

Heat by the wall.

More advanced ideas for domestic heating are also being fostered. Thus a system is being designed to capitalize on people's apparent ability to feel comfortable in a low ambient temperature provided there is plenty of radiant heat. The system requires highly reflecting walls containing aluminium with some pigment to remove the sheen, together with a series of carefully placed heaters that can be switched on when entering a room much in the way that electric lights are operated. It seems that a wall "paper" consisting of aluminium, polythene and rutile provides the best combination of high infrared reflectivity and low visual lustre. A variety of physical and psychological tests are also being carried out to gain a better understanding of what are the important ingredients of comfort.

The Electricity Council's preoccupation with ways of using off-peak electricity, now even cheaper, has also found outlets in the industrial sector. One of the more advanced projects at Capenhurst is the design of a process heater for the production of synthetic resins. This is apparently operational now, with a storage capacity of 520 kW and a charging time of eight hours.

A new way of cutting cloth using a plasma jet is also being investigated. The system uses a plasma torch in which the arc is struck between a central cathode and the interior of the nozzle, and the cutting is performed by a stream of argon which emerges from the nozzle at a very high temperature. The effects of varying several parameters such as the flame position are being studied, and it is felt that the technique could well prove valuable for materials such as linoleum, wallpaper and carpets as well as textiles. The chief advantage over oxyacetylene cutting is the lack of oxygen in the flame, so reducing the area of burning.

QUANTUM THEORY

Rocking the Boat

THE sport of trying to knock down quantum mechanics has been hanging on the periphery of physics ever since 1935 when A. Einstein, B. Podolsky and N. Rosen first put forward a paradox which led them to infer that quantum mechanics may not be a complete theory. Several theoretical physicists have latched on to the

need for so-called "hidden variables" in the intervening years and a team from three universities in the United States has now suggested an experiment to settle one way or the other whether hidden variable theories are logically necessary or just a flight of fancy.

The experiment proposed by J. Clauser *et al.* (*Phys. Rev. Lett.*, **23**, 880; 1969) is an extension of an earlier experiment by Kocher and Commins on the correlation of polarizations between a pair of optical photons. In the earlier experiment, two optical photons emitted in a cascade process in calcium impinged normally on a pair of polarizers the planes of which were parallel, and the correlation of polarization was measured by standard coincidence techniques. Clauser *et al.* claim, however, that this arrangement cannot provide a proper test of a crucial inequality in the hidden variable theory. They suggest that a decisive test would be to modify the Kocher-Commins experiment to include observations at two appropriate relative orientations of the polarizers, and also with first one and then the other polarizer removed. On the assumption of using practical calcite polarizers, they have worked out what they consider the critical inequality to be verified in such an experiment, and they give a description of how this experiment should proceed.

There is some doubt as to whether it is really possible to design an experiment to substantiate a hidden variable theory which lacks any clear formulation, but it may nevertheless be possible to design an experiment which does extract the essential information to place quantum mechanics in jeopardy (or to be its salvation). Clauser *et al.* believe that their version of the two photon experiment will provide this opportunity.

REACTOR FUELS

Reprocessing Refinement

GOVERNMENT organizations and private industry in eight European countries have set up a company, Société de Fluoration de l'Uranium (SFU), to exploit a new process in the nuclear fuel cycle. SFU will convert uranyl nitrate into uranium tetrafluoride by electrolytic reduction, followed by precipitation of UF_4 with hydrofluoric acid. More established methods of producing uranium tetrafluoride, that used by the UK Atomic Energy Authority at Windscale and Springfield for example, employ a three stage process which is obviously more costly, and the countries participating in SFU are probably looking towards the market for enriched fuels which should be expanded when the advanced gas-cooled reactor comes into service.

The company, set up on the initiative of Eurochemie (the European Company for the Chemical Processing of Irradiated Fuels), will operate at the Eurochemie reprocessing plant at Mol in Belgium. Eurochemie reprocesses fuel from reactors in thirteen European countries, separating plutonium and converting the depleted uranium to uranyl nitrate, which is then fabricated into uranium fuel elements. Enrichment of the uranium is carried out by recycling uranium hexafluoride in a gaseous diffusion plant. To produce the hexafluoride, uranyl nitrate must first be converted to uranium tetrafluoride. SFU will therefore provide an important link in this chain.

The new company will have a capital of 9 million Belgian francs (£75,000), one-third being supplied by

the Ugine Kuhlmann Group in France, about one-fifth by each of Steinkohlen-Elektrizität AG (STEAG) of Germany and Société Metallurgie Hoboken of Belgium. Companies in the Netherlands, Sweden, Norway and Denmark will supply under ten per cent each. The president of the Company will be Mr J. E. Leger of Ugine Kuhlmann, the secretary Mr de Roubaix (Metallurgie Hoboken) and the chairman of the management board Dr Voleker (STEAG). Ugine Kuhlmann and the Société Industrielle des Minerais de l'Ouest (SIMO) jointly developed and patented the process.

The UK Atomic Energy Authority may not be too alarmed by this news. The conversion of uranyl nitrate into uranium tetrafluoride is an important but small part of the reprocessing operation, and a drastic reduction in the cost of this process may not have much effect on the total cost of the operation. Further, reprocessing shows considerable economies of scale, and the Windscale plant is apparently much larger than the Eurochemic plant. It follows that, although the SFU plant will be able to handle all the uranium leaving the Mol reprocessor, the difference in scale may maintain the economic balance in favour of Windscale. It is also important that reprocessing capacity in the western world is considerably greater than the amount of fuel requiring reprocessing; although the advent of the fast breeder reactor may go some way to redress this balance, the immediate economics of fuel reprocessing do not seem very exciting.

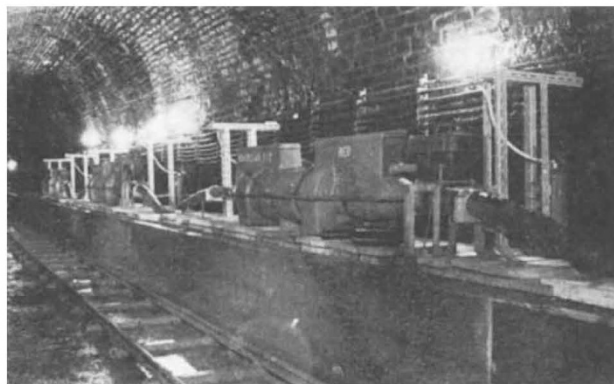
ELECTRICITY

New Use for Old Tunnel

A RAILWAY tunnel beneath the Pennines which is remembered as a major scandal of the Victorian era because of the loss of life involved in its construction is being used by the Central Electricity Generating Board for a section of the 400 kV supergrid. Until 1954, the tunnel carried the Manchester to Sheffield railway under Bleaklow Moor between Woodhead and Dunford Bridge. Its use by the CEGB means that a length of overhead cable across Bleaklow Moor, part of the Peak National Park, can be dismantled. This will be left until after the winter, and in the meantime the three-mile length of overhead cable will be available for research purposes. The overhead cable and its supporting pylons were allowed by the Ministry of Power after a public inquiry in 1963 on condition that it would be a temporary measure until the tunnel link was completed. The pylons are particularly objectionable in this part of the national park because they run along the skyline. At a cost of £2.75 million, the project represents quite a saving for the CEGB—although a similar length of overhead cabling costs £250,000, it could easily have taken £4 million to place the cables in a trench across the inhospitable environment of Bleaklow Moor.

The tunnel being used by the CEGB is in fact one of a pair of single-line tunnels which became obsolete in 1954 when the Manchester to Sheffield line was electrified and a third twin-track tunnel was opened. The old tunnels were becoming too expensive to maintain, and in any case they would have needed extensive modification to accommodate the pantographs of electric trains. Despite the age of the tunnels—the

tunnel which carries the cables was finished in 1852 and the parallel tunnel seven years earlier—the engineers of the CEGB were impressed by their good condition and the precision with which they were built. The maximum departure from linearity along the length of three miles twenty-two yards is only one foot, for example. But the tunnels were built at appalling cost. Thirty-two labourers died during the construction of the first tunnel—not only because of accidents and illness but also through riots among the work force—while twenty-five died from cholera alone during the construction of the second tunnel.



Inside Woodhead tunnel today.

The civil engineers of the CEGB found the construction of the tunnel link had unexpected problems. Because the tunnel falls within the collecting area for one of Manchester's reservoirs they were not able to hose away the two-inch crust of soot which lined the tunnel and which would have found its way into the water supply. Instead, the soot was removed by jets of compressed air and carted away. They also had to consider the possibility of a cable failure releasing oil into the cooling water, so a closed circuit cooling system is used.

At present the tunnel is carrying 2,000 MW, but there is room to double this by adding more cables. There are two cables each laid in a concrete trough through which water is flowing at 132 gallons per minute down the 1 in 200 gradient to the Woodhead portal, where it is pumped back to Dunford Bridge for cooling. The total loss in the tunnel when the two cables are on full load is 1.6 MW.

Although the CEGB had to give in to the pressure of public feeling on this occasion, the construction of the supergrid across the national park was made easy by the existence of the obsolete tunnel. The only case of a tunnel being purpose-built for the grid is in Hampshire where the CEGB has dug a tunnel under Southampton Water. Considering the difficulties involved in laying cables in a trench across Bleaklow Moor it seems likely that if the railway tunnel had not existed the overhead cables would have become a permanent feature.

TRAFFIC PLANNING

Are London Roads Viable?

SERIOUS criticisms of the Greater London Council's proposed network of motorways in London are made in a recent report by an independent working party