energy, though of course it will be much harder to do experiments at the higher luminosity—a result of the higher data rates, which challenge current technology. He said even without the higher luminosity the LHC will be extremely effective in the region below 500 GeV, "where the most interesting physics may well turn out to be," and it also will be able to do a lot of exciting B physics, including probably a study of *CP* violation. "The physics associated with mass generation and supersymmetric particles could in principle lie anywhere in the range 60 GeV to 1 TeV. I expect there to be important new physics below 500 GeV."

As for the Higgs boson, Llewellyn Smith said there are arguments that the notion of the Higgs makes little sense if its mass is greater than 1 TeV and that if our understanding of the mechanism is right, it ought to be found below that mass. He said that the standard Higgs boson could be found anywhere from 60 GeV to 1 TeV, although the physics of mass generation could conceivably only appear above 1 TeV; from this point of view, the SSC provides more of a margin of safety, he conceded.

LHC politics

Even as the scientific arguments for the LHC have become clearer and stronger, its political prospects have become murkier, mainly because of the higher-than-expected costs of German reunification and the strain those costs have put on the European monetary system and other European economies. The German government is believed to prefer a decelerated schedule for the proton–proton accelerator, which otherwise might actually be finished ahead of the SSC.

Llewellyn Smith is not convinced that the "horse race" with the SSC is all that important. He considers that there is an outstanding case for the LHC, independent of the timing, although a slowdown would damage the momentum of the project and have very serious consequences for the morale of the hundreds of physicists who are committing substantial parts of their careers to LHC experiments.

Echoing remarks made by a young particle physicist at the University of Cambridge during a visit PHYSICS TODAY paid last February, Llewellyn Smith seemed particularly irked by perceptions that particle physics constantly costs more money and that particle physicists always are asking for more still. He said that CERN's budget in real terms currently is about 15% lower than it was in the early 1970s and that British domestic funding for particle physics—which the Kendrew committee said should be cut 25% over a period of years—in fact has been cut by about 40% since 1985.

Llewellyn Smith admitted that if the UK wishes to contribute appropriately to the big LHC detectors, this will require extra domestic appropriations. But he said he hoped that, given the care with which the detailed detector proposals are being prepared and evaluated, CERN could proceed on the basis of realistic estimates and avoid the subsequent "descoping" of the proposals that has happened with the SSC.

Technical status of LHC

Detector proposals were to be presented to a CERN committee on 5 November, and according to CERN's Walter Hoogland, who is research director for LHC physics, it is hoped that two of the three competing proposals will be selected by March or April 1993. Final authorization of the detectors will have to await authorization of the whole machine, of course.

Originally there were four competing detector proposals, but after a meeting at Evian, France, last March, EAGLE and ASCOT merged into a new combined proposal called ATLAS. This could be an air-core superconducting toroid or a more conventional warm iron-core toroid similar to the EMPACT detector once proposed for the SSC. The spokespersons for ATLAS are Peter Jenni of CERN and Friedrich Dydak of CERN and the Munich Max Planck Institute for Particle Physics.

The other two competing proposals are the Compact Muon Spectrometer and L3P—where P stands for proton—which would involve rebuilding the LEP L3 detector led by Sam Ting. The spokesperson for CMS is Michel Della Negra.

People at CERN indicated earlier this year that the first magnet string test for the LHC might take place this fall. But Georgio Brianti, who is responsible for planning the machine, says that the test now is expected to take place next summer.

Construction of the LHC prototype magnets has been partly delegated to four private companies, and individual magnets already tested have achieved a field strength of 10 tesla. Still, the Large Hadron Collider evidently has not been immune to magnet development problems. Contractors, struggling with the most exacting specifications ever set for magnets, have had some trouble meeting deadlines, according to CERN's spokesman.

—WILLIAM SWEET

LUCKY LEAVES AT&T TO MANAGE APPLIED RESEARCH AT BELLCORE

Robert W. Lucky, formerly the head of communications research at AT&T Bell Labs, has taken office as Bellcore's vice president for applied research. He succeeds Alan G. Chynoweth, who had reached the mandatory retirement age.

An authority on digital technologies, Lucky was lucky to head up a part of Bell Labs that has grown rapidly in recent years, even as efforts in physics hardware and materials were somewhat de-emphasized. At Bellcore, the research organization created in the 1984 breakup of Bell Telephone to serve the seven regional "Baby Bells," Lucky will help guide much the same kind of reorientation of research.

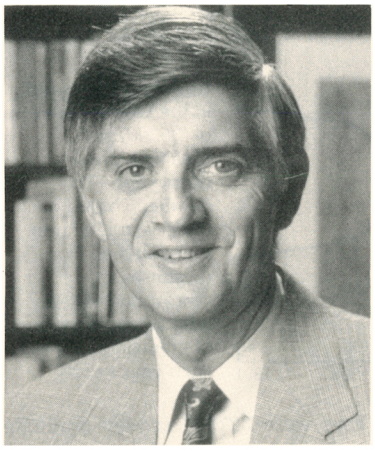
Interviewed by phone his third day in his new job, Lucky told PHYSICS TODAY that he already was struck by how different the Bellcore culture was from AT&T's, even though the two organizations started out from the same place in 1984. One big difference, he said, has to do with their respective customers: While Bell Labs serves some 20 business units, these do not compete with each other; the Baby Bells, on the other hand, increasingly do. On top of that, he said, antitrust regulations are much more of a concern at Bellcore.

To the first order, Lucky agreed, the Baby Bells have essentially similar technical interests and objectives. But at the second order, he said, profound differences appear.

Strategic objectives

Having just been immersed for three days in meetings with his new colleagues, Lucky seemed to be in an unusually philosophical mood for a research director. He wondered, given that the problems of greatest interest now have to do with software, how research can contribute to solutions. He worried that it may be harder to discern results in software research, as compared with hardware. He wondered how research does actually enhance competitiveness.

Lucky said he knew he had a limited time to revitalize Bellcore's



Robert W. Lucky

research program and to shape it to the rapidly evolving needs of the company.

Early last year Bellcore brought in George H. Heilmeier, who at that time had the top technology job at Texas Instruments, to head the organization. Heilmeier came to Bellcore with a reputation for having an aggressive leadership style as well as substantial scientific accomplishments—he was a former head of the Defense Advanced Research Projects Agency, where he had helped launch stealth aircraft technology, and as a young researcher at RCA he made discoveries that led to the first liquid crystal displays. Besides setting out to improve Bellcore's efficiency and lower costs, he wasted no time in setting new directions for Bellcore and by summer 1991 had formulated seven strategic objectives, which remain in effect:

▷ contributing to improved efficiency and cost-effectiveness of client company operations

▷ building robust networks and operations

▷ creating voice and voice-messaging services

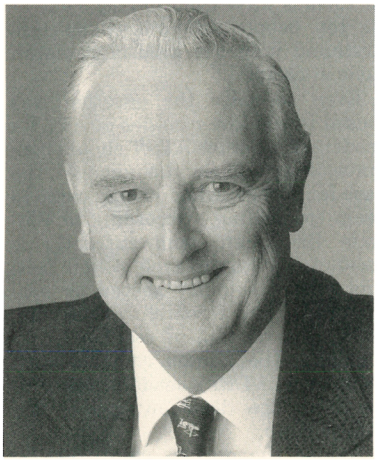
▷ enabling "nomadic" (mobile) personal communications and computing

▷ facilitating migration from private data networks to public data networks

▷ bringing "video dial tone" technologies to the applications stage to support delivery of video entertainment, teleconferencing, video telephony, multimedia information retrieval, and messaging

▷ providing technical support for new information services, both to network operators and to service providers.

Alan G. Chynoweth



As Lucky's predecessor Chynoweth said in a conversation with PHYSICS TODAY, the agenda facing telecommunications companies today is "very complex." Lucky said he just hopes his new job permits him to "have some fun with all the technology and science" and that finding funding doesn't consume all his time.

Perspectives from Chynoweth

Chynoweth looks back on an era of dramatic changes in telecommunications. These have included problems associated with the development of high-speed digital networks capable of providing universal voice, data and video services and the development of personal radio communications networks capable of offering universal connectivity. Both the service control problems and network control problems, often across heterogenous networks, are extraordinarily challenging, he told PHYSICS TODAY.

Commenting on changes at Bellcore in the last two years, which one source characterized as a "process of eliminating all forward-looking physics, materials and device work," Chynoweth said that such accounts are somewhat exaggerated, though "we have been making changes." He said that Bellcore had started its life understaffed on the software side, but that this has been rectified steadily year after year. He confirmed that some researchers were asked to find new jobs both in fall 1990 and in fall 1991—about a half dozen the first year and about a dozen the second. He said Bellcore's whole professional research staff numbers 460–500, with about 100 in the physical sciences—half in research, half in engineering.

Chynoweth asserted that the physical sciences group can claim achievements that are out of all proportion to its size, including optical laser arrays, multiplexers and acoustic-optic switches, batteries and high-temperature superconducting devices. He specifically mentioned development of the vertical cavity surface-emitting laser array, which enables one to have a million lasers on a single chip all emitting vertically.

Chynoweth credited the research staff with having provided the technical underpinnings for SONET, the synchronous optical network, and SMDS, the switched multimegabit data service, as well as with developing the research prototype of Video Window, the innovative teleconferencing system Bellcore both licenses to others and uses itself for conferencing between its facilities at Red Bank and Morristown, New Jersey.

Biographical background

Chynoweth was vice president for applied research at Bellcore from its inception. Previously he had worked at Bell Labs since 1953, most recently as executive director of the electronic and photonic devices division. Before that he had served as head of the crystal electronics research department and as assistant director and director of materials research. He earned his bachelor's degree and doctorate at the University of London in 1948 and 1950, respectively, and from 1950 to 1952 he was a research fellow with the Canadian National Research Council.

Like Chynoweth, Lucky spent virtually his entire career at Bell Labs before joining Bellcore. Before being named executive director for research in the communications sciences in 1982, he was assistant director and director of electronics and computer systems research, head of the digital switching and processing research department, head of the advanced data communications department and supervisor of the signal theory group. He joined Bell Labs in 1961 after earning his bachelor's, master's and doctoral degrees in electrical engineering at Purdue University.

From 1986 to 1989 Lucky served as chair of the Air Force's science advisory committee. He is the coauthor of a widely used textbook on data communications as well as the author of a popular book, *Silicon Dreams* (St. Martin's Press, 1989).

Lucky's position at Bell Labs has been filled by Arun N. Netravali, who was director of computing systems research and project manager of AT&T's high-definition television project with Zenith. Netravali is the author of many papers and patents on digital encoding and video processing. He has taught graduate courses at City College, Columbia University, MIT and Rutgers.

—WILLIAM SWEET