I spy with my little eye…

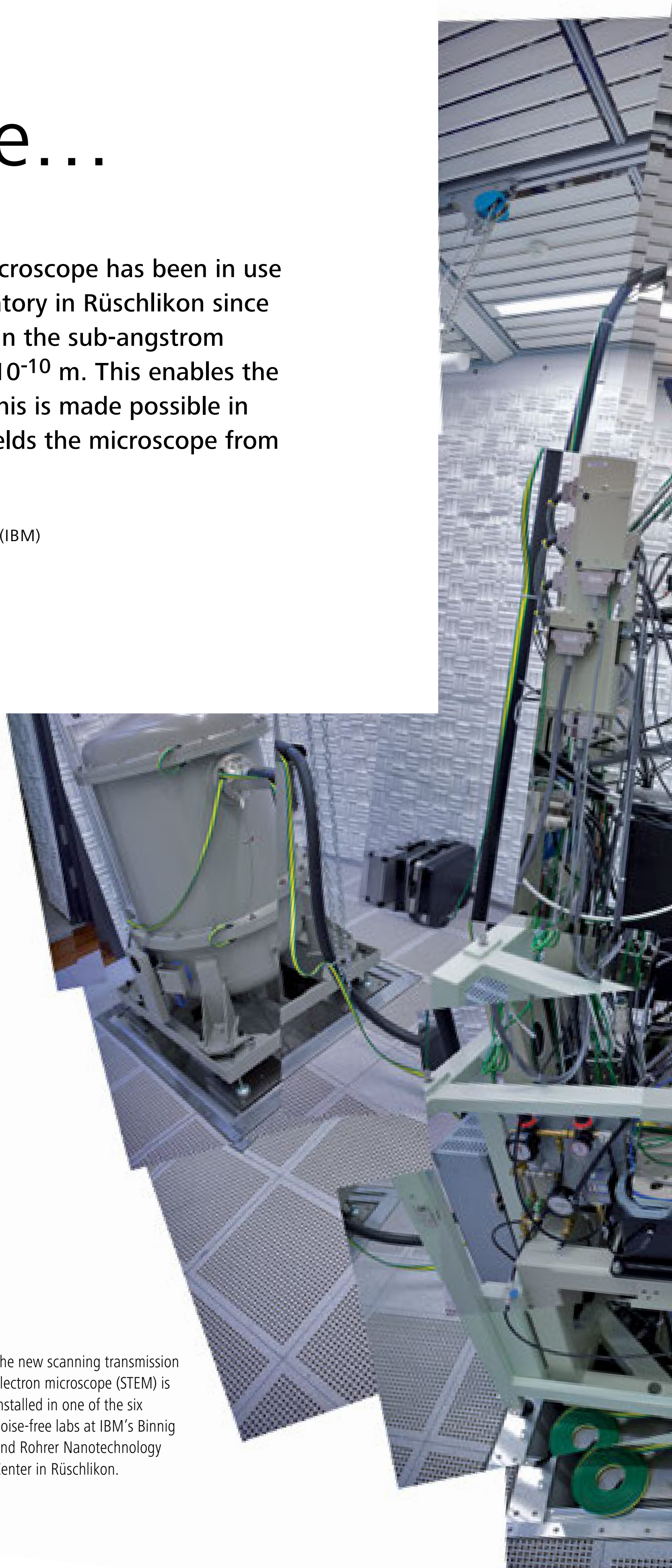
A unique transmission electron microscope has been in use at the IBM Zurich Research Laboratory in Rüschlikon since the summer, allowing resolutions in the sub-angstrom range, i.e. on a scale of less than 10^{-10} m. This enables the atomic structures to be studied. This is made possible in a special noise-free lab, which shields the microscope from any outside influences.

TEXT: Martina Peter / PICTURE: Urs Siegenthaler (IBM)

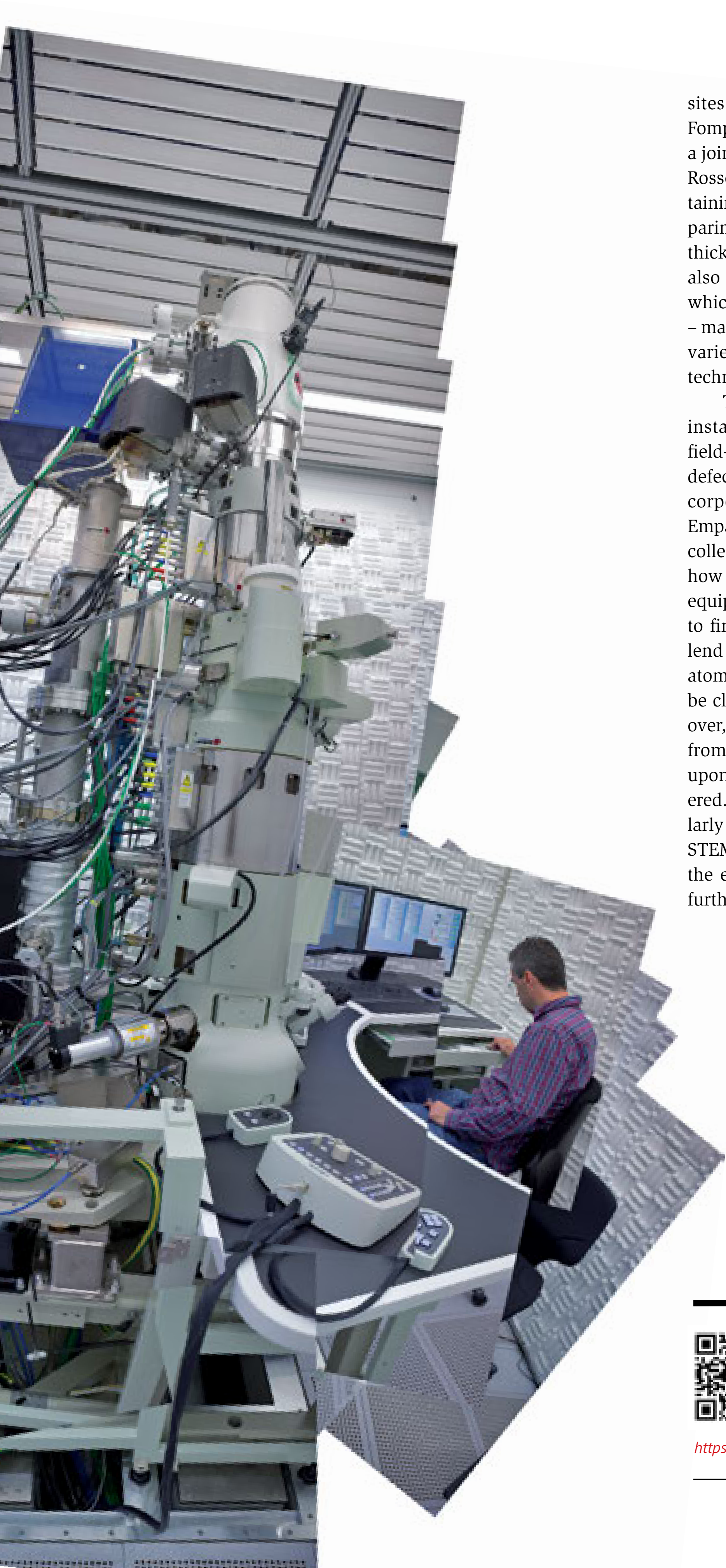
Eight meters underground, in the basement of the IBM Zurich Research Laboratory's Binnig and Rohrer Nanotechnology Center in Rüschlikon, a special-class microscope rests on a 40-ton foundation. It can display details that are smaller than the diameter of an atom. Despite weighing in at one and a half tons and towering three meters, however, the colossus is surprisingly sensitive: a draft created by the AC unit is enough to affect the readings, let alone the temperature fluctuations when the lab doors are opened or the noise from the nearby town or highway. All these influences need to be kept at an arm's length: in the noise-free labs, even electromagnetic fields are minimized through suitable constructional measures and clever shields and muffling.

The transmission electron microscope (TEM) works in a similar way to an optical microscope but uses an electron beam instead of light. The electrons penetrate the sample and interact with it before various lenses conduct them to detectors, which "translate" the electrons that are bent and scattered at different angles into an image. Because the TEM works in both a broad-beam and a grid mode (scanning TEM, STEM), not only can it display the structure of a sample; it can even chemically detect individual atoms.

The combination of a special lab and top-class electron microscopy makes readings possible at a precision that is unprecedented in Switzerland (and very rare worldwide). When it came to introducing the device, Rolf Erni, the head of Empa's Electron Microscopy Center, and his colleague Marta Rossell brought just the right prerequi-



The new scanning transmission electron microscope (STEM) is installed in one of the six noise-free labs at IBM's Binnig and Rohrer Nanotechnology Center in Rüschlikon.



sites to the table. Together with IBM researcher Jean Fompeyrine, they developed the highly sensitive device in a joint-venture and now run it as a joint user lab. Erni and Rossell look back on many years of experience in maintaining maximum-resolution electron microscopy and preparing samples, which are merely ten to 100 nanometers thick. Thanks to her expertise, before long Rossell was also able to present unique images on the new STEM, which allow scientists a glimpse inside “their” materials – materials which could in future be channeled into a wide variety of applications, such as in electronics or novel technologies for energy conversion or storage.

The team headed by IBM researcher Heike Riel, for instance, wants to find out how nanowires in novel field-effect transistors settle on a substrate. She is studying defects in novel semiconductor structures, which are incorporated into the crystal lattice during production. Empa scientists, on the other hand, have teamed up with colleagues from the University of Barcelona to investigate how nanoparticles made of magnetite (Fe_3O_4) can best be equipped with palladium and platinum atoms. The aim is to find the composition and arrangement, at which they lend themselves to an optimum catalysis as individual atoms or clusters. As Fe_3O_4 is magnetic, the catalyst can be cleaned easily (and without filters) and reused. Moreover, Erni’s colleague Yucheng Zhang and Empa scientists from Thun are examining different carbon nanotubes, upon which titanium dioxide molecules have been layered. The layers enable electrons to be “captured” particularly effectively in photovoltaic processes. Thanks to the STEM images, the researchers learn to understand how the efficiency of novel solar cells can be increased even further. //

First pictures made by the IBM microscope at flickr.

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