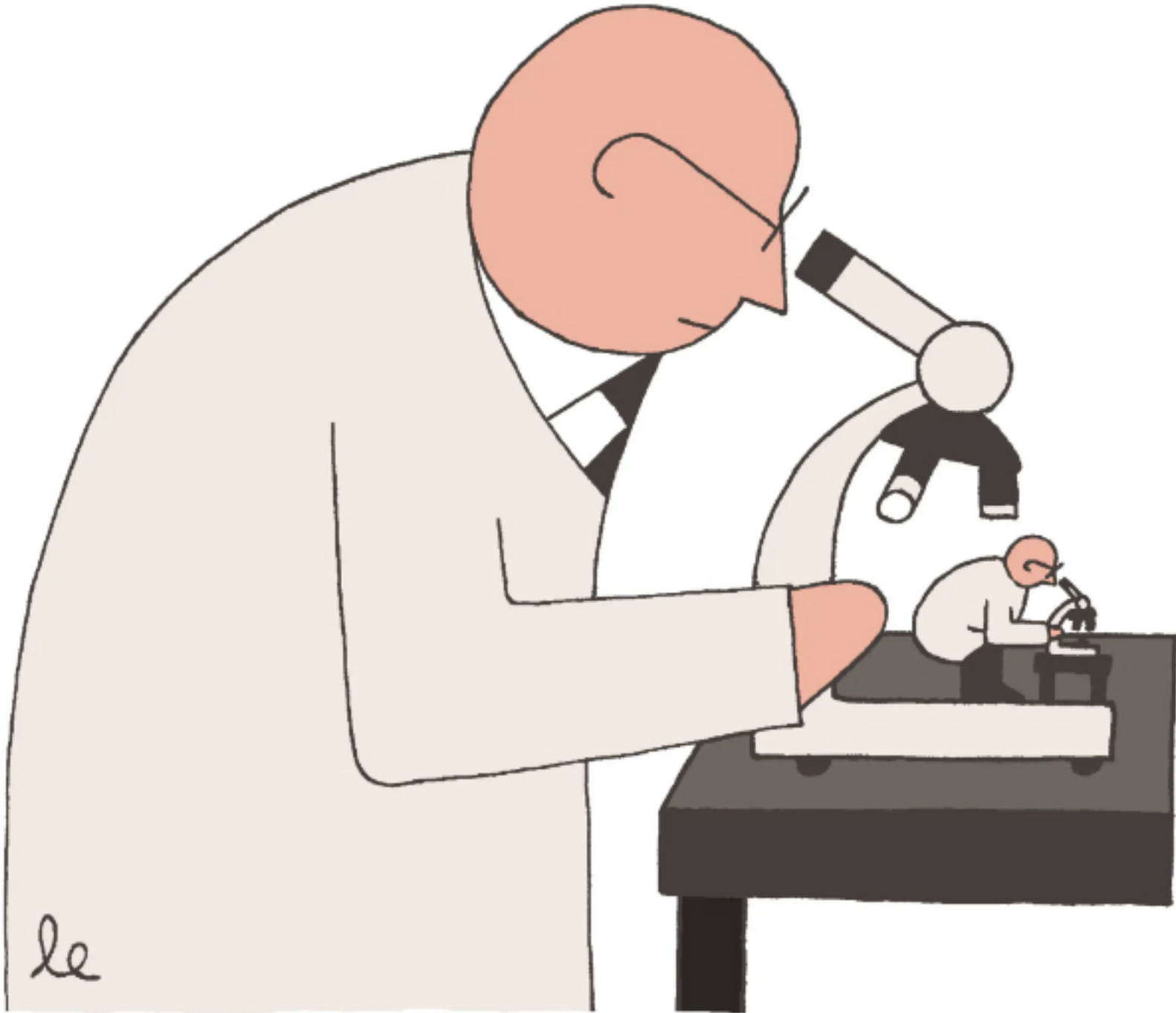


Beholding Life’s Creative Recipe

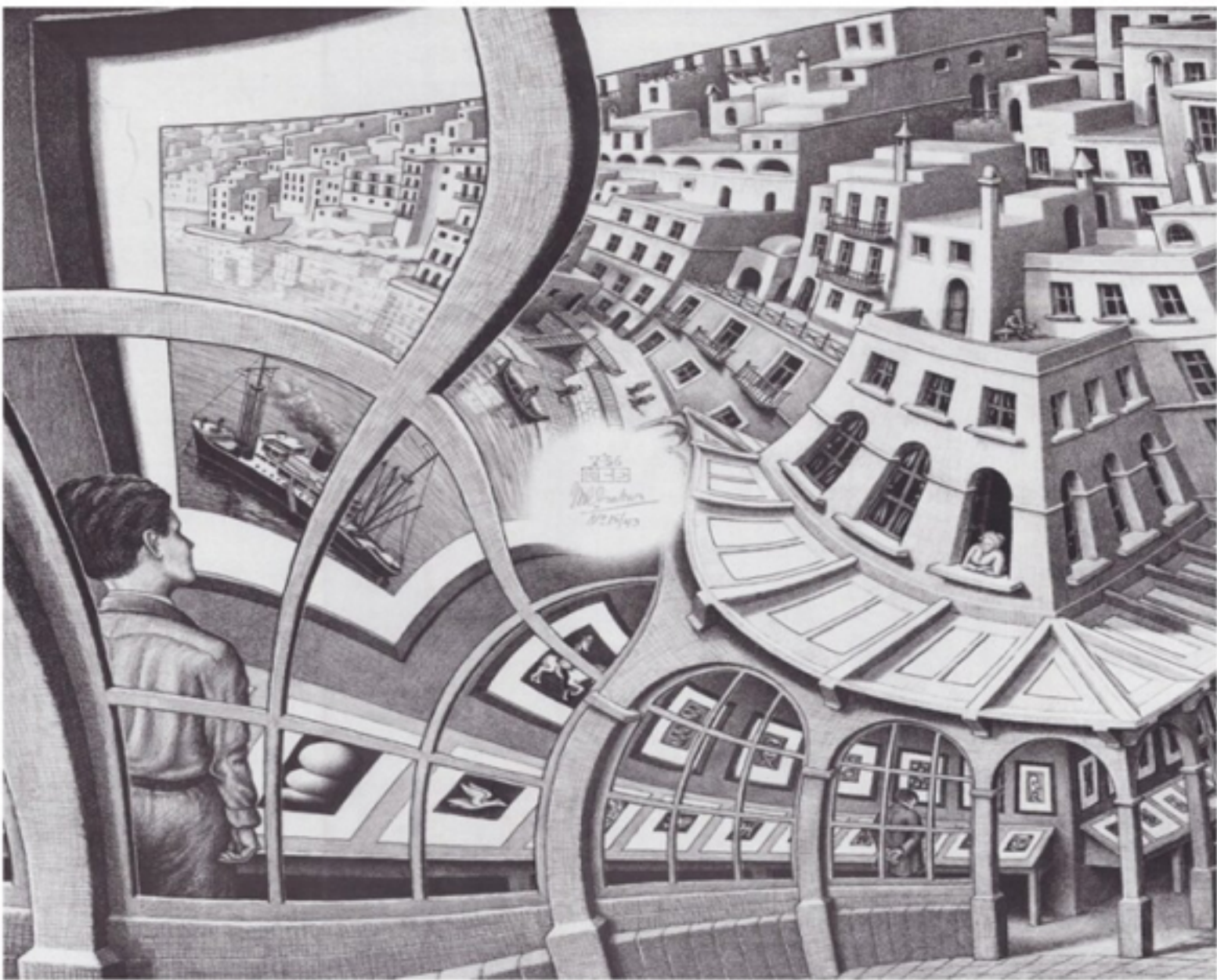
By Enrico Coen
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Leon Edler

I still remember the fear and incomprehension I felt when I first glimpsed the world without me. I was 11 years old and lying in bed at night when I suddenly had a sense of what it might be like if I was no more. Not only was I missing from the world, but the world was gone too, for there was no standpoint from which to contemplate it.

Many years later, I was reminded of this experience by a lithograph by M.C. Escher, “Print Gallery,” which shows someone viewing a contorted picture in a gallery. If you imagine yourself as the viewer, and follow the picture along the waterfront, down into the gallery, and along the corridor, you eventually arrive back at yourself. If that picture were removed from the gallery, then the gallery and everything in it, including you, would be lost.



“Print Gallery” conveys a predicament we all face. We look out on a world of which we are an inseparable part. Can we do the equivalent of the viewer in the picture and follow some transitions to get a better sense of where we stand?

In tracing this path for yourself, you would come across four remarkable living transformations. First is evolution, the process whereby you and all other living beings have arisen on the planet. Next is development, through which a microscopic egg turned itself into a baby. Upon being born, you were then transformed through learning, from a writhing ball of arms and legs into someone who can walk, talk, reason and hold opinions. Much of what you learned depended on the culture you were born into. If you had been born 10,000 years ago, you might be eking out your existence in a cave. You are the product of four living transformations: evolution, development, learning and cultural change.

It is through the last of these, cultural change, that modern science arose. Science provides us with perhaps the clearest lens through which we can look at the world.

As a scientist I wondered about the following experiment. Suppose we turned the scientific lens on itself and closely examined the four great living transformations, including that which gave rise to science itself. What might we learn? Would we find four very different beasts, or perhaps some common underlying principles?

There are several problems with attempting such an experiment. First, is our understanding of the four transformations up to the task? The answer would probably have been “no” until recently. But in the past few decades, our scientific understanding has made great strides, making the experiment more than just a theoretical exercise.

Another problem is the barrier between disciplines. To attempt this experiment, I would have to enter into fields like neuroscience and cultural history, in which I am hardly an expert. I would risk being thought an amateur or dilettante in fields that I should know better than to enter.

I decided nevertheless to go ahead with the experiment. I began to view the four great transformations of life together and compare their detailed inner workings. Gradually, common principles began to emerge, which I collectively call life’s creative recipe. I’ll give a taste of how this recipe works.

At the core of the recipe is the interplay between what I call reinforcement and competition. To give a cultural example of reinforcement, if you hear a good piece of music, tell two other people about it, and these people in turn tell two others, then the number of listeners is reinforced and rapidly increases. But if this process continues, then people will eventually start saying that they already heard the piece. Also competition will come in as other musicians attempt to produce something even better.

The same is found for other transformations. In evolution, organisms reinforce their numbers through reproduction while limitations are brought about by the environment. In development, molecules boost their own production while also bringing about their own inhibition. And in learning neurons boost their own connections, which in turn lead to a counteraction or inhibition. In all cases, reinforcing elements become a victim of their own success, providing engines for change.

These engines are fueled by population variation. Between 1685 and 1828 the population of German-speaking people produced Bach, Handel, Haydn, Mozart, Beethoven and Schubert. This is not because there was a special set of musical genes knocking around at that time, but because of the variations and cultural aspirations in that population. There should be many hundreds of people alive today with the same potential as Mozart or Beethoven, but most of them don’t compose symphonies or sonatas because they live in a different population context. Similarly, evolution, development and learning depend on interacting populations, but these are organisms, molecules, cells and neurons.

How is it that these engines of change can lead to such dramatic outcomes, like orchids, humans and smartphones? The trick lies in the way each change continually builds on what went before. The earliest telephones look very crude compared with what we use now. Yet when the first telephones came out in the late 19th century, they were no doubt considered state-of-the-art. Standards change as each phone stimulates inventors to come up with even better versions, again and again. The phone you have now will look like a dinosaur in a few years’ time.

Similarly, the wonders of evolution, development and learning arise by changes that recurrently build on themselves, shifting their own context and standards as they go. The detailed mechanisms of change are different in each case, but the basic ingredients of the recipe are always the same.

Where does this leave the 11-year-old boy who lay awake at night? His world will still disappear when he dies. But as an adult he now has a better appreciation of how he is connected with that world. He understands that he is the product of four remarkable living transformations based on a common recipe.

Through these transformations, the world arrived at the possibility of being able to contemplate itself, through his eyes and those of every other human. Science has provided him and others with a very powerful lens with which to see this more clearly, but it is by no means the only one. There are many more cultural ways of reacting to and engaging with the world that produced us — art, music, drama and travel to name just a few. And like science, every one of them is endlessly enriching, fascinating and beguiling for the beholder who stands in life’s gallery.

Enrico Coen is a research scientist at the John Innes Center, in Norwich, England, and the author, most recently, of “Cells to Civilizations: The Principles of Change That Shape Life.”