

## IN THE SHADOW OF WAR AND OTHER EXISTENTIAL CHALLENGES TO HUMANKIND

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Janne Blichert-Toft

When I was assigned this issue of *Elements* about a year ago to the date of writing this editorial, two things came to my mind straight away. First, the title. What a weird title, I thought, because concrete and cement are just two words for the same thing, right? Well... no! I found this out pretty quickly after

talking to the Guest Editors and which you will learn too (if you did not know so already) by reading this issue. For those of you as ignorant as I was (but am not anymore!), the difference between cement and concrete, simply put, is that cement is a powder (the variable compositions of which you will learn if you read on) that, once mixed with water, sand, and gravel and poured into the rotating barrel of a truck, or cement mixer, becomes concrete!

Being Danish and having grown up in Denmark, the other thing that came to my mind when I was confronted with the word “concrete” was its place in history, which several of the articles in this issue also touch upon. As much as the historical aspects of concrete are fascinating reading, there is also a more eerie side to it. This is because, when I think about concrete, I think about the German bunkers from WWII that still survive to this day, standing as imposing structures on the beaches of the west coast of North Jutland and further down towards the German border, reminding us of past wartimes by bearing testimony to the German occupation of Denmark during the last world war in Europe. Little did I know at the time, a year ago, that one year later this recollection would be frightfully pertinent to Europe in 2022, which is now once again at war despite all the horrors of WWI, WWII, and the cold war; despite the establishment of NATO, UN, and EU to avoid exactly this from ever happening again; and despite the twisted guarantee (or so we thought) of mutually assured destruction, MAD, which was not yet a concept during WWII but became one *because* of WWII and the Manhattan Project. One year ago, war in Europe, again, was simply unthinkable. And yet, here we are, again, on the brink of WWII. As I have always heard predicted: WWIV will be a war of stones.....nuclear weapons having obliterated the world during WWII. *Elements* editorials strive to relate the topic of the thematic issue in question to something relevant to our present-day world. I am saddened that my first editorial connects the topic of this issue, even if only indirectly so, to the unprovoked ongoing war in Europe, which currently holds the very real threat of becoming yet another example that could go down in history as a “small” war that became a “big” war. One can only hope that between writing this editorial and when it goes to press, the conflict will have ended. Whatever that “end” might be! A new global isotopic spike to mark the beginning of the Anthropocene in concert with all the other human-induced impacts on Earth’s geology and ecosystems, including climate change?<sup>1</sup>

<sup>1</sup> Post-script: As this editorial is now going to press, the war sadly is still going on with so far no end in sight, almost a full year after Russia invaded Ukraine on February 24, 2022.

One of the mysteries surrounding the old German bunkers in Jutland, today uncovered by the waves of the ocean and having withstood the wind and the sea for 80 years, is the “recipe” of the German concrete. My own institution in Lyon, which is a designer architect concrete building from the mid-80s, started coming apart within 25 years, and, hence, over the last 10 years, we have been working in the midst of a massive renovation site. As discussed in this issue, clearly not all concrete is of the same quality! Just like the German bunkers, the concrete structures built by the Romans over 2000 years ago are also still standing. Take as example the majestic Colosseum, which is composed mostly of concrete (with some blocks weighing over a whopping 300 tonnes) beautified with travertine or marble coatings. Maybe the ENS Lyon architect should have looked more to the Romans, who in 43 BC founded Lugdunum (later Lyon), capital of the northwestern Roman Empire and today a UNESCO’s World Heritage site.

In the shadow of war, the timeline of which is always immediate and catastrophic, the formidable challenges posed by climate change have fallen by the wayside. This seems inevitable as the timeline of climate change appears far longer than that of war, thereby reducing the sense of urgency by way of comparison. But, war or not, we cannot lose sight of climate change and, as laid out in this issue, daunting challenges lie ahead for the cement and concrete industry to lessen the environmental burden associated with the production and consumption of concrete, one goal being to reduce anthropogenic CO<sub>2</sub> emissions and another being to mitigate the draining of primary raw materials. Although the biosphere is highly efficient at recycling the materials it is made of, the technosphere (an offshoot of the biosphere) is not, but needs to be, despite discouraging financial barriers. Reading this issue’s articles, I came across some staggering numbers, not to mention the concept of “sand mafias”, that were not previously known to me. I wrap up this editorial by citing just a few examples of the mind-bending statistics presented in this issue that speak for themselves and should shock everyone into action: (i) *Each year, nearly 40 billion tonnes of raw materials extracted from the Earth’s crust feed into the construction industry, with about 30 billion tonnes of concrete produced annually.* (ii) *The global annual resource footprint for all forms of consumption (minerals, fossil fuels, biomass) is about 100 billion tonnes of materials.* (iii) *More than 90% of this stock is extracted as virgin materials, with recycled resources constituting less than 9 billion tonnes.* (iv) *The construction sector alone is responsible for 13.5 billion tonnes of greenhouse gas emissions annually.* (v) *The mass of the anthroposphere, or technosphere, is 30 trillion tonnes, 10% of which consists of the total mass of concrete produced throughout the history of mankind.*

**Janne Blichert-Toft**

École Normale Supérieure de Lyon, CNRS,  
and Université de Lyon

# Elements

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Universität Bayreuth  
Universitätsstr. 30  
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