signed into German law, the Conference of German Physics Departments (KFP), which I represent as a spokesman, and the German Physical Society (DPG), on whose executive board I serve, played a constructive role in implementing them. The resulting recommendations for the design of three-year bachelor's and two-year master's programs were adopted by essentially all German physics departments. Therefore, Barbara Kehm's opinion in Feder's story that German scholars are resisting the dual-degree system does not apply to the physics community. Both the KFP and the DPG have made it clear that physics bachelors should continue toward a master's degree to achieve a qualification comparable with the *diplom* in physics. That recommendation was motivated by discussions with leading industry representatives, who expect physicists to have skills equivalent to those of previous *diplom* holders. Interestingly, efforts at German universities are under way to retain the name of the highly popular *diplom* degree for students who have completed their master's-level education.

German physics departments have weathered the Bologna reforms and have preserved the high quality of their programs in the transition. Much work remains to be done to fine-tune the curricula. Unfortunately, the Bologna reformers have recently opened yet another can of worms by defining the doctoral degree as the third cycle of higher education. Traditionally, the focus of the German doctoral effort in the sciences has been on research rather than classroom study. A structured PhD program would put a stronger emphasis on classroom study. Research across German universities would suffer dramatically, since doctoral candidates are the universities' primary research talent. Enhancing educational components at the expense of research activities in physics doctoral programs is viewed critically by the German physics community.

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Historical perspective on spin-polarized tunneling

I read with interest the article "Frontiers in Spin-Polarized Tunneling" by Jagadeesh Moodera, Guo-Xing Miao, and Tiffany Santos (PHYSICS TODAY, April 2010, page 46). It was also a pleasure to see that devices made from europium chalcogenides, concentrated magnetic semiconductors first studied in the 1960s, are of current interest and subjects of ongoing research.

It is, therefore, useful to give some historical perspective in any review of the subject. Thus I list here earlier work at the IBM Thomas J. Watson Research Center that preceded the tunneling studies described in the article.

The intellectual and scientific environment in the mid-1960s merits a brief description. The first ferromagnetic insulator, EuO, had been discovered[1] in 1961, and a number of laboratories were busily measuring its physical properties. Among them were ETH Zürich, the Lincoln and National Magnet laboratories, and the Watson Research Center. Those labs had succeeded in growing single crystals of the chalcogenides, and most of their studies were on bulk samples, although optical investigations often required thin films.

The IBM researchers thought that EuO and related chalcogenides might provide an alternative to other magnetic materials, such as ferrites and thin-film permalloy, in the development of disk-drive technologies. Fred Holtzberg, a remarkably inventive materials chemist, and colleagues had also shown that the chalcogenides could be doped and that the magnetic characteristics were a strong function of the carrier concentration.[2] In fact, complementary measurements indicated that the transport properties were a strong function of the magnetic state of the material and could be manipulated through either temperature or magnetic field. At the same time, Leo Esaki and colleagues—most significantly the outstanding physicist Phill Stiles—were exploring thin-film semiconductor technologies for potential applications in computers. It was, therefore, a natural development to wed semiconductor and magnetic-materials physics to provide additional functionality to semiconducting devices.

The Esaki collaboration's tunneling spintronic device,[3] arguably the first, consisted of a junction of normal-metal electrodes separated by a chalcogenide magnetic insulator, Eu combined with either sulfur or selenium. The current–voltage characteristics depended on the insulator's magnetic state, and a value of the conduction-band splitting in the ferromagnetic state was extracted from the data.

Another significant early article on tunneling behavior appeared four years later. By that time, after IBM had learned how to make relatively clean Schottky barriers with the Eu chalcogenides, several experiments showed that the capacitance and transport characteristics of such junctions were also affected by magnetism.[4] The nonlinear current–voltage characteristics of the tunneling current through the barrier were dominated, once again, by the magnetic state of the EuS. In fact, reference 4 describes the band splitting also discussed in the PHYSICS TODAY article. Furthermore, with a detailed analysis of the zero-bias conductance, one could extract the magnetization of the material.

I hope that interested readers of the article by Moodera and coauthors will find this historical note valuable.

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When Holmdel lab opened for business

I find it curious that in his article on laboratory architecture (PHYSICS TODAY, April 2010, page 40), Stuart Leslie gives 1966 as the opening date of the Bell Labs facility in Holmdel, New Jersey.

As a young engineer in the electronic switching development department, I and many others worked in one of the mirrored cell blocks in 1963. I began work at the original Whippany facility in June 1960 and moved to the Holmdel location in, I believe, late 1962.

Buildings were still being constructed after I left for graduate school in 1963, but the facility was already operating with both lab and office space at that time.

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