

Abragam and Rubbia reports chart future for CERN

In assessing whether physics, science and society would be best served by building a 20-on-20-TeV "super collider" somewhere in the United States or something like a 7-on-7-TeV "large hadron collider" in the tunnel for the Large Electron-Positron Collider at CERN, the recurrent problem has been that most significant arguments tend to cut both ways. This is true of the arguments contained in two major reports that were issued this summer on the future of CERN, and it was true of the arguments in the report prepared two years ago by a British committee headed by John Kendrew.

In 1985, when the Kendrew committee recommended cutting the CERN budget by 25% and told particle physicists that their interests would be best served if they slowed down, some British particle physicists felt it was a "knee in the groin," as British theorist Christopher Llewellyn Smith told us at the time (PHYSICS TODAY, September 1985, page 67). The Kendrew group may indeed have been proceeding from the assumption that the United States would build the Superconducting Super Collider, so that construction of a smaller hadron collider at CERN would be unnecessary. But the argument the Kendrew group made for a slowdown in particle physics was not confined to the European community. What the group said was that particle physics should slow down worldwide, and that may be why American particle physicists such as SLAC's Burton Richter and Fermilab's Leon Lederman did not like the report any better than their European counterparts did.

Following the release of the Kendrew report, the CERN Council set up a management review committee under the chairmanship of the French physicist Anatole Abragam to evaluate the future of CERN under alternative funding scenarios. The council also established a long-range planning committee under the chairmanship of Italian particle physicist Carlo Rubbia to assess major new scientific projects for the lab. With the LHC, the SSC and



Placing the first magnet for the Large Electron-Positron Collider in a ceremony at CERN on 4 June, Gérard Bachy, leader of the LEP installation group, is at the extreme left, flanked to the right by LEP project leader Emilio Picasso, French Premier Jacques Chirac, Swiss President Pierre Aubert, CERN Director Herwig Schopper and French research minister Jacques Valade.

the future of CERN all hanging in the balance, the two reports have been eagerly awaited.

In June the CERN Council received a preliminary report from the Abragam group and a draft report from Rubbia's committee, and the reports are not a disappointment. Inspired by a frank desire to keep Europe's CERN at the forefront of particle physics, both reports are bold and sophisticated documents, based on a much larger amount of work than ordinarily informs advisory statements of this kind. In contrast to the Kendrew report, the reports seem to be meeting with a highly favorable reception among particle

physicists on both sides of the Atlantic. Nonetheless, the ultimate effect of the reports may be to sharpen unresolved questions about what kind of major new accelerator should be built, when it should be built and where it should be built.

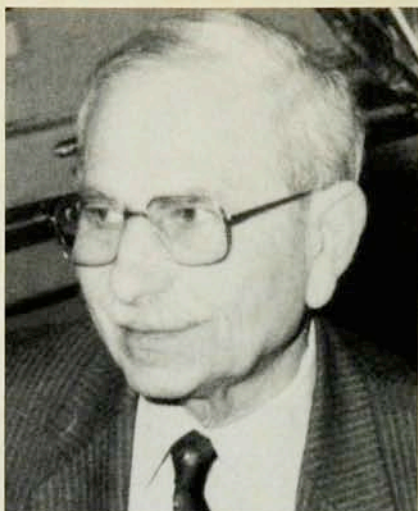
Abragam committee. One thing just about everybody seems to agree on is that of the two reports, the Abragam report has more immediate significance for CERN. The Rubbia report, while of great interest in technical detail, says by and large what it was expected to say—it makes a strong pitch for building the LHC in the LEP tunnel and, as a possible alternative, it

examines the idea of building a large, advanced linear collider at CERN, the so-called CERN Linear Electron Collider. In contrast, nobody knew quite what to expect from the Abragam committee, and some feared the worst.

The Abragam committee operated under a mandate from the CERN Council that specifically invited it to consider big cuts in the CERN budget or political changes that might fundamentally alter CERN's character. The committee was to advise the CERN Council on how resources could be optimized "to operate with maximum cost effectiveness and value for money at alternative levels of funding by present member states" and to "assess the possibilities for engaging and enlarging other sources of funds and resources."

Given the heavy representation of industrial management on the committee and the apparently weak representation of the particle physics community, some physicists worried that organizational details might loom larger in the committee's mind's eye than the ultimate scientific mission of the lab. The seven-member committee included two industrial magnates, Carlo De Benedetti of Italy's Olivetti and Haakon Sandvold of Norway's Norsk Hydro, a Swiss management consultant, Jean Vodoz, and a former finance and economics minister from Spain, Miguel Boyer. Apart from Abragam, the physical sciences were represented by Brian F. F. Fender, a physical chemist who is a former head of the Institut Laue-Langevin in Grenoble, and Wolfgang Paul of the University of Bonn, the head of West Germany's Humboldt Foundation. Llewellyn Smith and Pierre Petiau, a particle physicist who now works for the ministry of research in Paris, served as advisers to the committee.

Abragam himself seemed to be something of a wild card. A faculty member at the Collège de France and a former head of physics for France's Atomic Energy Commission, Abragam is known to have a personal preference for small physics and a skeptical attitude toward the claims of big science. "To obtain the large sums of money necessary for the projects of Big Science the scientists must convince people who have an influence in government circles or on the public opinion of the validity of their demands. . . . All too often it is the very bigness of the project, striking the imagination of the public, rather than its real usefulness to the progress of science that is being put forward," Abragam wrote in *Reflections of a Physicist* (Oxford U.P., 1986). "It is all the more regrettable," he continued, "that in each country the



Anatole Abragam, the head of the CERN review committee, once described particle physics as "pure tragedy." He meant that it is like classical tragedy, in which unessentials are stripped away to reveal the interplay of elementary passions, in that it "deals with the innermost core of the physical world and the laws it strives to understand and formulate are at the bottom of everything."

most effective argument that scientists can use to get money from their government is 'we cannot afford to fall behind the fellow next door.'"

Management recommendations. What did the committee headed by this cosmopolitan skeptic say about CERN? "The roots of CERN's excellent scientific record lie in the supranational scientific enthusiasm which prevails there. . . . This enthusiasm is directly ascribable to the world leadership currently enjoyed by CERN in its field of research. . . . If CERN were to lose this leadership and ceased to be a focus of excellence, it would lose its main *raison d'être*, its attractiveness and its dynamic qualities. However, . . . excellence in the scientific field alone is no longer enough. It must go hand in hand with excellence of management, in the use of resources and in the services offered to users. In these latter respects, CERN has fallen behind and must catch up systematically and quickly."

The committee found that users opposed any extension of CERN membership that would dilute the organization's European character, and it declined to consider lower funding levels and alternative scientific programs. "The committee considers that an *a priori* reduction of the budget will inevitably jeopardize CERN without giving a rationale for future management practice. A reduction of the program is in any case premature as a conclusion."

Instead the committee confined itself to suggesting improved management measures, admittedly some quite sweeping ones:

► Early retirement or departure of between 300 and 500 staff in 1988 and 1989

► No further granting of international status to nonprofessional and technical staff members, so that their social benefits would now be carried by the Swiss and French social security systems

► A new personnel system stressing assessment of performance and promotion based on merit

► In the short run, minimum recruitment of new staff and minimum granting of indefinite contracts

► A variety of reforms connected with financial accounting and management of the pension fund.

The committee complimented CERN on building LEP without expanding the lab's existing staff but took note, on the basis of a user survey, that "technical support at CERN had deteriorated from good—superb, pre-LEP, to poor—unacceptable now." The report said that CERN's director general should be "an outstanding scientist" with "top managerial qualities of an extremely high order."

Herwig Schopper, whose term as director general expires at the end of next year, told *PHYSICS TODAY* in late July that he does not feel personally rebuked by the report. His reaction to the Abragam report's conclusions was "quite positive," he said. He noted that the committee's favorable attitude toward the lab's scientific program was "not to be taken for granted," and he took particular satisfaction in the committee's recommendation to proceed with the upgrade of LEP, a measure that the CERN Council adopted in June.

Commenting on the Abragam report's final paragraph, which claims that the recommended measures "form a coherent whole incompatible with selective implementation," Schopper said he thought it would be possible to study the feasibility of the suggested management reforms by December, when the committee is scheduled to present its final report to the CERN Council. Schopper reserved his reactions to the report until it is published, although he said he thought it would be possible to reduce personnel by 10–15% in the long run.

Asked whether such cuts were compatible with a restoration of user services, given complaints about the deterioration in services connected with LEP construction, Schopper conceded that there were some inconsistencies in the report that needed to be ironed out.

But he said that complaints were coming mainly from users who did not have an interest in LEP.

Llewellyn Smith, asked about the same point, said the important thing is to bear in mind that something has to be done about the lab's very low turnover rate and its aging staff (see table, page 74). The average age of CERN staff members was 45.5 years as of the end of July 1986, and in the five years from the end of 1980 to the end of 1985 just 402 of 3500 staff members left the lab.

Wolfgang Kummer, president of the CERN Council, believes that restoration of services is compatible with staff cuts provided that there is a further big reshuffling of personnel, which will take some time. Kummer feels that Schopper "achieved something unbelievable" in reshuffling 1000 of the 3500 staff members to build LEP, and he believes that "compared to other international organizations CERN management is doing very, very well," especially considering that other international organizations such as the European Space Agency, not to speak of UNESCO, operate within "much more comfortable budgets."

British reaction. Abragam stresses in personal conversation that if CERN is to save money in the long run, it will be necessary to spend more money in the short run for severance pay, retraining and so on. He says that it was De Benedetti, whom he describes as "an Italian tycoon who has completely re-

furbished the firm Olivetti," who convinced the committee of this point. While the point is perhaps not greatly stressed in the report itself, Kummer says it is universally understood that the personnel measures recommended by the Abragam committee will require added funds for the next few years.

How will the British government, which wanted the Abragam committee to evaluate budget cuts going as deep as 25%, react to the report? At this point nobody really has any sure idea, but the British representatives are said to have responded favorably to the report when the interim version was presented to the CERN Council in June. Donald Perkins, the head of Britain's Nuclear Physics Board, which advises the Science and Engineering Research Council on particle physics, says that the research council considered the Abragam report in mid-July, welcomed its conclusions and said they would go some way toward meeting British aspirations.

Perkins says the British appreciate that personnel reductions will entail up-front costs, but without substantial reductions, he warns, continued British membership in CERN will be at issue. That said, he notes that Britain is honor-bound to contribute to the completion of LEP and is required to give one year's notice of any intent to withdraw. Britain certainly will not take any action before the CERN Council acts on the Abragam recommendations this December, Perkins agrees.

Daring where others fear to tread, Rubbia thinks the British government should be quite satisfied with the Abragam committee's recommendations. "It's a perfect example of the typical policy of England," Rubbia says. "It sounds like it came straight from Mrs. Thatcher's pen."

Rubbia personally feels that the report was maybe a bit harsh on CERN's management, but he thinks it is "very important that it does not say the budget should be cut and instead says savings are possible." As for its scientific recommendations, they are "almost a carbon copy of what's in our report," Rubbia says with satisfaction.

Rubbia committee report. The report of the long-range planning committee is based on studies from three subpanels: a panel on the feasibility of a hadron collider in the LEP tunnel, headed by Giorgio Brianti; a panel on the feasibility of a large e^+e^- collider, headed by Kjell Johnsen; and a panel on the physics potentials of these two major accelerator options, headed by John Mulvey of the United Kingdom. Regarding the mandate of the third panel, the Rubbia report notes that



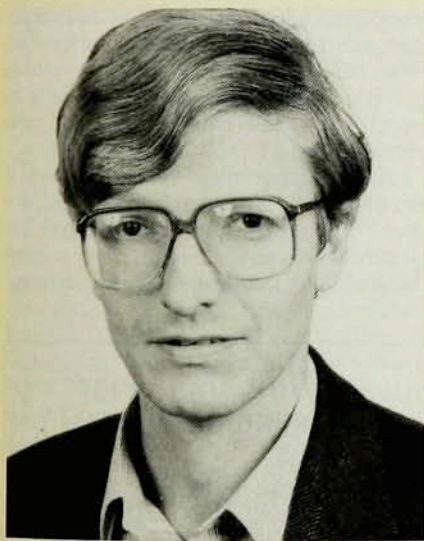
Carlo Rubbia, chairman of CERN's long-range planning committee, considers the scientific recommendations made by the Abragam review committee "almost a carbon copy of what's in our report." Rubbia thinks it is important that the Abragam committee called for savings rather than arbitrary budget cuts and he feels that the call for a "quantum jump" in management is probably sound.

much work has been done in the United States and Europe in the context of the SSC and LHC proposals, and that more is planned, but that "very little was actually known on the potentialities and processes initiated by ≥ 1 -TeV e^+e^- collisions and especially on the feasibility of practical experiments and on how the two possibilities, namely pp or e^+e^- , compare in their potentialities in order to answer the outstanding questions."

The central argument of the Rubbia report is, roughly, that new phenomena central to the resolution of unsettled questions connected with the Standard Model are expected to manifest themselves at about 1 TeV in the constituent center of mass, that the hadron collider proposed for the LEP tunnel could provide energy at that level, that the LHC could exploit higher luminosities to achieve an event rate that would compare favorably with the SSC's, and that the LHC could be built a great deal more economically than the SSC; alternatively, a linear collider with about ten times the energy of LEP could provide access to the same physics. In any event, "it is the firm and unanimous opinion of the long-range planning committee that, to maintain its leading role in the future, Europe must construct facilities giving access to this energy region."

The committee describes the alternative scenarios as follows:

► "Exploitation of the very large di-



Christopher Llewellyn Smith, a professor of theoretical physics and chairman of the newly consolidated physics department at Oxford University, served as a scientific adviser not only to the Abragam committee but also to the Kendrew group, which specifically declined to characterize particle physics as the most fundamental field imaginable.

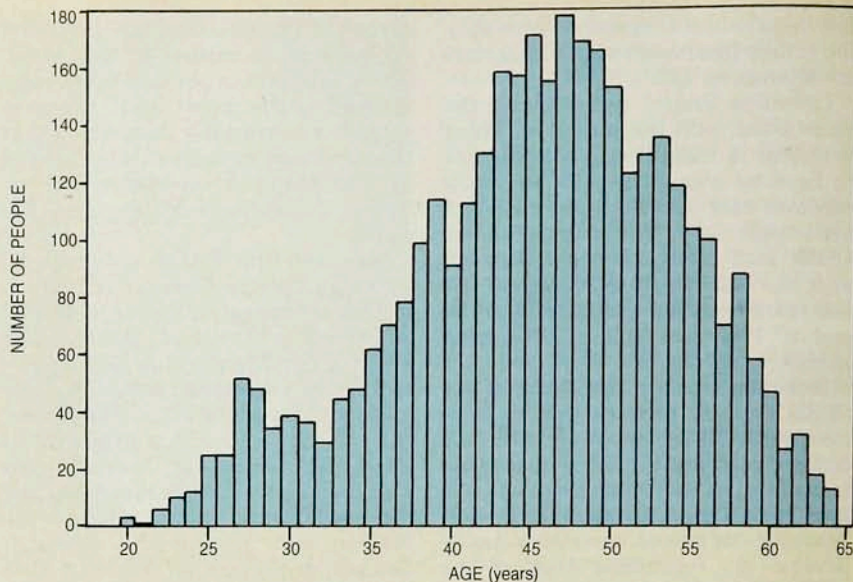
mensions of the LEP tunnel (~27 km) and of the injection facilities available with machines already operational at CERN. This could involve the addition of a superconducting magnet system capable of storing beams of hadrons at the highest energy compatible with present technology, for example giving a proton-proton center-of-mass energy in the range of 14 to 16 TeV, corresponding to a guide field of 8 to 10 tesla. The SPS is a perfect injector. The long-range planning committee prefers the addition of a two-channel superconducting magnet arrangement in which two counter-rotating beams of protons are stored—following the ISR mode of operation—since it would permit the realization of very high luminosity, of the order of $L > 10^{33} \text{ cm}^{-2} \text{ sec}^{-1}$. The more modest approach of a single-channel ring for protons and antiprotons would be limited to a luminosity $L > 10^{31} \text{ cm}^{-2} \text{ sec}^{-1}$.

"In both alternatives, electron-proton collisions could be studied at several times the energy of HERA, namely at a center-of-mass energy of 1.4 to 1.8 TeV and comparable luminosity.

"The interferences with the LEP program—namely the installation and operation of another, independent facility in the same tunnel—have been examined in some detail and they appear manageable."

► "An e^+e^- collider of energy about ten times the maximum energy of LEP, namely $\geq 1 \text{ TeV/beam}$, and a luminosity of order $L > 10^{33} \text{ cm}^{-2} \text{ sec}^{-1}$ appears exceedingly attractive. One of the advantages of an e^+e^- collider is that the particles are themselves 'constituents,' so that the energy of the accelerator can be much smaller than in the case of hadrons in order to access the same physical phenomena."

The report notes that the linear collider would represent "a large extrapolation of accelerator technology." On the other hand, while the technology for constructing a hadron collider is well in hand, "the difficulties of constructing a practical detector capable of operation at the very high event rates in hadron collisions at $L > 10^{33} \text{ cm}^{-2} \text{ sec}^{-1}$ must not be underestimated



Number of CERN staff members by age. The average age of CERN staff members was 45.5 years as of 31 July 1986, according to data in the Agram report. Given CERN's extraordinarily low turnover (see table below), its age distribution presents a formidable management problem.

ed as well, and it is likely to require an amount of ingenuity in the field of detector instrumentation which is comparable to that for the new linear colliders."

Rubbia recommendations. The report concludes that the Large Hadron Collider "offers the most cost-effective way for the world's high-energy physics community to achieve an early access to energies of about 1 TeV in the constituent center of mass, one order of magnitude larger than is at present accessible," and it believes that construction of such a collider in the LEP tunnel is to be recommended, "provided it is realized in a time schedule which allows for collisions to be achieved by 1995, and well before the SSC."

The long-range planning committee concludes, however, that both the LHC and linear collider options should continue to be explored, with a view to making a decision on which to pursue in about two years. The committee calls for intensive work on the development of higher-field superconducting magnets and establishment of a team at CERN to study concepts for advanced linear accelerators.

Regarding the first recommendation concerning the development of detectors capable of handling very high LHC luminosities, Kummer notes that such an effort already has been mounted at CERN with special funding from the Italian government; regarding the second, he says that the budget preview

adopted by the CERN Council in June already anticipates a substantial allocation of funds over the next four years for development of new superconducting magnets.

Kummer argues that the "higher energy of the SSC will be useful only if it turns out that Nature has chosen just this threshold [above the LHC's energy range] for some interesting, as yet unknown physical effect. . . . And from the point of view of finances, of course, the LHC is a much more favorable investment. One might even be able to say that it would be a much more moral decision."

At the same time, Kummer says it would be utterly senseless to duplicate the SSC with the LHC, and he says that Rubbia feels the same way, even though the long-range planning com-

CERN staff departures, 1980-85

Voluntary	65
Special indemnity	189
Retirement	34
Health or disciplinary	17
Elimination of post	3
Death	31
Fixed-term contract expiration	65
Total	402

CERN Long-Range Planning Committee

Giorgio Brianti, CERN
 Pierre Darriulat, CERN
 Gösta Ekspong, University of Stockholm
 Carlo Rubbia, CERN
 Abdus Salam, International Centre for Theoretical Physics, Trieste, and Imperial College, London
 Samuel C. Ting, MIT
 Simon van der Meer, CERN
 Gustav A. Voss, DESY

mittee may have left a somewhat different impression in its report.

SSC vs LHC. The Rubbia committee's report often adopts a rather Euro-nationalist tone, and it is perhaps not quite right to say, as Rubbia suggested, that the Abragam committee simply made a carbon copy of its central scientific recommendations. This is what the Abragam report says:

"It is... reasonable to propose to American physicists, as the CERN

management has done, to take advantage of the existing infrastructure at CERN in taking part in the construction of the LHC. The considerable financial advantages of such a solution should encourage the American government and American physicists to give it serious consideration, especially if it receives early signs of approval by the CERN member states and if, in return, CERN were prepared to consider contributing to the construction of a

linear collider of very high energies in the United States when the time comes. If, however, the American government decides to finance and build the SSC relatively quickly (with commissioning before the end of the century), it would probably be wiser to drop the LHC and concentrate efforts on development of the necessary technologies for CLIC [the CERN Linear Electron Collider], the physics potential of which is complementary." —WILLIAM SWEET

Romanians outdo US and Soviets in physics olympiad

She may not be as famous as Nadia Comaneci and she may not be a star athlete, but she is a star, she's Romanian and she happens to be the first woman ever to win a major medal in the International Physics Olympiad. One of 125 contestants from 25 countries in the 18th Physics Olympiad, which took place this year in Jena, East Germany, during the first two weeks of July, Didina Serban was the winner of one of ten silver medals, helping lead the Romanian team to a remarkable come-from-behind victory. Romanian contestants C. Maluranu and C. Necula won two of the three gold medals. The third gold medal went to a contestant from the Netherlands, B. V. de Bakker.

Started in 1967, the Physics Olympiad originally was an Eastern European event, but a large number of non-Communist countries now participate (see *PHYSICS TODAY*, September 1986, page 51). The United States sent a team last year for the first time. This year, for the second year in a row, the American team won three bronze medals. The Soviet team won a silver, two bronzes and two honorable mentions. The team from Canada won a bronze and two honorable mentions.

This year's US contestants were Bryan Beatty of Greer, South Carolina; Golda Bernstein of Tucson, Arizona (alternate); Franklin Ming Chen of Ann Arbor, Michigan; Eli Glezer of San Diego, California; Normand Modine of Oak Ridge, Tennessee; and Steven Worley of Reading, Massachusetts. Beatty, Glezer and Modine won the bronzes, Chen an honorable mention.

Glezer's performance at the olympiad was notable in that he gave a unique and unexpected answer to one of the questions on the theory exam, which led to a prolonged argument between the American coaches and the judges, a group of East German physicists described as first-rate by the American participants. The argument was resolved when one of the Russian coaches, Sergei Krotov of Moscow State University, intervened with an obser-

vation to the judges that Glezer's solution was in fact superior to theirs.

Jack Wilson, executive officer of the American Association of Physics Teachers, and Arthur Eisenkraft, a high-school physics teacher from Bedford, New York, who together ran the training sessions for the olympiad, feel that the mood of this year's olympiad was quite extraordinary: "A spirit of 'glasnost' was clearly evident," they wrote in a report about the event. "The Soviet and US students and leaders spent many hours socializing, visiting and talking physics. Every time we visited the students' rooms we found several Soviet students there. The level of interaction was unprecedented. It was also clear that East Germany was making a major effort to reach out to the Western nations present. Organization of the olympiad was superb and involved over 400 individuals, many of them physicists from Carl Zeiss—Jena and the Friedrich Schiller University in Jena. . . . We were treat-

ed as honored guests and did not have to suffer the bureaucratic indignities we might have expected—even at border crossings."

—WILLIAM SWEET



US contestants in the 1987 Physics Olympiad posed for this photograph in Jena, East Germany, with their trainers Jack Wilson, executive officer of the American Association of Physics Teachers, and Arthur Eisenkraft, a high-school physics teacher from Bedford, New York. From the left are Eisenkraft, Wilson, Eli Glezer, Franklin Ming Chen, Steven Worley, Normand Modine and Bryan Beatty.

Ward is president-elect of Acoustical Society of America

W. Dixon Ward is the president-elect and Eric E. Ungar is the vice president-elect of the Acoustical Society of America. They will succeed the current officers in 1988. Chester M. McKinney is the current president and Herman Medwin is vice president.

Ward, a specialist in psychoacoustics, received his PhD in experimental psychology from Harvard in 1953. He worked as a research engineer at Baldwin Piano in 1953–54 and as a research scientist at Central Institute for the Deaf in 1954–57. From 1957 to 1962 he was a research associate with the Committee on Conservation of Hearing