GERMAN UNIFICATION WILL STRENGTHEN PHYSICS THROUGHOUT COUNTRY

Marshall Foch, the supreme commander of the Allied forces at the end of World War I, is reputed to have once said to a subordinate: "Don't call up! Go see!" In that spirit, it was decided here at PHYSICS TODAY that it might be a good idea on the eve of German reunification to go see what reunification would mean for German physics. A meeting of the International Union of Pure and Applied Physics, which took place the last week of September in Dresden in what at that time was still just barely the German Democratic Republic (see PHYSICS TODAY, November, page 77), provided an opportunity to talk with some East German physicists about what lay ahead and to gather some general impressions about whether the unification of the country would leave physics stronger or weaker.

My first day in Dresden, walking about the market and the historic sections of town, I began to get the uneasy feeling that I had been carried back to a *West* German town circa 1960. The architecture, the cars and the texture of life itself were almost exactly the same as when I had lived in West Germany in the late 1950s and early 1960s. Sitting at the IUPAP meeting later that afternoon, I told the East German physicist who was responsible for the conference arrangements that I felt as though somebody had stuck me in a time machine and carried me back 30 years. He gave me a very level, serious look and said, "I think that is a very exact observation."

Damage from the British–American bombing of Dresden in February 1945 is still very much in evidence in the city, and when I was flying back to the United States, I felt that I had been on some kind of personal pilgrimage, as well as an intelligence mission for the physics community. And so I took out a copy of Kurt Vonnegut's *Slaughterhouse Five*, a little novel that is in some sense about the bombing of Dresden, which Vonnegut experienced as an American prisoner of war. In light of my own impressions of Dresden, it was not so surprising to me to find a time machine as one of the central motifs of the book. But I have to say that it did come as something of a shock to me, Bill Sweet, when I arrived at Vonnegut's first sentence: "Billy Pilgrim has come unstuck in time."

SWEET

Bombed-out castle in the center of the historic district of Dresden, just across the Elbe River from the newly built international hotel where the International Union of Pure and Applied Physics held its meeting at the end of September. The somewhat startling resemblance of the castle's towers to the tower that one sees in the middle of the most famous photographs of bombed-out Hiroshima is to some extent a temporary coincidence: Until recently the towers were completely gutted, and the steel frameworks for the cupolas were just added in preparation for full restoration.

A community in shock

Obviously one should not overgeneralize from an eccentric personal experience of a very special place. Basically, though, every place I went during my ten days in East Germany, my impressions were much the same. The physical appearance of things almost always was quainter and more charming, and the pace easier, than in a booming metropolis like Frankfurt or Hamburg. But there also was a discomfiting sense of the war, and of Nazism, being much less far removed in time. And there was an acute sense of the enormous adjustment that East Germans now will have to make to get into step with their West German compatriots.

For the East German physics community, the adjustment will border on the traumatic. Under the terms of the unification agreement that was concluded just weeks before the country's division ended on 3 October, the East German Academy of Science has been abolished, and every major scientific institution in the five East German states is under review by a committee of Germany's *Wissenschaftsrat* (Science Council), an advisory group that reports to the federal

Max Planck's New Policy toward East

On 15 November the Max Planck Society's governing senate adopted a resolution providing for the creation under the aegis of the society of new "working groups" and "project groups" in the five eastern states just incorporated into the Federal Republic of Germany. The working groups are supposed to be small teams that will be set up in close association with universities for up to five years; each will collaborate closely with at least one existing Max Planck institute, and each will have teaching as well as research responsibilities. The project groups are intended to be larger and possibly permanent: They either could be prototypes for new Max Planck institutes or, in exceptional cases, could be created as new institutes outright.

In a letter sent to members of the Max Planck Society in late October, Hans F. Zacher, the society's president, emphasized that finding additional funding for the new working groups, project groups and institutes will depend on preparation of convincing proposals. He asked members to submit an initial batch of proposals to his office by 30 November, so that the society senate can decide on recommendations by 30 March 1991. Zacher said that recommendations would take account of initiatives from the Science Council, which is evaluating all major research institutions in the five eastern states, as well as proposals from Max Planck society members.

The door seems to be open, in other words, for conversion of some East German research institutes into Max Planck institutes, contrary to a policy enunciated by Zacher last summer.

The idea of creating working and project groups was formulated this year by the society's presidential commission, in keeping with what it termed three fundamental principles of the society: support of significant researchers under conditions that minimize distracting responsibilities; support of newly developing fields, especially extra- or cross-disciplinary fields that are not yet ripe for incorporation into the curriculums of the technical universities; and support of novel research tasks requiring especially expensive or unusual equipment that cannot easily be provided by universities.

The commission described the working-group concept as consistent with the principle of transferring research in the five eastern states from the old East German Academy of Science institutes back into the university system. Each group is to be headed by an East German researcher, each is to exchange personnel regularly with a sponsoring MPG institute and each is to be subject to review by the sponsor's advisory board of internationally recognized experts. Each will have substantial teaching responsibilities, and each will carry the designation "Working Group of the Max Planck Society at University X."

Project groups can be established for limited periods of time, where completion of a research project can be anticipated, or—in a testing or definition phase—as a preliminary step to the creation of a full-fledged Max Planck institute. Preference will be given to research fields that up until now have not been funded at all or have been funded inadequately, and thus are ready essentially to be built from the ground up. Consideration also will be given, however, to conversion of academy institutes, on recommendation of the Science Council. Like the working groups, the project groups will be expected during the transition period to assume more pedagogical responsibilities "than has been normal up until now in the Federal Republic," the commission said.

—WS

and state governments.

To judge at least from the reception given technical presentations at the IUPAP meeting in Dresden, and from laboratory tours offered in connection with the meeting, most East German physics lags well behind forefront research in the field. And so, when the Science Council completes its work in 1991 and reports to the government, it is to be expected that many institutes will be closed completely and that many others will be sharply scaled back. A lot of older German physicists will lose their jobs and will have to take early retirement, and a lot of younger East German physicists—who did not have a lot of respect for their elders to begin with—will look to the West. "Unless we can find some way of making some very positive signs quickly," said Karl Lanius, a leading East German particle physicist who works at CERN, "this will become a country of old people." (Lanius was a member of the DDR's IUPAP delegation at Dresden.)

Because of the way East Germany's economy has collapsed in the process of unification, and because of the region's general backwardness vis-à-vis the West, it commonly is asked whether unification has yielded a country that is less than the sum of its two parts. And so it is natural to raise this question in connection with physics.

My overall impression, despite signs to the contrary and many uncertainties, is that physics will come out quite a lot stronger. First of all, the admittedly exacting review of East German physics institutions will leave the ones that survive leaner and tougher, and their full exposure to the bracing air of Western science will give them a strong new pulse. Beyond that, there will be an exchange of people between East and West that will leave many individuals and groups working harder, with more enthusiasm and with greater creativity.

Institutes and industry

East German science was done primarily in a network of institutes—some 50 in all—organized under the aegis of the Academy of Sciences. Around 24 000 professionals were working in this complex at the time unification took place, and many of the academy's institutes were very large: For example, the Central Institute for Electron Physics in Berlin employed about 650 scientists and the Central Institute for Nuclear Research in Rossendorf (near Dresden) about 1400; about half the scientists at both institutes were physicists.

The East German system closely resembled the USSR's, except that the East German academy is thought to have been even more deeply politicized than its Soviet counterpart. It is said, for example, that the (pre-*perestroika*) Soviet government could veto nominees to the academy but not impose a nominee, while in East Germany the government could and did insist on its own people. Party membership was a prerequisite for appointment to managerial positions in the science complex; department heads and team leaders often were selected from a pool of individuals determined, at a young age and heavily on the basis of party loyalty, to be eligible for such positions; and of

course all researchers working in sensitive areas had to obtain security clearances from *Stasi*, the hated secret police. Partly because of such practices, many of the larger institutes are considered to have been badly run, overstaffed and underproductive.

This is not to say that East Germany was wholly without institutes capable of doing world-class work. For example, the Institute for High Energy Physics in Zeuthen, where Lanius was director for more than 20 years, has been a participant in experiments at DESY in Hamburg and CERN in Geneva, as well as at Serpukhov and Dubna in the USSR. The Zeuthen institute built part of DESY's H1 and CERN's L3 detectors, and about ten East Germans currently are working in the L3 group. Lots of East German particle physicists have worked in the Soviet Union, Lanius told us in Dresden.

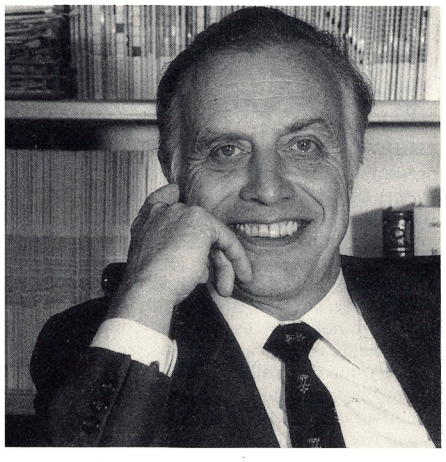
According to Lanius, the special strength of East German particle physics has been just the area where Western Europe and even more the United States have been weakest—training technicians to work over the long haul on machinery, equipment and instruments that require a deep acquaintance and loving care.

Emphasis on applied physics

Generally the emphasis in East German science has been overwhelmingly on the applied side. In recent years, Lanius told us, East Germany's most prestigious award—the *Nationalpreis*, or National Prize—almost always went to work done in microelectronics, lasers or applied optics.

Suffering as they did from a double embargo—first, the formal COCOM embargo on export of sensitive technology from West to East, and second, the informal but not trivial effort by the big industrial players in information technology to prevent seepage of proprietary knowledge—East German physicists were working at a considerable disadvantage. Still, researchers in Jena and Dresden somehow managed to produce, two years ago, a 1-megabit dynamic random-access memory chip. And until the walls suddenly came tumbling down a year ago, it looked like the East Germans were positioning themselves nicely to dominate the whole Eastern Bloc market for microelectronics technology.

Hans-Joachim Queisser



Now, instead, in addition to being exposed to the gale winds of Western competition, the East German institutes are being subjected to an unsentimental review by their big brothers from Bonn. According to Helmut Gabriel, the theoretical physicist at the Free University of Berlin who is heading the Science Council subcommittee conducting the review, 12 institutions involving physics will be visited and evaluated: in Berlin, the Central Institute for Electron Physics, the Center for Construction of Scientific Instruments and the Central Institute for Optics and Spectroscopy; in Zeuthen, the Institute for High Energy Physics; in Potsdam, the Einstein Laboratory for Theoretical Physics and the Center for High Pressure Research; in Frankfurt on the Oder, the Institute for Semiconductor Physics; in Leipzig, the Central Institute for Isotope and Beam Research; in Dresden, the Central Institute for Nuclear Research (Rossendorf) and the Central Institute for Solid State Physics and Materials Research; in Halle, the Institute for Solid State Physics and Electron Microscopy; and in Jena, the Physical–Technical Institute.

While the situation is changing very rapidly, at this writing the following can be said:

▷ The Max Planck Society has decided to encourage its institutes to sponsor newly created research groups at universities in the eastern states and to propose larger groups that could become Max Planck institutes (see box, page 60). Earlier, the president of Max Planck, Hans Zacher, had said that the society would *not* take over or participate in any of the East German institutes.

▷ Good scuttlebutt has it that at least 20 East German institutes have survived the Science Council review so far, and that 13 will enter into partnerships with institutes sponsored by the Fraunhofer Society, a counterpart in applied science to Max Planck. Conceivably, some institutes could be converted into national labs (*Grossforschungseinrichtungen*). Currently there are 13 such labs in Germany's western states.

In addition to the East German institutes, there are the large industrial *Kombinate* or "combines" to be concerned about—VEB Mikroelektronic in Erfurt, for example, which is said to employ 1200 scientists and engineers in its research laboratory, or Carl Zeiss Jena, a participant in the development of East Germany's prided 1-megabit chip. Many such industrial combines already are in bankruptcy, desperate to be bailed out by West German—or Japanese or European or US—companies. In the meantime, what will the nervous staff members of such combines and institutes do?

Go west, young man?

The assumption is widely held that there will be a big migration of East German scientists to the West German states (and to other countries as well), but this may be more in the nature of a medium-term phenomenon than something that occurs abruptly. In the first place, as many West German observers point out, the industrial market for researchers has been tight in what was until just now West Germany. Second, there are unresolved questions as to the qualifications and numbers of potential East German applicants. And finally, it is unclear to what extent even a Germany writ large is ready to go head-on with the Japanese and with North America in the areas of industry-relevant research that have become most fiercely competitive.

We discussed these issues in a telephone interview with Hans-Joachim Queisser, a director of the Max Planck Institute for Solid State Physics in Stuttgart. Queisser is one of Germany's most influential physics leaders and was the main author of a report five years ago to the West German government on the future of information technology, in which it was recommended that the government do much more to sponsor electronics research at the national labs, the institutes and the universities.

Commenting on a statement in a recent issue of *The Economist* that there are "no West German equivalents to the American basic-research laboratories run by IBM, AT&T, Exxon [and] Xerox," Queisser said that the sentence—despite a certain appearance of exaggeration—"is not altogether too wrong." Queisser said that only Siemens still maintains a major research laboratory, in Munich, and that even it is devoted

primarily to product development. (Siemens decided several years ago that chip development was the key to its future and recently entered into a joint agreement with IBM to develop the 64-megabit DRAM at IBM's East Fishkill, New York, facility. Each partner is putting about $225 million into the project.)

Pausing, Queisser mentioned that very good work is being done in silicon molecular-beam epitaxy by a team lead by Erich Kasper at the old AEG–Telefunken laboratory in Ulm, which Daimler–Benz acquired several years ago. Daimler, having now also acquired Messerschmidt–Bölkow–Blohm, Germany's largest aerospace company, is consolidating its research operations in Ulm, albeit more slowly than planned, Queisser said.

Also not to be left out of account, Queisser conceded, are the research laboratories run by Germany's formidable chemical industry. To name just one, BASF operates a gigantic central R&D laboratory in Ludwigshafen that employs a research staff on the order of 10 000. BASF is one of the three lineal descendants—the others are Hoechst and Bayer—of I. G. Farben, the giant chemical combine that was broken up after World War II because of complicity in war crimes. On the world scene, BASF ranks second only to Du Pont; as at Du Pont, much of the research at BASF stretches a long way into applied physics.

Qualifications and commitment

Queisser seemed skeptical as to whether East Germany will have much to offer West German industry. Because of the COCOM embargo, which made it impossible for parties in the Eastern Bloc to obtain from the West things like photoresists, ceramic packages or high-purity silcon slices, Queisser said East Germany had hoped to build a rather strong position as supplier of such items among the Warsaw Pact nations. "This was done with great priority, but also with great bureacracy and great secrecy. And these things don't work very well."

As for East Germany's 1-megabit DRAM, only a few showpiece items were made, Queisser said, and they looked a lot like the Toshiba–Siemens DRAM. "The Siemens people say, well, it looks strangely very much like ours and the Toshiba, but we didn't give it to them. So one can only speculate about how they came into possession of masks and so on."

While Queisser agreed with people like Lanius that East German physicists did surprisingly well, improvising with what they had—"they did rather nice experiments with limited pieces of equipment, limited ability to travel and limited access to international literature"—he feels such work was done mainly by the older physicists, those who may now be in danger of losing their jobs, rather than the young. Queisser said that the number of East German physics graduates was sharply curtailed in recent years by government decree, and that the policy emphasis was all on electrical engineering, chemical engineering and so on.

Spiritual environments

Despite Queisser's skepticism and pessimism, the logic of the situation would seem to suggest compellingly that applied research labs and institutes in the Western parts of Germany will benefit considerably in the medium term from acquisition of East German personnel. The East Germans are well trained, and the West can offer them not only much higher pay, but also a much more modern cultural environment.

It is true, as the novelist Günter Grass observes in his recent book *Two States—One Nation?* (Harcourt Brace Jovanovich, 1990), that East Germany offered "a slower pace of life," a "society of private niches." But it also seems to be true, as Thomas Schmid observes in another recent evaluation (*Staatsbegräbnis*, or *State Funeral*, Rotbuch, 1990), that East Germany was a country in which an officially decreed socialism and antifascism had stripped people of all true sense of the past. "Before the German Democratic Republic there was something dark that one was not permitted to touch; this other thing was to be sure still alive, but there was no language to discuss it in, and the great majority of people didn't want to discuss it," writes Schmid, a Green Party intellectual based in Frankfurt on the Main.

West German society, despite many evasions and diversions one still sees and hears, is a society that has taken a long, hard, unsentimental look at itself in the last 45 years. It seems a foregone conclusion that many East German intellectuals, both physicists and others, will prefer to live in a society that has done that to one that has not.

But let us give Grass's viewpoint its due. East Germany also has its attractions, and East German universities in particular may benefit from being in an environment that is attractive to some intellectuals.

Under the constitutional formula that led to the unification of Germany, the five East German *Länder* (or states) were admitted to the Federal Republic as co-equals of the West German states. Because higher education is primarily a responsibility of the states rather than of the *Bund* (or federation) in the German constitution, the East German university system—unlike the academy—has been left essentially unaffected by the unification. Compared to the West German universities, however, the ones in the East have a lot less money.

Probably there will have to be some kind of special Federal appropriations for the East German universities, and rather soon. As far as physics and the rest of the natural sciences are concerned, the principal funding mechanism is almost sure to be the *Deutsche Forschungsgemeinschaft* or German Research Society, Germany's counterpart to NSF, which is half supported by the federal government and half by the states. DFG has asked for special budget increases to support research and teaching in the five eastern states, beginning with 9% in 1991 and rising to 25% by 1996, but at this writing the government has yet to act on the request. The Cabinet did agree on 13 June, however, to appropriate DM 4 billion ($2.65 billion) to support graduate work and research by young scientists over a ten-year period, and a fair share of that money presumably will be available to East German physicists.

Ideology

Money aside, there is of course another important respect in which the East German universities have differed from those in the West, namely Marxism–Leninism. No doubt there will be some kind of effort on the part of the Federal government to purge some tenured faculty in the East, especially in the social sciences, but it is unclear how much this will affect physics.

As a natural science, academic physics in the East may have been relatively immune to ideological pressures; on the other hand, nobody claims that it has been very impressive, and one rarely hears mention of any particular university physicist having done anything especially noteworthy by world standards. Apparently academic physics in the East did not fare as well as some other fields in which Germans traditionally have excelled—philology or history, for example.

University physics in the five eastern states would appear to be ripe for

improvement, and so it would not be surprising to see a counter-migration of West German scholars to the East, matching—maybe with a rather long lag—the migration of researchers and technicians from the East to Fraunhofer and Max Planck institutes and to industry labs in the West. The West German university system—despite the uprisings of the late 1960s, despite huge increases in general enrollments and despite the opening of new universities with progressive agendas—has remained remarkably bound in tradition. As a result one finds a great many hungry young scholars in the western states doggedly competing for a surprisingly small number of choice positions. Under the circumstances, it stands to reason that many of those who have stayed committed to academic careers despite poor odds will now eagerly train their sights on new positions opening up in the five eastern states. There, they will have the opportunity to settle in communities that are still quiet and charming, to propagate the knowledge and wisdom of the West, and—once again—to help make names like Jena, Halle and Leipzig world famous.

In the months prior to unification, authorities toyed with the idea of abolishing Humboldt University, the historic university of Berlin, because it has been cloned by the (much superior) Free University of West Berlin. It seems now that Humboldt will survive and that Berlin is destined—taking the Technical University into account—to be home to three major universities.

—WILLIAM SWEET

AIP MEETING AT SANDIA FOCUSES ON TECHNOLOGY TRANSFER

Industrial competitiveness, especially in high technology, has become a critical concern in the US. Some companies are having to pare their basic-research budgets, and many consider the cost of translating new ideas into products prohibitive. Increasingly companies are combining forces, and industrial firms are more willing than ever before to contemplate cooperative ventures with the national laboratories. For a number of reasons, the labs also are increasingly receptive to partnerships with industry. And so, this year when AIP's Corporate Associates gathered for their annual meeting, the featured theme was "emerging technologies and technology transfer."

The Corporate Associates are corporations and organizations that provide advice to AIP and that pay dues in support of AIP's activities. Their meeting took place this year on 23–24 October at Sandia National Laboratories in Albuquerque, New Mexico.

In his welcome to the gathering of industrial, university and AIP society leaders, Venkatesh Narayanamurti, the vice president of research at Sandia, gave some background on the lab. Sandia is a multiprogram DOE laboratory that concentrates on the research and development of nonnuclear components for nuclear weapons, and the assurance of the safety and security of those weapons. Together with the other two nuclear weapons laboratories—Lawrence Livermore National Laboratory and Los Alamos National Laboratory—Sandia is now seeking a broader role. It currently has programs in semiconductor physics, pulsed power, computer science and materials science. Sandia developed expertise in all these fields to serve its main mission, but can apply this expertise to other areas as well, Narayanamurti said. He added that the lab is trying to make itself more "user friendly" to facilitate programs in technology transfer.

CECELIA BRESCIA

Making a point, Edward Stone of Caltech answers a question following his talk about the Voyager mission to Neptune.

Emerging technologies

The first group of talks on the program centered on the theme of technology transfer. James Gerardo of Sandia spoke about the lab's work in thin film synthesis and surface modification, which formed the basis for Sandia's Semiconductor Equipment Technology Center, funded by Sematech, the US semiconductor research consortium. Paul Peercy, also of Sandia, discussed semiconductor materials and devices that exploit the strain-induced electrical and optical properties of layers of lattice-mismatched semiconductors. Both speakers gave examples of projects in which Sandia researchers had collaborated with private industry.

Wilfred Veldkamp of MIT Lincoln Laboratories spoke about the possibilities of binary optics, which are based on diffraction rather than refraction. Federico Capasso of AT&T Bell Labs discussed several promising quantum electron devices.

In a group of talks dealing with policy matters, Ray Balcerak of the defense manufacturing office of the Defense Advanced Research Projects Agency addressed the government's role in fostering a competitive technology base. DARPA is one of several government agencies that have been very concerned about the decline in the US share of the world semiconductor industry. The regulatory side of technology was addressed by Rowland Redington of the General Electric R&D Center, who reviewed 20 years of government oversight with respect to diagnostic imaging devices such as CAT scanners.

The Corporate Associates had looked forward to a scheduled address by New Mexico Senator Pete Domenici, but the prolonged debate over the budget confined the lawmaker to Washington, DC. However, technology helped to transfer his speech to the Sandia auditorium: He sent a videotaped presentation and was on the telephone just after the tape was shown to answer questions from the audience. Domenici has cosponsored bills facilitating technology transfer and was instrumental in establishing Sematech. Domenici also helped to double DOE's defense programs budget for technology transfer to $20 million. In his taped message, he noted that industry, which showed little interest in technology transfer for about 15 years, has looked upon it more favorably in the last three years.