The correlated enlargement of the tibial sesamoid, together with a consideration of the muscles and ligaments functionally associated with the radial sesamoid (p. 183), clearly indicate that ***simple hypertrophy of the bone was all that was required*** to produce the whole mechanism. The genetic mechanism underlying such hypertrophy may be, and indeed probably is, ***quite simple***. A further, but relatively minor, polishing effect of natural selection is evident in the detailed modeling of the bone."

Davis further asserts (p. 102; his italics): "*Only two adaptive features, the relative shortness of the forearm and the remodeling of the radial sesamoid, appear to result directly from natural selection on the bones themselves*."

> "…it appears that the differences between the skeleton of *Ailuropoda* and that of *Ursus* ***could be based on no more than two gene effects***. There is, of course, no way of proving that the situation actually was so simple, but mechanisms capable of producing comparable effects on the skeleton have been demonstrated experimentally in other mammals. ***The alternative explanation numerous small gene effects screened by natural selection postulates a vastly more complex process***, and leaves unexplained the many clearly inadaptive features in the skeleton. We could, of course, assume that these several inadaptive features appeared one by one during the evolution of *Ailuropoda*, and persisted simply because there was little or no selection against them. But if each of these is unconnected with any of the other gene effects, then any selection pressure would have eliminated them. Obviously, there is some selection against any inadaptive feature; no feature is truly adaptively neutral. Therefore, it seems to me that probability strongly favors ***a single gene effect*** **as the causal agent for all the hereditary differences between the skeleton of *Ailuropoda* and *Ursus*, except in the radial sesamoid**."

And eventually/finally (p. 327) Davis emphasized somewhat more cautiously that "very few genetic mechanisms perhaps ***no more than half a dozen*** were involved in the primary adaptive shift from *Ursus* to *Ailuropoda*."

I have to admit that I was somewhat surprised: D. Dwight Davis, the ardent admirer of Darwin, who even named his son "*Charles Darwin Davis*", rejected the proposition of "the alternative explanation of numerous small gene effects screened by natural selection" for "it postulates a vastly more complex process". But once, he had even proposed "a single gene effect as the causal agent for all the hereditary differences between the skeleton of *Ailuropoda* and *Ursus*, except in the radial sesamoid."

Recall please again that Darwin had imagined the origin of species (and, in fact, of all life forms) by selection of "infinitesimally small changes", "infinitesimally slight variations" and "slow degrees" and hence imagined "steps not greater than those separating fine varieties", "insensibly fine steps" and "insensibly fine gradations", "for natural selection can act only by taking advantage of slight successive variations; **she can never take a leap**, but must advance by the shortest and slowest steps" or "the transition [between species] could, according to my theory, be effected only by numberless small gradations. … **natura non facit saltum**."

[98] See Stanley above as well as Barrette (2023): "Cette monographie … demeure **LA référence** sur tout les aspects de l'anatomie du panda."
[99] *Cf.* however, the functional unit as described above.

In contrast to "extremely slight variations", even "no more than half a dozen" would imply an immense/enormous/gigantic leap from *Ursus* to *Ailuropoda*, not to speak about a "*single gene effect* as the causal agent", "*except in the radial sesamoid*"*– a tremendous leap (ingenti saltu)*!

Nevertheless, I would like to give Davis credit for showing that, despite all his enthusiasm and adoration for Darwin, he did not become dogmatic and was open to other genetic approaches – although always in combination with the *deus ex machina*, to wit natural selection.

So, what do we really now know 60 years later?

The studies of Yisi Hu, Yibo Hu, Wenliang Zhou and Fuwen Wei Hu have considered several genetic aspects in their paper (2024) about *Conservation Genomics and Metagenomics of Giant and Red Pandas in the Wild*.[100]

For some basic general considerations see please the footnote[101] and for the details the original paper.

So, what do we know in the interim about panda genetics?

Ruiqiang Li et al. in their *Nature* paper of 2010: *The sequence and de novo assembly of the giant panda genome* (altogether 122 authors if a counted correctly)[102] state:

> P. 311: "The assessment of panda genes potentially underlying some of its unique traits indicated that its bamboo diet might be more dependent on its gut microbiome than its own genetic composition. We also identified more than ***2.7 million heterozygous single nucleotide polymorphisms in the diploid genome***."
>
> P. 313: There are 27 known panda mRNA genes in GenBank, one of which is the SRY sex determination gene located on chromosome Y, thus not present in the female panda. We were able to detect the remaining 26 genes in the assembled scaffolds with 99.3% total sequence aligned (Supplementary Table 4).

Taylor et al. report in 2018 in Genes: *The Genome of the North American Brown Bear or Grizzly: Ursus arctos ssp. horribilis* (18 authors):

> "The final assembly was **2.33 Gb** with a scaffold N50 of 36.7 Mb, ***and the genome is of comparable size to that of its close relative the polar bear*** (**2.30 Gb**). An analysis using 4104 highly conserved mammalian genes indicated that 96.1% were found to be complete within the assembly. An automated annotation of the genome identified **19,848 protein coding genes**.[103]

But Armstrong et al. 2022[104]: **2.47 GB**; de Jong et al. 2023[105], Tumendemberel et al. 2023.[106]

[100] Annual Review of Animal Biosciences 2024: 12:69–89: https://www.annualreviews.org/content/journals/10.1146/annurev-animal-021022-054730 (By the way I am fond of the author's following comment: "When reading the word panda, the first image that comes to people's minds might be the cuddly, adorable, and lazy black-and-white animals munching on bamboos—the star animal, the giant panda. In reality, however, the word panda was first applied to the red panda…")

[101] "Because giant pandas are elusive animals that are difficult to follow in the bamboo forest, accurate individual identification and population surveys have posed a challenge. This situation changed when we successfully established a molecular scatology method for giant pandas, involving ***extracting DNA from feces, and conducted genotyping using microsatellite techniques***, which doubled the previous population size estimate in the study areas using conventional methods based on fecal characteristics such as bamboo bite length. … We then collected fecal and tissue samples from wild pandas across the six mountain ranges they inhabit and quantified their genetic diversity on a large scale. ***Based on mitochondrial and nuclear markers, we found giant pandas still have a medium to high level of genetic diversity compared to other wild animals***, indicating high evolutionary potential to adapt to environmental changes. **Whole-genome SNP data also confirmed this conclusion**."

[102] https://www.nature.com/articles/nature08696

[103] https://www.mdpi.com/2073-4425/9/12/598 ("The grizzly bear genome has a **diploid karyotype of 37 chromosome pairs** [12,13], and there is a mean distance of 688 bp between heterozygous positions in this assembly. Based on the N50 of our assembly and the **estimated genome size of 2.3 Gb**, the longest scaffolds in the grizzly bear assembly most likely represent full chromosome arms, and the observed heterozygous positions can act as a starting point for further population diversity studies. The polar bear is the closest relative to the grizzly bear for which the genome has been sequenced [14]. Based on BUSCO analysis of both assemblies, using the 4301 gene mammalian dataset, the grizzly bear genome is more complete. The grizzly bear genome is also more contiguous than the polar bear genome as detailed in Table 2.)" Pandas: "The research, published in Nature, shows that **pandas have about 21,000 genes packed into 21 pairs of chromosomes**, including one pair of sex chromosomes.11.12.2009" https://www.nature.com/articles/news.2009.1141#

[104] A Beary Good Genome: Haplotype-Resolved, Chromosome-Level Assembly of the Brown Bear (Ursus arctos):" **The final genome size is 2.47 Gigabases (Gb)**" https://academic.oup.com/gbe/article/14/9/evac125/6656105?login=false

[105] Range-wide whole-genome resequencing of the brown bear reveals drivers of intraspecies divergence: https://www.nature.com/articles/s42003-023-04514-w But: "What's the Difference Between Grizzly Bears and Brown Bears? The difference is regional: bears found inland are referred to as grizzlies, while those on the coasts are known as brown bears. Grizzlies are actually a subspecies of brown bear, Ursus arctos horribilis, found in dense forests, alpine meadows and mountain valleys." See the excellent/admirable/outstanding photographs by Emily Goodheart in https://www.nathab.com/blog/alaska-story-grizzly-bears-and-brown-bears/#

[106] https://onlinelibrary.wiley.com/doi/full/10.1111/mec.17091

Incidentally, Grizzly/brown bear: **37** chromosome pairs. Panda: **21** chromosome pairs (details in footnote previous page).

Cronin et al. (2014) in their paper on *Molecular Phylogeny and SNP Variation of Polar Bears (Ursus maritimus), Brown Bears (U. arctos), and Black Bears (U. americanus) Derived from Genome Sequences* detected for:

Panda *vs.* bears 0.01385737 average substitutions/site.

> Also, they report: "We identified **13.8 million** single nucleotide polymorphisms (**SNP**) in the 3 species [(*Ursus maritimus*), brown bears (*U. arctos*), and black bears (*U. americanus*)] aligned to the polar bear genome." [107]

In my book about the domestic dogs and their origin I have discussed the phenomena of Single Nucleotide Polymorphisms (SNPs) and Copy Number Variants (CNVs) in detail with respect to natural selection[108].

Results – also largely applicable to our pandas:

> This [the enormous numbers of SNPs and CNVs] clearly refutes the synthetic theory of evolution (= neo-Darwinism), which claimed that all changes at the molecular genetic level were controlled and directed by selection, on two important points: (1) **The number of SNPs in the millions in humans alone exceeds anything that could even be imagined in terms of variation in pre-molecular times and even up until a few years ago** – a diversity that no amount of strict natural selection could even come close to controlling [in contradiction to Darwin and the neo-Darwinians "…natural selection is daily and hourly scrutinizing, throughout the world, every variation, even the slightest; rejecting that which is bad" etc. – see quotes above], (2) we now also find a completely unexpected variation for CNVs (copy number variants) at around 30 000 in humans according to the current state of research.
>
> "*Scitable by Nature Education* (2010) reads: "Neutral theory claims that ***the overwhelming majority of evolutionary changes at the molecular level are not caused by selection acting on advantageous mutants, but by random fixation of selectively neutral or very nearly neutral mutants***[109] through the cumulative effect of sampling drift (due to finite population number) under continued input of new mutations." Matoo Kimura (1991): The neutral theory of molecular evolution: a review of recent evidence. Jpn J Genet 66, 367-386.
>
> Ohta emphasized (1980, p. 120) that this approach is ***totally against the neo- Darwinian view of evolution***. "In 1968, Kimura (1968) proposed a neutral theory of molecular evolution which states that the majority of amino acid substitutions in evolution must be neutral with respect to natural selection and due to random genetic drift at reproduction. In the next year, King and Jukes (1969) advocated the theory from the more biochemical standpoint in the name of "non-Darwinian evolution". Since this hypothesis ***is totally against the neo-Darwinian view of evolution, it met strong criticisms and objections in the subsequent years*** (see Kimura 1979 for review). Although the original theory needed a few modifications (Ohta 1974), it has survived and much data have suggested its correctness."
>
> Similarly Kimura 1980, p. 1: "I believe that the traditional paradigm of neo-Darwinism needs drastic revision..." And in 1983, Kimura explained his view as follows: (p. 306:) "Unlike the traditional synthetic theory (or the neo-Darwinian view) the neutral theory claims that ***the great majority of evolutionary mutant substitutions are not caused by positive Darwinian selection*** but by random fixation of selectively neutral or nearly neutral mutants."

See more, especially on slightly deleterious DNA variations, in the book on dogs (2014), the pages as cited above in the respective footnote. *Cf.* perhaps also pp. 18 and 19 in https://www.weloennig.de/Hummingbirds.pdf (2024).

Barrette mentions natural selection some 17 times in his book (2023) – always in agreement with Darwin and the neo-Darwinian theory of evolution – just like most of the biologists quoted on the pandas above. However, on almost all biological levels (from incipient structures to the 99.999% and more of the DNA variations) one can reasonably doubt whether these interpretations in the context and support of natural selection are the last word on the origin of our pandas.

[107] https://academic.oup.com/jhered/article/105/3/312/768816?login=false
[108] https://www.weloennig.de/Hunderassen.Bilder.Word97.pdf pp. 150-168/179/183-184. Slightly changed.
[109] Mostly ***slightly deleterious alleles***.

The original French texts of Cyrille Barrette (2023), cited and discussed on over 15 pages above and which have been translated into English there, read as follows (page numbers according to Kindle version – retrieved 12 June 2024):

(P. 99) "C'est la sélection naturelle qui lui a bricolé ce faux pouce à partir d'un petit os insignificant de ses ancêtres, que les autres ours actuels possèdent également: le sésamoïde radial. Celui du Panda est devenu plus long et mobile grâce au développement des muscles associés (figure 18). Cet os mesure 35 millimètres de longueur. Ceux des autres ours ne dépassent pas 10 millimetres (figure 19)."

(P. 99) "Dans une remarquable étude récement publicée, l'équipe du paléontologue Xiaoming Wang du Musee d'histoire naturelle du comté de Los Angeles a montré que la longueur du sésamoïde radial, donc celle du faux pouce, est limitée en premier lieu par sa localization sous la main. Pour saisir la nourriture, le pouce doit émerger du rebord de la paume; or dans cette position, s'il était plus long, il nuirait à la démarche plantigrade de l'animal, comme un caillou dans notre chaussure nous cause un grand inconfort."

(P. 99) "Pour minimizer cet inconvénient présumé, le Panda a peut-etre tendance à marcher légèrement sur le côté externe de main. Á moins que la bosse occasionnée par le pisiforme (figures 18 et 20) ne serve a redresser la paume de la main autrement déséquilibrée par la presence du faux pouce. Ces deux suppositions restent à vérifier."

(P. 99) "En deuxième lieu, la longueur du sésamoïde et du pouce résulte d'un compromis entre deux éléments de sa capacité de préhension. Si le faux pouce était plus court, l'amplitude de son ouverture serait réduite et limiterait la taille des tiges de bamboo manipulées, en rendant l'alimentation moins efficace."

(P. 99/100) "Si a l'inverse, il était plus long, c'est la force de préhension de son extrémité qui serait indument limité. La longueur de faux pouce est par conséquent un compromis entre deux besoins contradictoires: ceux de favoriser à la fois son degré d'ouverture et sa force de préhension. Sa longueur n'est donc ni minimale ni maximale, mais optimale, comme la plupart des produits de la sélection naturelle."

(P. 99) "Selon le chercheur Dwight Davis, agir avec ce pouce serait comme saisir un objet avec une mitaine sans pouce, une manipulation empotée. Malgré tout, il suffit à la tâche, puisqu'il permet au Panda de manipuler habiliment la nourriture."

(P. 104) "Ce pouce du Panda illustre en effet à merveille que la sélection naturelle ne peut pas faire du neuf avec du neuf comme le ferait un ingénieur ou un architecte intelligent, mais qu'elle ne peut que bricoler des adaptions à partir du matériel hérité des générations précédentes."

(P. 104) "On doit cette metáphore de bricolage à François Jacob, un biologiste français, récipiendaire du prix Nobel. Loin d'être parfaits, de tels bricolages approximatifs sont des traces laissèes par l'histoire évolutive. Leur existence constitue des preuves de l'évolution ou des preuves que la vie a une histoire. Le deuxième pouce du Panda en nest une illustration formidable."

TO BE CONTINUED [in PART 2]

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