Japan as a high-energy power

Japan's new electron–positron collider seems to have quickly won itself a reputation for excellence, showing that the familiar excellence of Japanese engineering can bring academic benefits.

Tsukuba

ATTENTIVE readers of the international physics journals will have noted in the past few weeks a spate of papers from the new electron–positron collider TRISTAN now operating here. On the leapfrogging principle that new machines usually produce their most interesting data in that brief interval before they are overtaken in performance by another, that is not in itself surprising. But TRISTAN's demonstration of how to hit the ground running seems to have bettered what has been done elsewhere by a substantial margin. What can be the explanation?

Although there are many in Japan who regard TRISTAN as a proof that the country is interested in basic science, not merely in profit-making technology, the machine is also a talisman of the Japanese scientific community's willingness to throw resources into the international collaborative melting-pot.

TRISTAN has also slipped into being an object of national pride. Dr Tishi Ozaki, director of the project, explains that his colleagues worked on the commissioning of the machine in the spirit of "we must succeed". A practical side-benefit is that the enthusiasm appears to have spread to the industrial companies contracted for construction and the supply of equipment; Professor Tetsuji Nishikawa, director-general of the National High-Energy Physics Laboratory, explains that, in Japan, if the design team knows what it wants to have made, construction companies will struggle to be given the chance to do the work. An American fellow visitor marvels at this state of affairs, saying that contractors in the United States regard the academic community as a source of profitless fiddling work.

The first machine in Japan on this scale, may, of course, be an exception. But that seems improbable. One of the familiar, if elsewhere unexpected, features of Japanese life is that academics who know what they want are respected by their colleagues in industry even if they are less well paid. Tsukuba's TRISTAN is a monument to the success of this formula. The academics' reward is not so much money as the international respect that will be their due. TRISTAN's staff is already dreaming of the detectors it will be asked to build for the US Superconducting Supercollider, the site of which has not yet been chosen (see page 289 of this issue). For the time being at least, the people here are saying that there is no question of their building a successor to this machine, but that international collaboration will become the only way forward in high-energy physics.

Meanwhile, Japan's approach to high-energy physics seems delightfully empirical. The great names of the past — Yukawa and Tomanaga — are those of theoreticians, Nishikawa is quick to say. Ozaki is not sure how many experimenters there may now be, but thinks they may amount to 500, some 300 of them students. "There must be three or four times as many theorists", he says. But he is also respectful of the machine-building tradition in Japan, pointing out that there was a substantial cyclotron at the University of Tokyo before the Second World War, that the war itself was a "great interruption" and that the builders of the machines nevertheless got to work again soon afterwards.

Ozaki does not even accept the proposition that the Japanese community may need more help than most with the design of modern detectors. While many of the Tsukuba team have done time at US laboratories — Ozaki himself was for many years at Brookhaven — things are changing so fast, and so much now depends on the software, not the hardware, that he and his colleagues are confident of their self-sufficiency.

Ozaki is convinced that he has the best-instrumented electron-storage ring in the world — there are a dozen computers behind the wall of the control room, and another twenty distributed around the ring. He insists that designers of detectors for the ring should give precedence to the design of their software.

The government, meanwhile, is proud of its deliberate investment of funds over the the past decade in the most esoteric kind of basic research, so much so that it has sanctioned a 28 per cent increase of the operating budget for 1988 that will, among other things, allow an increase of operating time by a half to 1,200 hours (see page 289 of this issue). For the politicians, what matters about TRISTAN is that it is a demonstration that Japan is able successfully to invest in basic science. It would, of course, have been more human to have made the investment and to have made a hash of it, but that is not the Japanese tradition.

What are the results? TRISTAN (roughly a kilometre in diameter) has four equidistant experimental halls around the circumference, one of which is occupied by a simple device of laminated plastic designed to look for magnetic monopoles, whose production cross-section must be very small at 27.5 GeV. That, Ozaki says, is a long-term investment, even a gamble. There is nothing much to report so far. Otherwise, there are three general purpose detectors of the particles possibly produced in electron–positron collisions, each operated by a different university collaboration. One of them, interestingly, involves not merely experimentalists from the United States, but also people from mainland China and from Korea.

The outcome, so far, is that there is no sign of the top quark at a centre of mass energy of 55 GeV, and no signs of exotic electron-like leptons other than muons and tauons below the same or a slightly smaller energy threshold. The difference of the collision energy at Tsukuba and Hamburg in West Germany (25 per cent) is not so great as to keep theoreticians awake at night, but it must sharpen in many minds the still unanswered question "Why is the top quark so much heavier than the others?" Meanwhile, largely because of the quality of the software built into the detectors, it seems likely that TRISTAN will have a field-day in unravelling the hadronic products of quark disintegration, which show up nicely on computer reconstructions as opposing streams of particles.

But what will happen after the Stanford Linear Collider (which is already late) eventually comes on line, with LEP at CERN a few months later, in the middle of next year? Nobody at Tsukuba is taking any bets. Ozaki believes that the lifetime of his machine is "between five and twenty years".

But it is most probable Japanese high-energy physicists, having cut their teeth on this successful project, will somehow manage to stay in the game. They have fallen into the traditional trap for the Japanese of making things work. They have also built a high-energy physics laboratory that differs from all others in its dazzling cleanliness, which is something to be pleased about in itself. **John Maddox**