

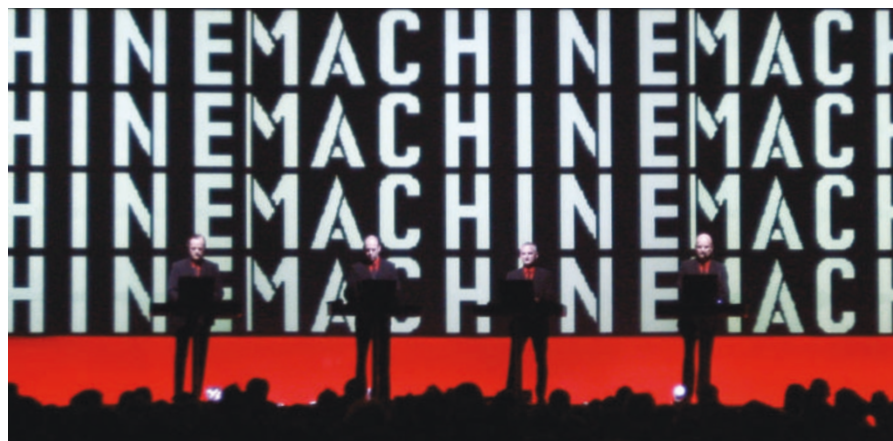
absorbed new geographical knowledge and medical advances. When they did reject a particular Western development, it was nearly always for specific reasons. For example, mechanical clocks, which had been constructed in Europe since the beginning of the fourteenth century, were of little interest to the Ottomans. This was not because they had no interest in clocks or time-keeping, but because European clocks had such a large margin of error (as much as half an hour) that they were not much use for calculating times for the five daily prayers.

A seminal paper in Ihsanoglu's collection describes the introduction of copernican astronomy to the Ottoman Empire. The Turks first became aware of Copernicus' heliocentric system through the translation of French astronomer Noel Durret's *Nouvelle Theorie des Planetes*. It was translated by Tezkireci Kose Ibrahim Efendi, a Hungarian who settled in Istanbul, as *The Mirror of the Heavens and the Limits of Perception*. In contrast to Europe, where Copernicus caused much dispute, the Ottomans embraced the new theory wholeheartedly. Even the religious scholars, who are traditionally accused of suppressing the transfer of science from Europe to Turkey, accepted it. Whether the centre of the Universe is the Earth or the Sun is irrelevant to Islam, declared Ibrahim Hakki, an influential religious scholar, in his celebrated study *Marifetname*. In principle, Muslims should believe that the Universe is the work of an exalted Creator, but different theories concerning its shape are strictly a matter for science. Now that Copernicus had laid the foundations of a scientific theory, earlier theories should be dismissed as illogical and unscientific.

It was the defeat of the Ottoman army at Vienna in July 1683 that changed things radically. From this point, the Ottomans grudgingly began to acknowledge the superiority of Western science and technology. They slowly became convinced that to master the techniques of modern warfare, they needed not just to embrace Western science but speed up the transfer of technology from the West. Modern scientific curricula were introduced in military academies, with the emphasis on applied rather than theoretical science. Ihsanoglu suggests that it is the neglect of theoretical science, in particular physics and chemistry, that eventually thwarted the development of Ottoman science in the nineteenth and twentieth centuries.

*Science, Technology and Learning in the Ottoman Empire* does not qualify as easy reading. Most of the meticulously researched papers are highly technical. But determined and persistent general readers will reap rich rewards. ■

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Big idea? Kraftwerk combine visuals and music to explore the boundary between man and machine.

Concert

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Electronic evolution

Kraftwerk

Despite their differences, science and art evolve in quite similar ways. Long periods of gradual and detailed explorations are occasionally disrupted by sudden jumps that take us to new spaces of scientific understanding or artistic exploration. One such jump, in the evolution of electronic music, was provided by the German band Kraftwerk. As part of their latest world tour, and their most extensive for 23 years, Kraftwerk performed a live show in Frankfurt on 7 April 2004, and will play in the United States, Canada and across Europe before the tour ends in June.

Inspired by the German composer and father of electronic music Karlheinz Stockhausen, Kraftwerk were among the first bands to create modern electronic compositions outside the 'classical' music scene. The quartet achieved world fame some 30 years ago with a series of now-acclaimed electronic albums including *Autobahn*, *The Man-Machine* and *Computer World*. This work laid the foundation for the subsequent development and diversification of house, ambient and other forms of modern electronic music. Kraftwerk's music explores human relationships with science and technology, in an attempt to redefine the role of technology in our daily lives.

After their significant contribution to early electronic music, Kraftwerk became less influential for a couple of decades. But their new album, *Tour de France Soundtracks*, sees a return to their progressive standards as they bring their glamorous electronic sound to the faster beats of modern house music. In their live performances, the music is complemented by dazzling digital visual arts.

The curtain lifts to the sound of *The Man-Machine*, revealing four figures in black suits who control the music on their laptops. It doesn't matter that they remain motionless, as your attention is immediately caught by

combinations of the words 'Man' and 'Machine' on gigantic screens at the back. The visual style echoes Soviet imagery, with few colours and plain but compelling messages.

As the show unfolds, the music pays tribute to several forms of transportation, with *Autobahn* and *Trans-Europe Express*. The band also focus on their own favourite means of transport: the bicycle. Digitally edited footage of the Tour de France leads to songs about aerodynamic design and heart physiology. As the lyrics turn to nutrition, a rain of brightly coloured vitamin pills turn slowly and eventually dissolve behind the artists.

The track *Radio-activity* is a powerful political warning about the risks associated with the generation and accumulation of nuclear waste. The strong message is supported by fascinating images of chain reactions and intimidating radioactivity warning symbols. The show moves into the world of calculations and mathematics with songs such as *Numbers*, with its multilingual recitations and projections of numerical sequences, and *Pocket Calculator*, in which electronic signals of arithmetic operations are converted into playful melodies.

For the encore, the four musicians are replaced by robotic counterparts. Ironically, the robots are much more active than their human equivalents and seem to enjoy moving around to *The Robots*. Later, on a dark stage, four fluorescent-green silhouettes reveal that the artists are back. They finally disappear one by one, leaving us with the rhythm of *Musique Non Stop*.

Kraftwerk have certainly evolved. Their stunning visual work is part of a new and original artistic style that supports their message about the role of technology in our lives. The overall concept, however, has stayed the same. The musicians invite us to see not only pure functionality but also beauty in the world of science and technology. ■

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♦ [www.kraftwerk.de](http://www.kraftwerk.de)