The overthrusting paradox: a challenge to uniformitarian geology and evolution

John D. Matthews

Overthrusting is regarded as a paradox by the geological community. The concept of overthrusting has been defined by secular motives rather than physics. However, the paradox disappears if geologists recognize that they have treated the geological column as immutable rather than empirical and therefore open to questioning. Since the geological column is a key pillar supporting evolution, Christians ought to actively re-engage in discussion about the column's validity.

Many geologists believe that overthrusting[1] has occurred in places where large blocks of 'older' rock overlie 'younger' rock. This unusual positioning of the older rock is therefore interpreted, not by a sedimentary event, but through massive physical movements, all of which are then judged to be paradoxical.[2] To unravel the paradox we need to:

1. examine the rationale for identifying overthrusting,
2. recheck the physics behind the proposed movement, and
3. show that a reasonable explanation for the origin of the overthrust rock and its pathway to its new location (palaeo-reconstruction) can be provided.

Little effort has gone into item 1. Most of the effort by uniformitarian geologists to resolve the paradox has focused on item 2, the physics. Many of the examples considered by uniformitarians merely reaffirm the paradox that the physical aspect of the overthrusting movement is impossible. In other cases, elaborate and often imaginative geochemical physical models, which will be shown to contain fundamental flaws, have been offered as explanations. Therefore, these do not make the overthrust paradox disappear. Item 3 has rarely been tackled. Our study shows that there is no effective way to achieve palaeo-reconstruction. Thus dilemmas with items 2 and 3 point to item 1 as the key to resolving the paradox. Identification of the 'overthrust' as a movement depends critically on the robustness of the geological column. Thus there are two key reasons to reject the column—the deep questions about the assumptions and motives behind its construction and the problem of overthrusting. We end with a call for Christians to engage more actively on discussions about the column because of its direct links to evolution.

The rationale for identifying overthrusting

There are many places in the world where large blocks of 'older' rock overlie 'younger' strata. The belief that older rocks overlie younger rocks is based on the observed inconsistency with the expected stratigraphic order of either rock facies or their fossils from the geological column,[3] metamorphic rock overlying 'country rock', or radiometric dates. This implies that the older rock was emplaced over the younger by a sliding movement.

There may be an interface layer between the lower younger layer and the upper older one which has rheological properties that could have aided overthrusting. However, it is circular reasoning to use this as proof of overthrusting. Such layers can exist within vertical sequences of rocks deemed to be undisturbed because they replicate the geological column.

Instances where a thrust is identified by metamorphic rock overlying country rocks are limited. And while creationists have suggested that radiometric dating can at least provide relative dating,[4] there are serious doubts.[5] There are instances where overthrusting has been identified by seismic sections and well-bore core analysis. In this short paper, the focus has to be on visible overthrusts. Mechanisms and explanations are not likely to be different elsewhere.

The geological column

The history of the development of the geological column is complex,[6] but for convenience we identify three key stages. Giovanne Arduino, in 1759, proposed three divisions of Earth's rocks based primarily on rock type.[7] Later, the focus moved to identification by fossils with the geological mapping in the UK by William Smith.[8] In coal mining and canal construction (1795 onwards) he found what appeared to be similar vertical sequences of fossils across wide areas. Geologists in continental Europe were noting the same thing, so Arduino's classification of Primary–Secondary–Tertiary strata developed into a more sophisticated column. The column is now tightly defined with respect to fossils and radiometric dating by international committees of uniformitarians.[9] While some realise that it is shaky in places, there is a distinct unwillingness to undertake fundamental reviews.[10]

While localized correlations, as Smith noticed, may accurately demonstrate portions of the geological column, the worldwide correlation is purely hypothetical.[11] Our historical study of overthrusting shows that the column (and its template, which correlates the strata with the time of original deposition) is intimately bound up with the effects and attitudes, even on scientists, of the 18th-century 'Enlightenment'. Dominated by French philosophers, but with support from countries like Germany and Scotland, their aims may be summarized by Charles Lyell's words: "A class of writers … had been laboring industriously for many years, to diminish the influence of the clergy, by sapping the foundations of the Christian faith."[12] In private letters published after his death, we learn that he wanted to subvert the idea that the Mosaic texts had anything useful to say about geology.[13] Much the same attitude to the biblical Flood is shown by Arthur Holmes a century later—that the belief in the Noachian "Deluge … obstruct[ed] the progress of geology".[14] But his suggestion that Biblicalism obstructs geology is wrong.[15] Secular motives are not a good starting point for finding truth.

The paradox

Attempts to explain the mechanics of 'thrusting' are legion.[16–19] However, many overthrusts remain paradoxical because "for a thrust sheet to overcome the shear resistance when moving along its base, higher stresses are required than the sheet can withstand".[20] A solution is no nearer today than in 1991, when Price and Cosgrove wrote that studies are "openly or tacitly critical and contradictory".[17] Tentative explanations have been offered for cases where the 'overthrust' block (apparently) slid downhill under gravitational forces, but these are a minor fraction of cases.[21]

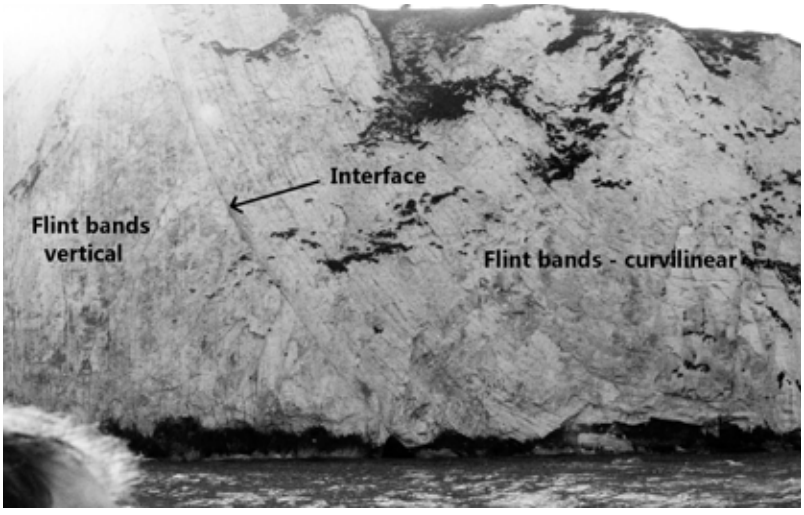

Figure 1. Ballard Down Cliffs, showing the supposed 'overthrust' (Author's photo, May 2002)

Horizontal and uphill overthrusting becomes more difficult to explain, since tractive effort is needed. Gravitational spreading, 'caterpillaring', and base contraction have been suggested, but there are doubts about these, and they only apply to a very limited class of overthrusts.[18]

A specific overthrust, physics, and motives

As geological mapping moved from the eighteenth century to the nineteenth, contradictions appeared with the 'Enlightenment' desire to demonstrate a consistent worldwide 'geological column'. Thomas Webster, said to have been a competent geologist,[22] spotted an unconformity at Ballard Down, Dorset, UK, in the chalk in 1812.

The curvilinear form of the rock 'layering' dies out to the north (figure 1, right side), and there is no change in fossil assemblages across the interface. The logic for identifying it as an unconformity is illustrated in the schematic (figure 2). The flint bands have been used to define a series of depositional layers since they follow the trends of other lithostrata outside the photographed area.

The interpretation is that 'Cretaceous' chalk was deposited in the south as a series of layers (1 to 8 (figure 2), and possibly others obscured beneath sea level) roughly horizontally over local 'Jurassic' strata. Subsequent progressive folding to the North while chalk sedimentation was still taking place resulted in new chalk layers (i to v (figure 2) eroding the hatched area and being distorted into that curvilinear shape while still in an unconsolidated state. It is therefore an unconformity because chalk layer i, which is younger than layers 1 to 8, progressively oversteps those older layers 8 back to 1.

This assessment of Ballard Down occurred at the time 'The Enlightenment' was making serious inroads into people's attitudes to biblical history[6] and the feature was as much a battleground as it was an outcrop.[6] To avoid retreating from this new 'enlightened' worldview with its emerging geological column, Ballard Down was proclaimed a thrust in 1822.[22] If it had not been, unformitarians would have had to admit that there was an unconformity in 'Cretaceous' deposits caused by a 'Tertiary' timed event which tilted layers 1 to 8 to the vertical.

Almost ten different rock mechanics and structural geological studies have appeared since 1822 trying to explain the feature as an 'overthrust'. The latest was a discussion between those supporting a southern overthrust[23,24] and others supporting a northern underthrust.[25] There

was no reconciliation. Furthermore, the thrust interpretation implies a lateral movement of at least 100 m, implying a visible brecciation zone at least a metre thick.[26] Like other physical issues, its absence (see figure 1) seems to matter less than the preservation of the paradox. To uniformitarians, Ballard Down is a puzzle, whereas creationists have no reason to reject Webster's original interpretation of it being an unconformity.

Creationists challenge overthrusting

By 1926, George McCready Price[27] had documented his view that overthrusting remained a paradox because of uniformitarian assumptions in their identification—our item 1. Davis Young, though a Christian and a geology professor, criticized Price and his argument.[28] He noted that Price was a self-taught geologist who wrote and communicated with sufficient sophistication to deceive many untrained in uniformitarian geology with his view that "the whole idea of overthrusting was devised by geologists simply to salvage the dogma of fossil succession", and thus link it intimately with evolution.

But Young's critique falls short. Morris noted that Price was well trained in science and engineering.[29] Furthermore, Young's description of Price as an amateur geologist and good communicator could equally describe Sir Charles Lyell, who had launched the questionable uniformitarianism as part of his personal contribution to 'The Enlightenment', ridding science of its original Mosaic/biblical anchor.[13] Price objected to evolution and uniformitarian geology for many reasons, not just overthrusting. Young, an igneous petrologist, is not a stratigrapher either, and his attack on Price is essentially *ad hominem*.

In 1931, Byron Nelson addressed the overthrusting paradox,[30] as did John Whitcomb and Henry Morris (1961) in *The Genesis Flood*,[31] using the examples of the Heart Mountain and Lewis overthrusts. Photographs of the planes along which the rocks supposedly moved showed no significant breccia, which should be present.[26] But they also noted two significant problems:

1. Failure to provide a plausible palaeo-reconstruction. This is a significant problem for uniformitarian geology in the oil industry.[15] Chemical signatures are often used to suggest how different masses of rocks had a common origin,[32] but typically ignore palaeo-reconstruction. Potentially this is due to the failure to consider that sediments were sourced directly from the fountains of the great deep in an episodic manner (as Genesis 7:11 implies) rather than to only consider them as erosional products from topographic highs as part of a Davisian cycle;
2. No mechanical solution for such movements has been demonstrated.

Uniformitarian geologists have attempted to explain large movements, like that of Heart Mountain, which Young[28] used, to oppose the Flood paradigm. But even assuming that the Heart Mountain block slid downhill (discussed and rebutted below), there are other serious problems. Even those geologists not willing to use the word 'paradox' still recognize its problematic nature.[17,33]

Many more overthrusts have been described by both creationist authors[34] and uniformitarian Murrell,[18] the latter of whom mentions the well-known Glarus and Lewis thrusts. He notes the significant distances moved and the dimensions of the blocks. Movements have exceeded 80 km, and block sizes have exceed 170 km. So if 'older' rock came to rest on 'younger' rock, explaining how is not trivial.

The reluctance to challenge the geological column

We can understand the motives of uniformitarians not to challenge the geological column—the theory of evolution is at stake. But what is the problem for Christians? Some creationists accept the column as an observational fact (e.g. Garner,[35] Snelling,[36] and Tyler[37]). They accept the same fossil order as evolutionists do, but they do not believe the fossil order substantiates evolution. An appeal is typically made to a concept called the 'Law of Faunal Succession'

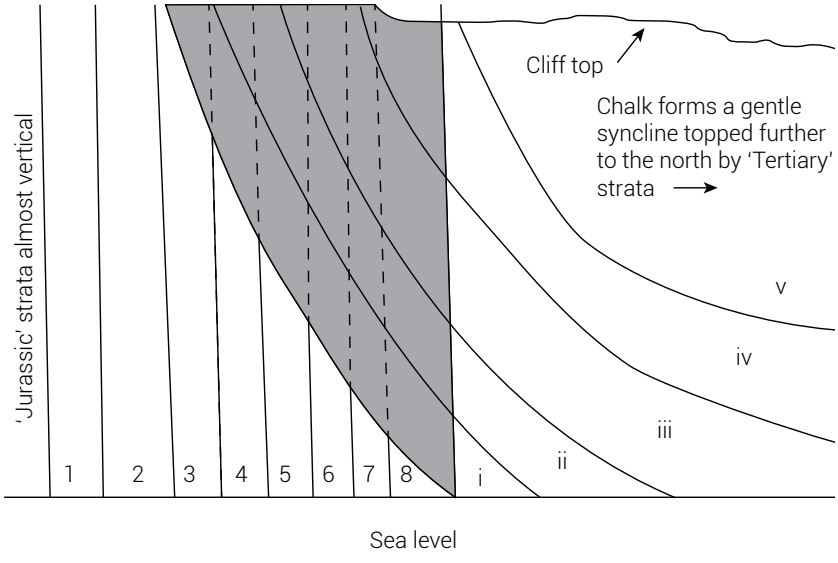

Figure 2. The layering of the chalk deposits across the unconformity

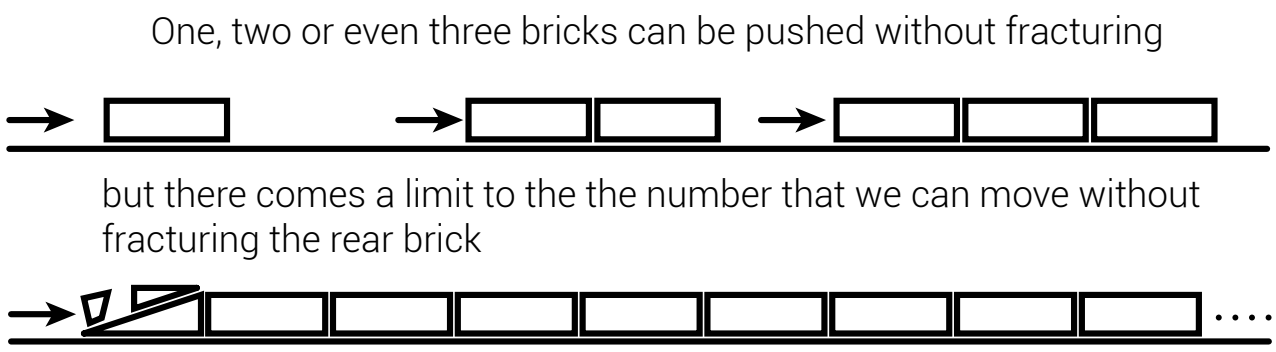

Figure 3. An Illustration of the problems of overthrusting using household bricks

to explain localized correlations. But against observational challenges to the geological column, such as in this paper and elsewhere, such creationists will always struggle to explain the law in its local and the more problematical continent-wide correlation. We have no independent record of the number or the locations of the Fountains of the Great Deep, which caused the burial environments for the pre-Flood ecological distribution of living creatures that ended up as fossils. Only those would provide a starting point to justify further discussion on the subject, so the 'law' remains merely an *en passant* idea.

Aside from numerous creationists who accept the column, there are many influential Christians who insist that evolution is true because of the geological column. These include Dr Denis Alexander, a biologist and past editor of Science and Christian Belief. He is a prolific author[38,39] and believes that evolution is demonstrated by the rocks. He claims that any examples of out-of-order fossils would appear in 'mainstream' journals,[39] but ignores the explicit embargo on such material, like that of the 2008 statement by The Geological Society, London[40] or the Royal Society that insists the earth is very old, evolution took place, and is supported by the fossil record. They affirm Gould's NOMA solution, separating religion and science,[41] in contradistinction to St Paul's claim (Romans 1:20) that they cannot be put into separate compartments. But debate on the subject is not the Society's forte.[42] One of Alexander's books, with co-author Professor Bob White,[43] is cited by the Society in support of this deliberate separation.

Other Christians taking the same position include Professor R.J. (Sam) Berry,[44] who insists that "fossils demonstrate that the earth goes through major changes and long ages". He and others do not engage with published critiques of his arguments which have long been discussed in Journal of Creation.[45] Professor Simon Conway Morris (evolutionary palaeobiologist) stated that "the fact of organic evolution itself is not in dispute. … the fossil record … seems to be unanswerably correct".[46] There are many others.[47–51]

The physics offered to explain thrusting

If there is reluctance to re-examine the geological column, we need to look more closely at the physics of the movements—our item 2. Readers are referred to classic papers for the detailed mathematics.[17–19]

Mechanical problems with large thrust blocks can be illustrated by using common bricks. If we place one brick on a flat surface, we can move it with ease (figure 3). If we place a second brick in front of the first, the force needed to move both doubles. Adding more bricks increases the necessary force proportionately. When the line of bricks is 10 km long (and depending on the quality of bricks, coefficient of friction, etc.), the rearmost bricks will begin to undergo micro-fracturing. With more bricks added up front, the rear bricks will eventually fail, with fractures at about 40° to the horizon.

Figure 4 explains this phenomenon. The upper curve (the Coulomb failure curve) represents the strength (bearable shear) of the brick and increases with the vertical (lateral) compression applied. The internal forces in the brick are represented by the hemispheres (Mohr's curves). When only a few bricks are being pushed, the hemisphere is small (curve A). With more bricks, it grows in size (curves B and C). With even more bricks, the hemisphere intersects the failure curve, and the back brick fractures.

Substituting a large block of rock for the bricks, we find that only a relatively short length of rock (compared to observed overthrust dimensions quoted above) can be moved without internal failure. This was known over 100 years ago by uniformitarian geologists.[2] The tractive force needed to overcome friction was judged to be the main restraining factor, and little attention was paid to cohesion. If we cement a single brick to the surface, the force needed to move the brick increases enormously. Under enough force, the brick and cement fracture in an erratic fashion. But strata do not usually merely rest on each other. Rocks are bound by

cements. Overcoming both friction and cohesion requires a smooth, clean sliding surface to avoid erratic fracturing.

We can use the equations developed by Jaeger *et al.*[33] to calculate the maximum lengths of overthrusts. Using common parameters, strength (C_o) = 200 MPa, internal sliding friction (p) = 0.1, cohesion (S) = 50 MPa, friction (μ) = 0.6, and density 2,800 kg/m^3, those lengths are shown in table 1. If cohesion is not a factor, it is possible to explain how overthrust-rocks may have been pushed moderate distances, but these are fractions of 'reality'. When cohesion is factored in, the distances are insignificant.

Many ideas have been floated to explain the 'observed' greater movement by thrust blocks. These focus on decreasing the frictional coefficient at the sliding surface, typically using lubrication by water. But none applies on a wide scale in the field.

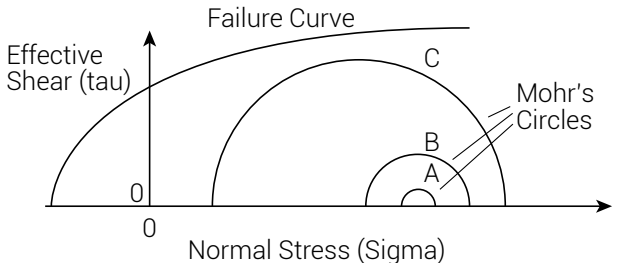

Figure 4. The Coulomb-Mohr representation of a rock under stress and shear

Table 1. Lengths of blocks that could be moved without fracturing

Height (m)	Household bricks (0.06m)	1	10	100	1,000
Without cohesion					
Length horizontal	12.1 km	12.1 km	12.1km	12.2 km	12.2 km
Length (15 degrees uphill)	8.4 km	8.4 km	8.4 km	8.4 km	8.4 km
With cohesion					
Length horizontal	0.24 m	4 m	40 m	385 m	3.0 km
Length (15 degrees uphill)		4 m	40 m	380 m	2.7 km

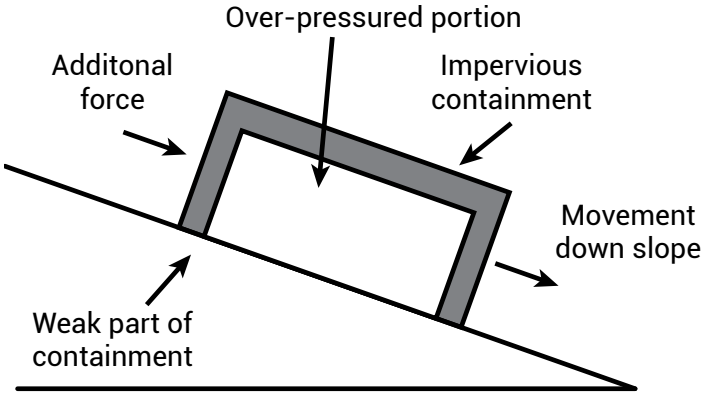

Figure 5. Murrell's illustration for overthrusting of an overpressured block

Alleviation by overpressure?

Overpressured strata, found when drilling for hydrocarbons, are an observational fact. Instead of following a normal pressure gradient with depth (~10 MPa/km or ~0.44 psi/ft), overpressured rocks exhibit sharp increases in pressure.[52] The maximum is 2.3 times that of normal, which is equivalent to supporting the lithostatic load back to surface. Hubbert and Rubey[19] suggested that such an overpressured porous rock could effectively 'float' above the substrate, enabling large-scale thrusting. There are ten major problems which they did not address, and after another 65 years, uniformitarian comments on these are still absent.

First, although observed overpressure values in the field range as high as 92% of the maximum, they are more typically around 60%,[53] so even granting an overpressured block, significant force is still needed.

Second, overpressure situations affect the rock mechanics. The strain hemisphere (cf. circle C in figure 4) moves to the left and increases in radius, bringing it closer to the failure curve.[33]

Third, geologists cannot explain how an overpressured condition at the sliding surface could be maintained once the block detaches from the location where it was deposited. Uniformitarian Murrell[18] recognizes the problem and wraps the block that is supposed to be moving with impervious rock (his figure 1). This is shown in figure 5 in simplified form. How did such a convenient wrapping arise? It is certainly not a characteristic of overpressured regions in the North Sea. The largest regions are small compared with what we have to explain.[52] It is another ignored aspect of palaeo-reconstruction.

Fourth, the amount of impervious rock needed has not been assessed, nor its effects. That requires an assessment of the strength of the cuboid container, with the weakest part being at the edges. Finite element methods could be used, but as an alternative we can simplify the mathematical challenge by changing the geometry.

Suppose we consider the sliding of an upright cylinder of overpressured rock surrounded by an annulus of strong impervious rock. We now have a one-dimensional tractable problem. Other

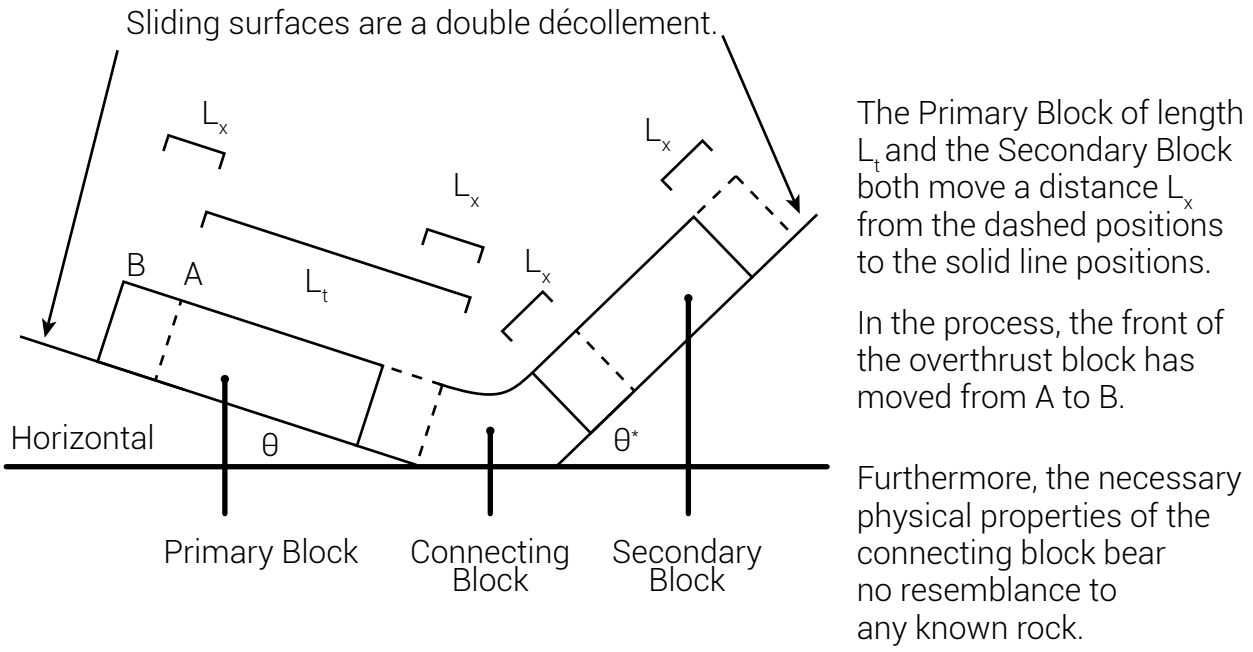

Figure 6. Palaeo-reconstruction of overthrusting

equations in Jaeger *et al.*[33] allow us to compute the amount of impervious rock needed to meet the hoop stresses from the overpressure (and a cylindrical shape minimizes the amount of extra rock). The result is a 16-fold increase in mass using the listed rock properties. This extra mass does not 'float' on the substrate. It is 'dead-weight' and moving it without fracturing is impossible. Murrell's[17] more realistic admission shown in figure 5 must require an even greater ratio of impervious rock than in our minimal example.

Fifth, even if the duplex block ever existed, how did the wrapper disappear without a trace being left?

Sixth, toe and heel effects have been ignored.[2] Figure 1 shows the 'toe-problem' at Ballard Down—the bending of the strata. This typically quadruples the force needed for movement, and decreases the amount of motion.[2] In the case of Ballard Down, plastic deformation of strata would have been possible if the chalk were not lithified, but if 30 million years had passed before the movement took place, it would by then have been lithified, and deformation would be a problem.

Seventh, reservoirs that are overpressured are generally weaker because they were buried rapidly and were not able to expel sufficient pore fluids to dewater completely. If it is hard to push a solid block of rock, how is it possible to push one that can plastically deform internally rather than slide across a décollement?

Eighth, non-porous rocks have been overthrusted.

Ninth, studies have shown that overpressured conditions could not persist in crustal materials for more than 10,000 years.[54]

Tenth, how did the overpressures arise? Mainstream literature suggests that they arise from hydrocarbon generation.[52] But there is evidence that hydrocarbons cannot be formed under such suggested conditions and must have existed before the sedimentary events.[15] A uniformitarian fall-back suggestion is that of rapid sedimentation and loading, but such geologists won't acknowledge that as evidence for The Flood.

Palaeo-reconstruction—our item 3)

Thrusts require a base, a block to be moved—the *primary block*—and often another block to push the primary block—the *secondary block*. To move the primary block horizontally or uphill requires a push from the secondary block moving under the force of gravity and in contact with the primary block. To maintain contact between the two blocks during thrusting, a third block connecting them is required, length of which must be at least that of the translation of the primary block (figure 6). If the initial movement of the secondary block is downhill, then its ability to push is lost once it reaches a horizontal plane or uphill slope, and it will add to the frictional resistance of any movement.

Figure 6 shows that a primary block of length L_x sits on the substrate with an assumed angle θ. During overthrusting

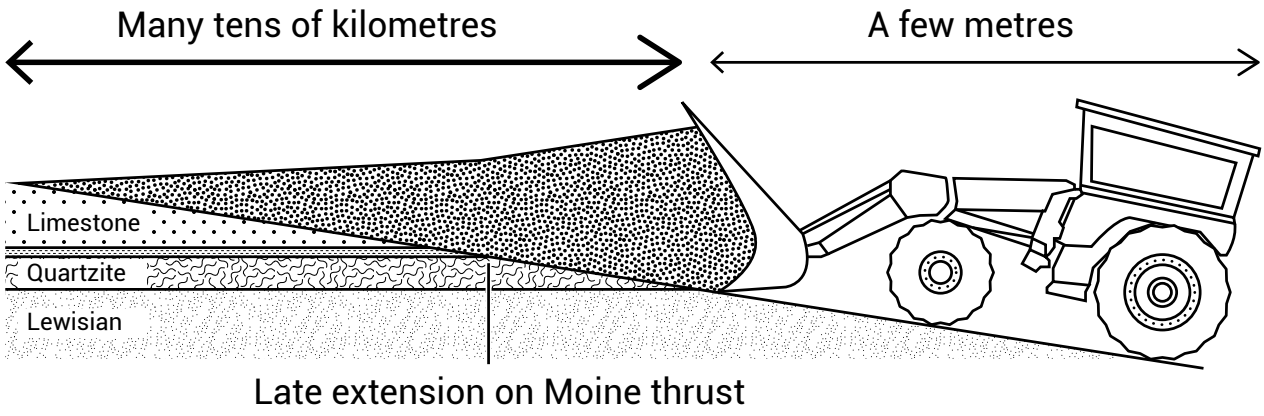

Figure 7. Trewin's explanation for the Moine overthrust

it moves a distance L_t so that the leading face moves from position A to position B. The secondary block, aligned in a downward direction (angle θ*), also must move a similar distance.

As the primary block moves, the space vacated by its rear edge must be replaced by other rock, otherwise the force of the secondary block can no longer be transferred, and sliding will stop. Also, the compressive strength of all blocks must be greater than their failure force. The effective distance of thrusting is controlled by these factors. Any palaeo-reconstruction of thrusting must account for all of these factors. They limit both the size of the blocks and the distances that can be moved compared with the results in table 1; both are fractions of field interpretations.

There are two other problems in performing a viable palaeo-reconstruction. The required height of the secondary block is greater than observed field data. Based on angles (θ*) of 30°–60° and linear lengths of 200 km, the secondary block would require a height between 100 and 200 km. Mount Everest is only 8.8 km high! Some uniformitarians recognize this problem.[17] In addition, any connecting block would have to behave in a plastic manner to accommodate the slope change, yet such consistency would prevent it from translating force. Furthermore, no such rock has been observed near thrusts.

Other 'overthrust' examples

Glarus, Switzerland

The out-of-order strata at Glarus was probably the first major documented 'overthrust'. In 1840, Arnold Escher noted that Permo-Triassic strata overlay Cretaceous and Jurassic rocks. But, clearly unsure of his interpretation, did not publish his findings until 1849, and even then only after consulting Roderick Murchison.[55] In the conflict between physical field data and the template of the emerging geological column, they chose the latter, and inferred that the Permo-Triassic strata (which, because it is a double-barrelled term, is a euphemism since the rocks are strictly 'undifferentiated') had been moved over the Jurassic and Cretaceous strata. Like Ballard Down, motives dominated and the desired explanation trumped data.

Moine, Scotland, UK

Northwest Scotland possesses a wide range of overthrusts.[56] The most significant is that at Moine, which is considered by many geologists to be similar to thrusts found in the Appalachians and Canadian Rockies. Many of these are not outcrops, but inferred from seismic and oil wells.

Moine illustrates uphill movement (about 15°), and shows metamorphic rock overlying unmetamorphosed strata. Metamorphic rock is thought to be former 'country rock' exposed to extremes of heat and/or pressure. The thrust is also identified by biostratigraphy and radiometric dating. Geologists propose that the metamorphic rock slid from a distant location since any metamorphism afterwards would have affected the underlying rock. This interpretation was introduced in 1861.

Like Ballard Down, there have been numerous studies of the mechanics of the Moine thrust. Johnson and Mykura[57] note that this (paradoxical) overthrust "still presents considerable problems". These include the uphill motion and the presence of additional strata on top of the primary block. Worse, some of these piggy-backed strata are also out of order.

Trewin[58] offers a simple diagram (his fig. 4.48), redrawn as figure 7, to show how the Moine overthrust occurred. In his illustration, a bulldozer pushes the overthrust block up the slope. This misrepresents the force required. The block

would require the force of a million bulldozers behind each other every two metres. As noted earlier, such forces are difficult to generate and must still be lower than the failure strength of the rocks. Figure 7 reinforces the paradigm of sliding/overthrusting in a dishonest way. Furthermore, the 'overthrust' is said to have moved the visible block by 100 km.[59] Our mechanical analysis shows that this is not possible, even if we reduce the cohesion and friction to zero, since the maximum length of the block and its displacement cannot exceed 27 km for any practical thickness known in the area.

Other field data suggest Moine is no overthrust because the sequence of strata there is not a simple case of metamorphic rock overlying unmetamorphosed rock. Geological maps of the area show that a complex mixture of erosion, non-deposition and overthrusting would have been required to achieve the present configuration as interpreted by the geological column. Keeping the column violates Occam's razor. We prefer to believe that minimizing assumptions yields a better approach, since basic faulting during emplacement could explain the data when the timing constraints associated with the geological column are removed. In addition, this suggests that metamorphic rock can form apart from heat.

Heart Mountain

The Heart Mountain thrust (or detachment) is significant because of its size. It has been the subject of many studies in the past 50 years, perhaps impelled by its use in *The Genesis Flood* and the desire to rebut the Flood paradigm and continue to live in the secular 'Enlightenment'.

Recent theories propose that the release of carbon dioxide at the detachment surface provided a cushion, allowing the blocks to 'float' down a two-degree slope, even though the natural coefficient of friction at ~0.6 would still be much in excess of tan 2° (0.03). Some creationists have accepted the explanation, and focused on its catastrophic nature—a high speed detachment.[35,60] But note serious objections to this. The physics of the gas 'cushion', pressures, sustainability, etc., which supposedly allowed the block to 'float', have not been evaluated. In particular, since heat would be needed to release the CO_2 from the underlying strata, abrasive friction is needed first. It is physically impossible to have the effect happen before the cause. Furthermore, if the 'slide' achieved the proposed velocity, perhaps 200 km/h,[61] what happened when the cushion was exhausted? With the surfaces now back in grinding contact, the block would have taken at least ~1,000 m to skid to a halt, thereby leaving a 1–10 m layer of breccia along the interface.[26] It isn't there.

Without a viable mechanism, there is no reason to accept the thrust explanation, leaving it a well-documented glaring exception to the geological column. Otherwise 'Enlightenment' motives again usurp even the simple laws of motion developed by Newton.

Summary and recommendations

We have traced how overthrusting has been identified, and attempts made to explain the general principles within the uniformitarian paradigm over the last 200 years. It remains paradoxical, both because of the physical problems explaining the movements and inability to palaeo-reconstruct. Obviously the overthrusting paradox disappears if we are freed from the template of the geological column. Taking into account the technical issues discussed above and the subverting motives which still persist from the days of 'The Enlightenment', everything points firmly to the fallibility of the geological column.

Therefore we can still say that Price's dictum: "that the whole idea of overthrusting was devised by geologists simply to salvage the dogma of fossil sequence" is true and Young's criticism of him is wrong. If the column is not a reliable template to Earth's strata, then an edifice of secular natural history is wrong.

Sadly, Christians and even young-earth creationists are divided about the geological column. There have been calls for all interested parties to participate more actively in forums to explore the differences as the number of challenges to the column increases, rather than stay in their own corners. The prize is enormous—nothing other than a full-fronted challenge to a world that swung away from truth.

References

1. We use 'overthrust' to mean any implied large-scale movement of this sort. It is a generic term encompassing 'thrusts', 'nappes', 'slides', 'detachments', and 'shallow-angle reverse faults'. We exclude folding from this discussion because of very different mechanisms.
2. Briegel, U., Rock mechanics and the paradox of overthrusting tectonics; in: Briegel, U. and Xiao W. (Eds.), *Paradoxes in Geology*, Elsevier, Amsterdam, 2001.
3. Audley-Charles, M.G., Geometric problems and implications in large-scale overthrusting in the Banda Arc-Australian margin collision zone; in: McClay, K. and Price, N.J. (Eds.), *Thrust and Nappe Tectonics*, Special Publications 9, Geol. Soc., London, pp. 407–416, 1981.
4. Humphreys, D.R., Accelerated nuclear decay: a viable hypothesis? in: Vardiman, L., Snelling, A. and Chaffin, E. (Eds.), *Radioisotopes and the Age of the Earth,* ICR, El Cajon, CA, pp. 333–379, 2000.
5. Matthews, J.D., Was the UK once totally under water? *J. Creation* **27**(1):107–113, 2013.
6. Sibley, A.M., *Cracking the Darwin Code—Exploring the Non-Scientific Foundations of Deep Time and Evolution,* Fastnet Publications, Devon, 2013.
7. Mortenson, T., The historical development of the old-earth geological timescale; in: Reed, J.K. and Oard, M.J. (Eds.), *The Geologic Column,* CRS, Chino Valley, AZ, pp. 7–30, 2006.
8. Winchester, S.B.A., *The Map that Changed the World*, Viking, London, 2001.
9. Ogg, J.G., Ogg, G. and Gradstein, F.M., *The Concise Geological Time Scale*, Cambridge University Press, Cambridge, 2008.
10. Matthews, J.D., The stratigraphic geological column—a dead end, *J. Creation* **25**(1):98–103, 2011.

11. Reed, J.K., Klevberg, P. and Froede, C.R., Interpreting the rock record with the uniformitarian geologic column; in: Reed, J.K. and Oard, M.J. (Eds.), *The Geologic Column,* CRS, Chino Valley, 2006.
12. Lyell, C., *Principles of Geology*, 9th edn, D. Appleton & Co., New York, p. 54, 1854; www.gutenberg.org/files/33224/33224-h/33224-h.htm, accessed 11 December 2015.
13. Lyell, K.M., *Life, Letters and Journals of Sir Charles Lyell*, *BART* (Original 1881), reprinted Cambridge University press, Cambridge, 2011.
14. Holmes, A., *Principles of Physical Geology,* revised by Holmes, D., Chapman and Hall, London, 1978.
15. Matthews, J.D., The origin of oil—A creationist answer, *Answers Res. J.* **1**:145–168, 2008.
16. Hsu, K.J., Role of cohesive strength in mechanics of overthrust faulting and of landsliding, *Bull. Geol. Soc. Amer.* **80**:927–952.
17. Price, N.J. and Cosgrove, J.W., *Analysis of Geological Structures*, Cambridge, 1990.
18. Murrell, S.A.F., The rock mechanics of thrust and nappe formation; in: McClay, K. and Price, N.J. (Eds.), *Thrust and Nappe Tectonics*, Special Publications 9, Geol. Soc., London, pp. 99–108, 1981.
19. Hubbert, M.K. and Rubey, W.W., Role of fluid pressures in mechanics of overthrust faulting, *Bull. Geol. Soc. Amer.* **70**(1):115–166, 1959; p. 115.
20. Wiltschko, D.V., Thrust sheet at a ramp: summary and extensions of an earlier model; in: McClay, K. and Price, N.J. (Eds.), *Thrust and Nappe Tectonics*, Special Publications 9, Geol. Soc., London, pp. 55–63, 1981.
21. Price, N.J. and McClay, K.R., Introduction; in: McClay, K. and Price, N.J. (Eds.), *Thrust and Nappe Tectonics*, Special Publications 9, Geol. Soc., London, pp. 1–5, 1981.
22. Arkell, W.J., *The Geology of the Country around Weymouth, Swanage, Corfe and Lulworth*, Her Majesty's Stationery Office, London, 1947.
23. Ameen, M.S. and Cosgrove, J., Kinematic analysis of the Ballard Down Fault, Swanage, Doset, *Proc. Geol. Assoc.* **101**(2):119–129, 1990.
24. Ameen, M.S. and Cosgrove, J., An upper strain detachment model for the Ballard Down Fault: Discussion, *Proc. Geol. Assoc.* **101**(4):303–320, 1991.
25. Carter, D.C., An upper strain detachment model for the Ballard Down fault: Discussion, *Proc. Geol. Assoc.* **102**:309–320, 1991.
26. Scholz, C.H., Wear and gouge formation in brittle faulting, *Geol. Soc. Amer.* **15**:493–495 1987.
27. Price, G.M., *Evolutionary Geology and the New Catastrophism,* Pacific Press, Mountain View, CA, 1926.
28. Young, D.A., *The Biblical Flood—A Case Study of the Church's Response to Extrabiblical Evidence*, Paternoster Press, Carlisle, UK, 1995.
29. Morris, H.M., *History of Modern Creationism*, Master Books, Green Forest, AR, 1984.
30. Nelson, B., *The Deluge Story in Stone,* Bethany Fellowship, Minneapolis, MN, 1968.
31. Whitcomb, J.C. and Morris, H., *The Genesis Flood*, Presbyterian and Reformed Publishing, Phillipsburgh, NJ, 1961.
32. Scott, R.A., Smyth, H.R., Morton, A.C. and Richardson, N. (Eds.), *Sediment Provenance Studies in Hydrocarbon Exploration and Production*, Special Publications 386, Geol. Soc., London, 2014.
33. Jaeger, J.C., Cook, N.G.W., and Zimmerman, R.W., *Fundamentals of Rock Mechanics*, 4th edn, Blackwell, Oxford, 2007.
34. Lammerts, W.E., Recorded instances of wrong-order formations: part viii, *Creation Res. Soc. Quart.* **24**(1):46–47, 1987.
35. Garner, P., *The Genesis Flood* 50 years on, *Origins (BCS)* **55**:4–10, 2011.
36. Snelling, A.A., *Earth's Catastrophic Past,* Institute for Creation Research, Dallas, TX, 2009.
37. Tyler, D., Accept the column, reject the chronology; in: Reed, J.K. and Oard, M.J. (Eds.), *The Geologic Column*, CRS, Chino Valley, AZ, pp. 53–71, 2006.
38. Alexander, D., *Rebuilding the Matrix*, Lion Hudson, Oxford, 2001.
39. Alexander, D., *Creation or Evolution—Do We Have To Choose?* Monarch Books, Oxford, 2008.
40. Nield, T., Fighting the good fight, *Geoscience* **18**(1):3, 2008.
41. Gould, S.J., *Wonderful Life—The Burgess Shale*, Norton, New York, 1989.
42. Walker, T., The Geological Society of London uses bully tactics, www.creation.com/the-geological-society-of-london-uses-bully-tactics, 13 May 2008.
43. Alexander, D. and White, R.S., *Beyond Belief: Science, Faith and Ethical Challenges*, Lion Hudson, Oxford, 2004.
44. Berry, R.J., *Christians and Evolution,* Monarch, Oxford, 2014.
45. Matthews, J.D., Creationism, evangelism and that bothersome debate? A review of *Christians and Evolution* by R.J. Berry, *J. Creation* **29**(3):28–32, 2015.
46. Conway Morris, S., *The Crucible of Creation*, Oxford, 1998.
47. Forster, P. and Marston, R., *Reason, Science and Faith*, Monarch Books, Crowborough, UK, 1999. Reviewed by Kulikovsky, A., *J. Creation* **16**(2): 31–36, 2002.
48. Johnson, R.J., *Genesis, Geology and Catastrophism*, Paternoster Press, Exeter, UK, 1988.
49. Lucas, E., *Genesis Today—Genesis and the Questions of Science*, Scripture Union, London, 1989.
50. Polkinghorne, J., *Science and Creation*, SPCK, London, 1988.
51. Wright, R.T., *Biology through the Eyes of Faith*, Apollos, Leicester, 1991.
52. Holm, G.M., Distribution and origin of overpressure in the Central Graben of the North Sea; in: Law B.E., Ulmishek, G.F. and Slavin, V.I. (Eds.), *Abnormal Pressures in Hydrocarbon Environments*, AAPG Memoir **70**:123–144, 1998.
53. Evans, D.C., Graham, C., Armour, A. and Bathurst, P., *The Millennium Atlas: Petroleum Geology of the Central and Northern North Sea,* London, The Geological Society, 2003.
54. Muggeridge, A., Abaioglu, Y., England, W. and Smalley, C., The rate of pressure dissipation from abnormally pressured compartments, *Bull. Amer. Assoc. Petro. Geol.* **89**(1):61–80, 2005.
55. Murchison, R.I., On the geological structure of the Alps, *Quart. J. Geol. Soc.* V(I) Dec. **13**:157–313, 1848.
56. McClay, K.R. and Coward, M.P., The Moine Thrust Zone: an overview; in: Price, N.J. and McClay, K.R. (Eds.), *Mechanics of Thrust Nappes,* London, Special Publications, Geological Society, pp. 241–260, 1981.
57. Johnstone, G.S. and Mykura, W., *The Northern Highlands of Scotland,* Her Majesty's Stationery Office, London, 1989.
58. Trewin, N.H. (Ed.), *The Geology of Scotland*, The Geological Society, London, 2002.
59. Butler, R.W.H., The nature of 'roof thrusts' in the Moine Thrust belt, NW Scotland: its implications for the structural evolution of thrust belts, *J. Geol. Soc.* **161**(5):849–860, 2004.
60. Oard, M., The Heart Mountain catastrophic slide, *J. Creation* **20**(3):3, 2006.
61. Craddock, J.P., Geary, J. and Malone, D.H., Vertical injectites of detachment carbonate ultracataclasite at White Mountain, Heart Mountain detachment, Wyoming, *Geology* **40**:463–466, 2012.

Dr John D. Matthews *is a retired chartered geologist (EurGeol) from the oil industry. He holds a B.Sc. in Mathematics (1958–1961) and a Ph.D. in Earth Science (2000–2004) completed in a university department specializing in petroleum engineering and rock mechanics.*