(I remember having coffee with a Star Warrior physicist who was desperate to spend the remaining $500,000 of his annual budget by lunchtime so that the authorities would not realize how hard he was finding it to spend his grant.)

After the war, with many leading physicists keen to return from military projects to basic research, high-energy physics "exploded", as Kragh says. In the golden years of 1945–65, experimenters and theoreticians laid the foundations of what we now call the Standard Model of the strong, weak and electromagnetic interactions of all the fundamental particles.

Kragh is keen to tell us in great detail about the social and economic climate in which physicists developed the model, but he falters when he comes to one of the key events in the story, the discovery of the J/ψ particle in 1974. He writes as if physicists agreed instantly that this particle consists of a charm quark and the corresponding antiquark, whereas the confirmation of that hypothesis came after more than a year of exciting debate among theorists and experimenters. Kragh's version of the story is simplistic — he is hoist with his own petard.

Quantum Generations covers far more material than I can describe here, including plenty of examples of phenomena that later proved illusory, such as the 'discovery' of N-rays (nominated for a Nobel prize in 1903!). Kragh has wisely not tried to be comprehensive — he has reasonably left out medical physics and materials science, for example — but I believe some of his omissions are indefensible. Why, for example, is there almost nothing on liquids (neither classical nor quantum), why nothing on modern developments of classical mechanics, including chaos theory? In addition, I suspect many experimenters will believe that their work is not satisfactorily recognized here, if only because Kragh does not make clear how difficult it is to ask the right questions of nature so as to elicit new insights into its workings.

But enough of the complaints. Kragh has produced a readable and enormously valuable book, full of useful references. Physicists who are prejudiced against historians of their subject will be pleasantly surprised by the breadth of Kragh's learning as well as by his attitude. Unusually for a contemporary historian, he is quite happy to doff his cap to genius, and to acknowledge the role played by the truly outstanding talents. He has no time for the 'science is just another branch of human endeavour' relativism, and he rightly regards the modish idea that it is meaningless to speak of progress in science as "folly".

I would recommend the book to any physicist, even Harry Lipkin. I suspect it will make him want to eat his words. ■

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Science in culture

St Christopher and the vortex

A Kármán vortex in the wake of St Christopher's heels.

Taketo Mizota, Mickey Zdravkovich, Kai-U. Graw and Alfred Leder

Theodore von Kármán, who was born in 1881, was a celebrated fluid dynamicist and pioneer of aerodynamics. In 1911, when he was studying the flow of fluid around a cylinder, he realized that the reason the flow had separated into two series of vortices which were staggered like street lights was because this asymmetrical configuration was the only stable one. His famous stability calculation, which he formulated over a weekend, gave the phenomenon its name, 'Kármán's vortex street'.

A direct and precise motivation for this finding was clearly described in von Kármán's autobiography (*The Wind and Beyond: Theodore von Kármán, Pioneer in Aviation and Pathfinder in Space*, Little, Brown, 1967): "Vortices were observed and recorded many years before I came on the scene. In a museum at Bologna, Italy, I remember seeing a painting of the great Christophe (St Christopher) wading through water with the child Jesus on his shoulder. Behind his heels was a series of alternating vortices. The problem for historians may have been why Christopher was carrying Jesus through the water. For me it was why the vortices.

"I wondered about them for a long time, but the actual stimulus, which led me to study them, arose out of a curious situation in our laboratory. At the time, Prandtl was interested in measuring the pressure at different points on the surface of a circular cylinder when it was placed in a steady stream of water. He got one of his doctoral candidates, a fellow named Hiemenz, to carry out the measurement. Unfortunately Hiemenz found that the pressures he measured always fluctuated. No matter how hard he tried, he couldn't remove this unsteadiness. The motion of the water was always oscillatory."

It was seven years after seeing the picture of St Christopher at Bologna that von Kármán calculated a stability analysis for alternative vortex arrays. We suggest that the picture that inspired him initially was a fresco picture at the museum at the Church of St Dominic in Bologna, Italy, entitled *Madonna con bambino tra I Santi Dommenico, Pietro Martire e Critoforo* (shown below), painted by an unknown artist in the fourteenth century. Around St Christopher's heels there is a series of alternating vortices similar to those shown in the figure from von Kármán's original paper, although the pattern cited in the paper is not that from St Christopher's heels, but from other objects, not shown.

St Christopher is said to have waded across a river carrying a child on his shoulder. The child became heavier and heavier until he was as heavy as the entire Earth. This was because he was bearing the pain of the whole world — the child was Jesus. This painting adds romance to von Kármán's work and might turn out to be an artefact of significance in the history of scientific thought. ■

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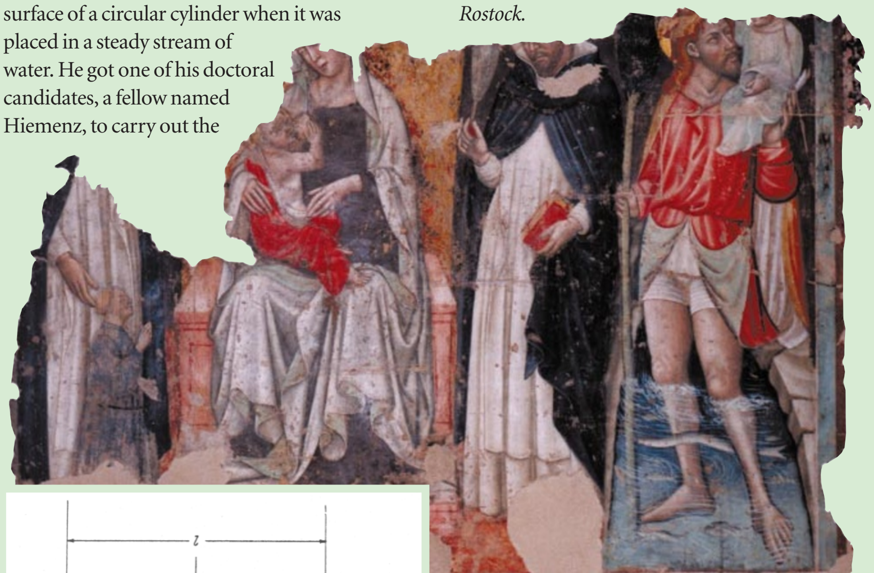

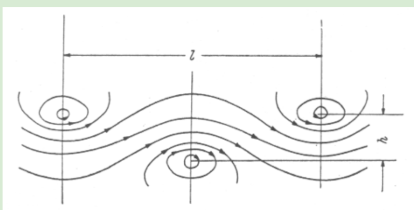

Was Kármán's vortex street originally inspired by a painting of St Christopher?