European high-energy physics

Poor marks for enterprise

In the thirty years since the establishment of CERN, the European Organisation for Nuclear Research near Geneva, the laboratory has produced only two "crucial discoveries" compared with a dozen or more at United States laboratories, whose total cost is similar, and may even be less.

This is the bottom line of a lengthy balance sheet, with many other conclusions and observations, drawn up in nearly two years' work by social scientists Ben Martin and John Irvine, of the Science Policy Research Unit at the University of Sussex, and published today (6 September). The two-part report is certain to be influential in this particular reappraisal of its membership of CERN.

The first CERN discovery categorized as "crucial" was in 1973 ("neutral currents", a new form of weak interaction). By then, US laboratories had discovered a second neutrino, the omega-minus (the beginning of the quark model), charge-parity-violating interactions, deep inelastic scattering (which indicated that the proton really had components, now known to be quarks) and more. CERN, on the whole, has been thorough but dull, say Martin and Irvine — CERN lacked "bazzz". But the second of CERN's crucial discoveries is very recent (the intermediate vector bosons W and Z found last year), is attributable to a new adventurousness at CERN and, according to the review, "to a certain extent the balance of power in experimental high-energy physics between North America and Western Europe seems to have reached a turning point".

Martin and Irvine are famed (or notorious) for their previous critical assessments of the Jodrell Bank radiotelescope, British astronomy (notably the Isaac Newton telescope) and the Daresbury electron synchrotron NINA. But their review of CERN is more important as it may affect real policy in two ways: first, a British scientific committee (see box) is studying whether Britain should remain a member of CERN, given the present £27-million price tag; and there are indications that Martin and Irvine's much-improved approach to scientific assessment in the CERN report is finding favour among British policy-makers, and could be applied to other fields. (A study has already been made of protein crystallography, for example, and delivered to Sir David Phillips, chairman of the Advisory Board for the Research Councils, which allocates basic research funds among the different research councils in Britain.)

But does the Irvine and Martin method work? The two researchers' earlier reviews drew criticism that in assessing scientific productivity (or the lack of it) in terms of indicators of publication volume, citation frequency and peer ranking of laboratories, they ended up with too bleak a

picture of what began to seem "targets" rather than mere subjects for research. There were mitigating circumstances, and forms of productivity unmeasured by the indicators.

But Martin and Irvine's present effort — two papers published in *Research Policy* — can hardly be criticized on those grounds. The CERN survey is sophisticated, and the two investigators clearly recognize a development in their technique. For example, they previously described their method as one of "converging" indicators, thus begging the question of whether or not the indicators do indeed converge on a single black-or-white assessment of a laboratory. In the case of CERN, the indicators clearly do not converge, and, write the researchers, "the results based on each indicator need to be carefully interpreted". Interpret they do, basing their analysis on 182 interviews with particle physicists from the Soviet Union to the United States.

High-energy physicists, even those at CERN, who have seen draft versions of the papers describe the analysis as fair, balanced and (mostly) accurate. CERN is admitted to have just missed the boat on many occasions. The two quarks called charm and bottom, which highlighted a revolution in physics in the 1970s described by Martin and Irvine as "the American Revolution", could have been found at CERN, the study claims. Missing the discovery of these particles was described by one physicist interviewed by Martin and Irvine as "a tremendous failure".

CERN even produced serious errors. One particle, the A_2 , was claimed — falsely, as it turned out — to be split, or

European dimension

SIR John Kendrew, the molecular biologist who is chairing a committee looking into Britain's future commitment to CERN, said last week that the Irvine and Martin report (see above) will be distributed to all the members of the committee — but along with many other papers it had received ("too many actually", said Sir John).

His committee will report "early next year" to the Science and Engineering Research Council, together with the Advisory Board for the Research Councils, and the committee plans to visit CERN in October, Sir John said.

Just what impact the committee's views will have remains to be seen — Sir Keith Joseph, Secretary of State for Education and Science, announced on setting up this committee that its scientific review would be "without prejudice" to a final (political) decision on CERN membership. The final decision will have to be taken in the wider context of Britain's whole relationship to Europe. Robert Walgate

twofold, creating a puzzle which absorbed theoreticians for nearly five years during the late 1960s. But similar errors were made in the United States (the "high- y " anomaly of Fermilab which caused equal consternation in the 1970s). Here the balance sheet is even.

In terms of positive results, CERN's first big machine, the 28 GeV proton synchrotron (PS), though on line before the equivalent alternating gradient synchrotron (AGS) at Brookhaven, was no-

Dr Herwig Schopper

where near as productive at the beginning. Physicists attribute this, above all, to lack of experience in the design of high-energy physics experiments in Europe. Then the intersecting storage rings (ISR), designed to collide PS protons with each other head on, was a brilliant technical success — but failed to produce revolutionary physics. (It helped in understanding the quark structure of nuclear particles, but could have seen and not missed charm and bottom.) Martin and Irvine suggest the machine was underexploited by CERN management. The 400 GeV super proton synchrotron (SPS) that followed came too late — more than four years after Fermilab in the United States had creamed the energy region — and had to rely on tidying-up (which, nevertheless, it did well, with resources that were considerably greater than Fermilab's).

The lesson, if there is a single one, is that Europe's laboratory was run too much by committee, whereas American laboratories owed more to individual flair. (Maurice Goldhaber at Brookhaven, R. R. Wilson at Fermilab and Pief Panofsky at Stanford Linear Accelerator Center are singled out.) But Martin and Irvine say that things are changing at CERN under director-general Herwig Schopper and that a more individualistic style has emerged.

Nevertheless, CERN has committed itself now to just one future machine and its 15-mile tunnel, the electron accelerator LEP now under construction. A future and more controversial report by Irvine and Martin will discuss the prospects for LEP, and at least one official involved in the British decision to support it has said he wishes he had had the report before him when he said yes.

Robert Walgate