

Chariots of Fire

Reflections of Oded Goldreich
On the Occasion of His 60th Birthday Celebration

By
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Chariots of Fire, the multi-oscar winning movie of almost 30 years ago, seemingly focuses on the British Athletic Team going to the 1922 Olympics, a tight group of athletes and friends (by the end) at a revolutionary time, when athletics transitioned from amateurish to professional. The transition was not so much, at that time, about the injection of Money into sports, but about the advent of TOTAL professionalism and TOTAL dedication. With Vangelis's evocative soundtrack, the movie starts and ends with a celebration, at Saint Mary Le Bow Cathedral, in London.



There, Lord Lindsay and a few, still alive but by then decrepit, members of the team eulogize their departed friends, Abrahams and Lindell, with whom they shared an incredible bond.

We also hold similar celebrations, in our cathedrals of Science, like the Weizmann. But our Fests celebrate our *living*, and indeed *very active* friends. Ours are 60th, not 100th, Festschrifts. And it is good and proper that we hold such celebrations. Extraordinary scientific fields are made by extraordinarily knit groups of extraordinary scientists. It is not the first time that “we” have witnessed such extraordinary converge. Think of Athens, with Socrates, Plato, and Aristotle dialoguing with each other, as well as fighting with one other over their ideas. (The famous paraphrase of Aristotle, *Amicus Plato, Sed Magis Amica Veritas* --- Plato is a friend, but Truth is a better friend --- is quite telling about the intensity of their relationship.) Think of the Renaissance, with Leonardo, Michelangelo, and Raffaello *inspiring* one other, as well as *competing* with each other. Closer to our times, Plank, Einstein, Bohr, etc., met very often and very vigorously interacted with one other. The EPR paradox was allegedly raised in a heated, post-seminar, Q&A session. Thus, two possible patterns emerge for scientific revolutions.

Either: Once in a while, extraordinary scientific developments occur and attract extraordinary people, who influence each other in extraordinary ways.

Or: Once in a while, extraordinary researchers find each other, and it is from the released energy of this intellectual fusion that extraordinary scientific developments are born.

The two alternatives are, of course, *indistinguishable*. But, with all due respect to indistinguishability, it is obvious to me that the *latter* is the true underlying pattern.

The second (and on-going) revolution in Theoretical Computer Science came about, because a group of extraordinary individuals, endowed with different skills and visions, came together, influencing and complementing each other in extraordinary ways. One of them was, and indeed *is*, Oded Goldreich. His extraordinary results are only too well known. (Zero Knowledge, Multi-Party Computation, Randomness Extraction, List Decoding and Graph Property Testing, are just my favorite ones.) I thus just wish to share with you a few reflections about him, organized in five chapters.

1. Intensity

Oded is INTENSE. Period. Ask his students and all his closest collaborators. These people survived a continual bombardment. I met Oded in 1983, when I joined MIT's Theory of Computation Group as an assistant professor. Many great theorists were already there. Shafi Goldwasser joined at the same time and so did Oded, who arrived as a postdoc, allegedly for a single year, but ended up staying for three. Michael Ben-Or arrived as a postdoc too. Joahn Hastad arrived as a student. Leonid Levin arrived as a "refugee" *and* as a force of Nature. Avi Wigderson came to visit for days at a time. Michael Rabin was often around. It was a time of MARVELOUS and INTENSE interaction. But no interaction could be more intense than that one has with Oded.

Here is mine.

START.

Wake up. Shower. (For the record!) Meet Oded at 10am. (Different times folks!) Argue and write the current paper with him until noon. Argue and eat lunch with him until 1pm. Argue and do research on the next paper with him until 4pm. Argue and revisit dead branches until 7pm. Argue and discover promising leads until 9pm. Go arguing at dinner. At 10pm, jump in the car and rush, avoiding pedestrians and speeding tickets, to the Somerville 12 movie theater, to catch, only a few minutes late, the best last show on the menu (just to prove to ourselves that we had a life after work). Drive home and go to bed at 12:30am.

REPEAT.

Day after day. Weekends included. For 3 full years. When Oded left for the Technion, we were sad, but also RELIEVED. We could finally reclaim our borders. You know, humans need to think they are INDIVIDUALS. For the next several years, Oded and I kept in touch at a safe distance, so as to restore separate personalities. It is hard to be WITH Oded, and it is hard to be AWAY from Oded.

2. **Omnia Munda Mundis**

All is pure to the pure. If you do not understand Oded's behaviour, you are in good company. But rest assured: his motives are pure. In fact, it is the purity of his motives that, so very often, make his actions so hard to understand. The purer his motives, the less clear his actions. Purity is rare. The Medieval symbol for purity is the UNICORN. It makes sense: HOW MANY UNICORNS HAVE YOU SEEN LATELY?



Length contracts in the direction of motion, and psychological space bends around the direction of the argument. Hence, the unicorn's horn is twisted, rather than smooth. The path to purity is a tortuous one.

Example: "Oded: why on hearth you did not tell me about X?" Legitimate question. "Because, you know, if I told you X, you have understood Y, and based on past history, you would have reacted with Z, being misunderstood by W, who would have retorted with either A or B. Etc., etc., etc." A straight and coherent path to the pure, but a *contorted* and *twisted* one to other SPECIES, that is, all those whose psychological alphabet lacks sufficient letters to distinctly label all possible twists and turns.

It is hard to be Oded.

3. Kyz



In the most iconic picture of the Seven Samurais, Kyz stands on the extreme right. He is alone, confident and calm. He has a single and pervasive goal: *the perfection of his swordsmanship skills*. True: he is also generous and humble. But almost without merit, because he is satisfied by his own pursuit of perfection. Trade Science with swordplay, and you have ODED!



Indeed, Oded's all-consuming goal is PERFECTING HIS OWN UNDERSTANDING. If you just so slightly improve his understanding of his latest result, you find yourself a co-author! On the Other hand, if he improves your result, he is happy to do it for free. Having improved his own understanding, he is already as happy as he can be.

Understanding is firstly (and foremost) about notions, and only secondly about proofs and techniques. (After all, theorems exist only to point towards the right definition, that is, "the right theorem" is what enables us to identify "the right definition".) All of Oded's papers could be retitled "On a better Definition of X". You just plug in "X". Oded can go on for days to dissect and distill a new definition. Sometimes, his new proposed notions luckily have (for the paper's fate) *complex* constructions. Sometimes, unluckily for the paper, they have *simple* constructions. Oded may appreciate the difference, but NOT the reason to appreciate one more than the other. A better notion is always a sacred gift: the right path was lost, and has now been regained. STOC and FOCS will surely agree...

It is hard to be Oded.

4. The Lost Café

Following Gian Carlo Rota, the cafés I am talking about are the Viennese ones of a hundred years back. Romantic and vibrant places, where philosophers argued all night, mathematicians played chess and proved theorems, and revolutionaries of all persuasions planned brighter futures for humanity.

Oded was born in Israel from an Austrian father, an engineer from Vienna. Oded's father left in time to save himself. But, psychologically, he never left Vienna. Oded recalls that, after 30 some years of living in Israel, waiting with his son for the bus, he always looked at his watch commenting: "Strange, this bus is 5 minutes late!"

The apple did not fall far from the tree. Whether because of genetics or upbringing. At 60, Oded continues to cling to a notion of Science where advisors NURTURE their students, but never coauthor their students' findings. Where awards DISTORT scientists' drive towards true improvement. Where scientists forgo writing a few more articles, so as to write books and provide a solid stepping stone for new generations. And so on. And on. And on. So, some may wonder,

Isn't about time for Oded to open his eyes and accept the Reality of Science?

5. The Eternal Café

But: since the reality of Science is such a common knowledge, how to explain that we have always been aware of Idealized Science? Idealized Science is NOT our latest concocted notion. It has been with us "FOR EVER", that is, since we decided to cooperate to make sense of the World, external and internal.

The truth is that our *common and romantic ideal of Science* persists because in *every* field, and in *every* generation in that field, a *champion* emerges that embodies and personally lives that romantic ideal. Our field is *Theoretical Computer Science*, our generation is, well, *us*, and our champion is *Oded*.

It is because of him, and of those who will bravely follow him on his hard and solitary path, that the Ideal of Science, so highly conceived and so courageously lived, shall not perish from the Hearth.