proposals to scale back the space station, achieving essentially the same capabilities but a few years late, filtered down to the European Space Agency and Japan's Science and Technology Agency — and to the US Congress — all were furious.

Unless NASA can regain the confidence of its partners and of Congress next year, the future of the space station — and the missions to the Moon and Mars which could depend on the space station as a base for developing a lunar outpost — looks bleak.

Human genome project

An international effort to sequence the human genome is just taking off. Led by James Watson, a man hugely popular with Congress, the genome project's budget was almost doubled this year to about $60 million but its goal of a $200-million annual budget within two years seems unreachable.

Watson has already caused consternation in **Japan** with his suggestion that countries failing to contribute adequate finance to the human genome project should be denied access to the fruits of the research. Although such a suggestion is clearly unworkable for a multi-national project, Watson plainly has a legitimate complaint. While the **United States** and the **United Kingdom** have come forward with donations for the Human Genome Organization (HUGO), Japan has failed to scrape together its $300,000 contribution. That has only served to reinforce the widespread perception that Japan is not serious in its professed desire to contribute more to basic research. But several Japanese ministries now see a chance to make their names in the project.

The Superconducting Super Collider is a different matter. Japan (and several other countries) would prefer not to be asked to help on the grounds that a refusal often offends. But despite recent advice, Japan will not learn how to say "No", but will follow along late and unwillingly.

Europe

The United States and Japan are not at the heart of all collaborative research efforts. Leaving Japan completely out is a European collaboration in microelectronics known as JESSI. Five European countries and three multinational companies decided to back the project with an eye on the Japanese, who they fear will dominate the strategic market in semiconductor chips by the end of the next decade. But like the space programme, JESSI — which stands for Joint European Submicron Silicon — is drawing criticism for pouring public money into an area best left to private enterprise. The United States may eventually become part of the team. The big decision is whether JESSI will link up with a similar US effort called Sematech. □

Cold fusion

The scientific event to be proud of in 1989 was not the announcement by two Utah researchers — Stanley Pons and Martin Fleischmann — that low-temperature fusion-in-a-bottle was possible but the world-wide activity that it stimulated. The international scientific community showed it could take on board totally novel scientific ideas, digest them and despatch them, all with considerable speed and relatively good humour.

AP

IMAGE UNAVAILABLE FOR COPYRIGHT REASONS

The non-event of 1989?

Cold fusion has come and gone in eight months (23 March was the date of the press conference at which first word of cold fusion reached the world, November the date of the Department of Energy report which virtually ended interest in the phenomenon).

Most of cold fusion's critics are already back at whatever they were doing earlier. Pons and Fleischmann apparently remain undeterred and a few supporters remain. A group at Texas A&M are now the most vocal, but by their own admission they find only 'anomalous heat output', and absolutely no evidence for any nuclear products — no helium, no gamma rays, no neutrons — and the tritium that has been found in some of their experiments is definitely not being produced in a high-energy process.

Occasional claims of success are heard from elsewhere in the world — as recently as December in Japan. But most Japanese scientists are sceptical about the effect. Research continues in India at the Bhabha Atomic Research Centre in Bombay. The director, P.K. Iyengar, believes cold fusion to be the source of the enormous amount of tritium produced in his experiments in which deuterium gas is pumped into titanium under pressure. He claims that US scientists are convinced that cold fusion can take place but are keeping their results secret. □

Space

Voyager's last hoorah at Neptune last year left the **United States** devoid of any active spacecraft with the exception of Magellan, sent on its way to map by radar the Venusian surface next August. But a resurgence of space-based astronomy and planetary exploration is on the way. Galileo was sent off to Jupiter in October. COBE, the long-awaited Cosmic Background Explorer, was launched in November. This year the Hubble Space Telescope is still due for launch in March. The next couple of years look good too, with a strong programme in astronomy. And a full fleet of launch vehicles is now in business: the space shuttle, along with Titan, Atlas and Delta rockets.

Beside the **Soviet Union** (whose own shuttle has flown only once — unmanned — and seems unlikely to fly again) only **France** and **Japan** have hopes of grand achievements in space. France has the more immediate hopes with manned space flight its first objective. France has always been the strongest supporter of the European Space Agency (ESA)'s Columbus contribution to the Space Station and is going to provide 45 per cent of the cost of the Ariane 5 rocket needed to launch the Hermes shuttle.

This year, France will spend FF1,812 million on the Ariane rocket launcher and FF737 million on the European shuttle Hermes and contributions to Columbus. But Hermes' costs are spiralling and partners elsewhere are growing restive. The election of a Frenchman to the post of director-general of ESA would undoubtedly help — Reimar Lüst leaves in October. But with the United States increasingly uncertain about its commitment to the space station, the need for Hermes is not clear. And if Hermes is unnecessary, then Ariane 5 is not needed either.

West Germany has so far managed to reduce support for Hermes, Ariane and Columbus without endangering the projects. But this year Research Minister Heinz Riesenhuber will have to decide how to raise the next big contribution to the ESA projects, due in 1991. If he takes it out of existing programmes, as he has promised not to do, there will be a tremendous uproar. If he makes further cuts in the ESA budget, he will make West Germany look like a miser in France's eyes.

Japan's plans for space greatness are more distant — but manned space flight is one of its objectives, according to the grandiose official plan released last year. But for the time being it is David, rather than Goliath, that is calling the shots. A neat slingshot manoeuvre should next year enable Japan's low-budget Institute of Space and Astronautical Science (ISAS) to send a satellite to the Moon.

But if Japan is to get serious about space exploration then someone is going to have to bite the bullet and give ISAS access to really big payloads by forcing it and