sible for negotiating the terms of the licence—a process which seems to take a very long time. Mr Duckworth told the sub-committee that so far none of the three agreements with the companies has actually been signed, an announcement which seems to have caused some concern.

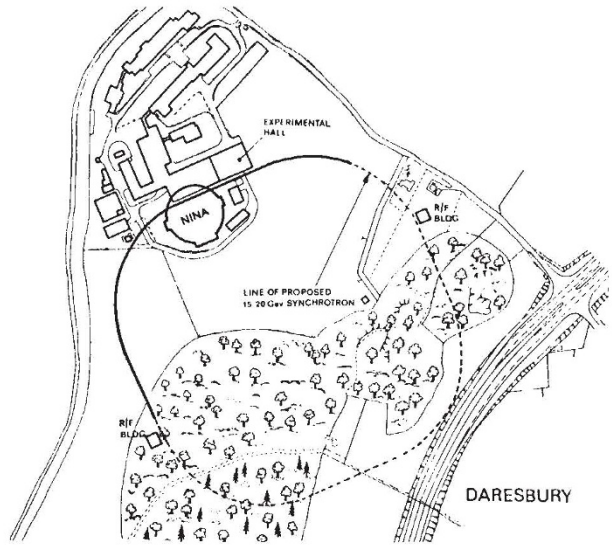
The most substantial of the sub-committee's recommendations is that a large plant for the production of carbon fibres should be built without delay. A plant producing 450 tons a year of carbon fibre should be built jointly by the three licensees, with government support if necessary. If the licensees are unwilling to go ahead, two other possibilities are suggested. One is that the NRDC should look for a further licensee who would be prepared to go ahead; the other, more unlikely, suggestion is that the Atomic Energy Authority should set up its own plant. This would, however, require legislation, so the sub-committee adds that "every effort should be made to ensure that the AEA has a financial interest in a large scale plant", whoever builds it. The sub-committee recognizes that there is a risk in going ahead with a plant "before demand materializes", but is convinced that the economies of scale would reduce prices so quickly that a large market would be created. It seems to have been particularly impressed by a study carried out by AERE Harwell which suggested that a plant producing 450 tons a year could bring costs down to somewhere near £5 per lb, or even less. Courtaulds was far less optimistic, suggesting a price of between £5 and £10 a lb ten years hence; the present price is about £100 per lb.

ACCELERATORS

Boosting NINA

It is hard to see what the Daresbury Nuclear Physics Laboratory expects to gain from the design study which it has been carrying out for a 15–20 GeV electron synchrotron. The scheme is attractive enough—it makes use of the existing NINA electron synchrotron at Daresbury (Lancashire) as an injector of 3 GeV electrons for the new machine, which would save nearly £1 million—but in the present climate it must be as obvious a non-starter as accelerator designers have produced for years. The plan has been on the stocks for some time now (*Nature*, **218**, 1095; 1968)—it was put forward first in a 1966 Daresbury internal report on large electron synchrotrons and then last year in an internal report narrowed down to the scheme involving NINA. But the genesis of the scheme was prompted by the success of the 20 GeV Stanford linear accelerator and the 10 GeV Cornell electron synchrotron, which made clear the need for a machine with the energy of the linear accelerator but with the better duty cycle of the synchrotron, and encouraged Daresbury to drop ideas of building high energy storage rings for NINA and to go in for electron synchrotrons instead. Daresbury has now published a preliminary design study of the work done since last year's internal report on what it calls the "NINA booster".

Two schemes seem to be open for the NINA booster. Both allow for a maximum energy of 20 GeV with a current of at least 1 μA and a duty cycle of more than 5 per cent, going up to 20 per cent if the electron energy does not have to be closely defined. The first and cheaper



One of the plans for the NINA booster. Dotted line denotes tunnelling.

scheme uses the present experimental halls, but unfortunately involves the new synchrotron cutting across the NINA ring. If the disturbance in the operation of NINA which this would involve is unacceptable, an alternative scheme is possible, but would require new experimental halls. Unfortunately, however, the Daresbury team do not consider in the report what is likely to be the biggest problem of all—where the money will come from. For, although the NINA booster is undoubtedly a cheap way of building a 20 GeV electron synchrotron, the basic scheme, providing 1 μA at 15 GeV, would cost £3·8 million, rising to £4·9 million for 3 μA at 20 GeV, and £5·4 million for the scheme involving least disturbance to NINA. Nor is it obvious how this preliminary study fits in with the SRC's manoeuvrings to join the 300 GeV project by running down the accelerators at Daresbury and the Rutherford High Energy Laboratory, and the intention to reduce the 40 per cent of its funds which goes to nuclear physics.

PHYSICS

Instruments on Show

from a Correspondent

Labour problems almost deprived participants in the 53rd exhibition of scientific instruments and apparatus at the Physics Exhibition this week of the benefits of electricity. Nobody will be surprised that the professional descendants of Faraday managed, for the most part, to mount their exhibits as planned. The Physics Exhibition is always interesting and often a scene of fascinating contrasts. There is something almost whimsical about displaying devices measuring a micro-this or a nano-that in the hall at Alexandra Palace. In the Scientific Instrument Manufacturers Association exhibit next door, incredibly sophisticated electronic hardware was being explained by demonstrators who were attempting to capture every erratic photon from the Calor gas radiant heaters mounted on obsolete porters' trucks.

The quality of exhibits was well up to the usual standard. If there is a dominant new theme in the

Physics Exhibition it is the spread of the science into the medical, biological and agricultural fields. A simple instrument was shown to measure the motility of semen in an objective way; it raised more questions of physics than it answered when one saw spermatozoa, in serried ranks, breaking into frenzied group motion. Holography was added to radiography and ultrasonics as a medical tool, and infrared scanners displayed thermal images as diagnostic aids. A microstep motor, which works in rather the same way as lead was said to walk off church roofs (in the days when it could safely be left there), can jab micro-electrodes into nerves with interferometric precision. The surgeon is to be assisted by a whole host of devices, from a cryoprobe to an organ bank. Photosynthesis in wheat is studied with isotopes, and the permeability of soil is measured by simple mechanical apparatus.

Of course, most of the exhibits demonstrated progress in the instruments and techniques of physics itself. Every branch of the subject was represented and one had to be selective in visiting the exhibition if intellectual saturation was not to ensue. We shall hear a great deal more of semiconductor indicator lamps; rugged and operating from a low voltage, their deep red glow can now be tailored at will into integrated circuits. Lasers grow more versatile each year and they were seen welding, reconstructing ultrasonic holograms or generating sub-picosecond pulses. The pattern of future computing was foreshadowed by digitized instruments on-line to computers, by desk-top special purpose computers and by a console connected to a large time sharing machine. Night was turned into day by electronic image intensifiers coupled to a large diameter lens, the whole system being 10,000 times more sensitive than the human eye. In a short account one can do no more than mention developments in microwave sources, metrological instruments of great elegance, new vacuum techniques, electron microscope accessories and gauges of all kinds. It was impossible to visit the exhibition without being impressed and inspired by such diverse achievements.

The university and college exhibits were rather different. Some of them were purely for the benefit of other university teachers—an ingenious teaching laboratory experiment or an elegant demonstration of some law of physics. Others exhibited ideas or techniques which are still in their infancy, but which, one hopes, will be taken up and become commercial devices in due course. One thing they mostly seem to have in common—they grow tattier each year alongside the lavish stands of industry or government establishments. The University Grants Committee and Science Research Council could spend a profitable day comparing the instruments and equipment available to the various branches of physics research represented at the exhibition. The disparity became depressing when one saw a stand complete with a helium cryostat with automatic replenishment and thermostatic control not very far from one at which representatives of one of our leading technological institutions were using a thermos flask from Boots and a decade box which might have been on loan from the Science Museum. Despite these difficulties, the spirit of "academic" research shone through here and there. One of the most impressive stands at the exhibition featured a diagram, a cubic centimetre of silicon, a crude foam plastic model and a chart recorder trace. With such simple aids one understood clearly how Bragg diffraction, interferometry, moiré fringes and an R. V. Jones parallel motion machine inside a silicon crystal had been combined to measure X-ray wavelengths accurately and to show lattice defects. It is the essence of the Physics Exhibition that such ingenious ideas can be seen side by side with the awe-inspiring complexities of technological progress.

AVIATION

Gulls at Foulness

Now that the Roskill Commission has narrowed the search for a site for London's third airport to only four, popular movements, like the one which successfully defended Stansted, are springing up. Of the possible candidates, Foulness is the one least likely to inspire an upwelling of popular feeling, but already an ingenious defence has been put forward, by the British Trust for Ornithology. In its latest Newsletter, the trust publishes the results of a survey of the flight patterns of sea-birds over the proposed site at Foulness. As luck would have it, it turns out that the air lanes above Foulness are among the most congested in the whole of the south-east of England. Maplin Sands, just a little farther from the shore than the Foulness site, is a favourite roosting site for gulls, serving the whole of the gull population of Essex.

The article published by the BTO was written by Dr W. R. P. Bourne, who used results from a survey by Dr Peter Rudge, Secretary of the unlikely-sounding Foulness Wildfowl Counting Group. Dr Bourne says that at the height of the autumn passage in September, as many as 180,000 birds could be airborne on a broad front over Foulness, to say nothing of the wildfowl and waders which also inhabit the area, but which seem not to have caught the eye of the group. In mid-winter, the hazard would be less—perhaps only 10,000–14,000 birds—but neither of these estimates takes account of the birds migrating to Maplin sands from the other side of the Thames Estuary.

Dr Bourne argues that the building of the airport might disturb the birds temporarily, but he doubts that they will ever leave the area altogether. At high tide and at night they would continue to roost on the airport, and even if they did go, he thinks that they would still fly back and forth across the Maplin Sands between roosting areas inland and on the estuaries of the Thames, Crouch, Blackwater and Medway. The birds would, he feels, constitute "a small but constant risk to life", as well as causing many millions of pounds worth of damage. Oddly enough, the airport at Heathrow is also near roosting sites of gulls, but happily their flight paths from one roost to the next never seem to cross the approaches to the airfield. This does not mean that the birds have learned to avoid the aeroplanes, but simply that accidents of geography prevent the two from coming into contact.

The danger of bird-strikes would not, of course, amount to a conclusive argument against Foulness if all else could be seen to be in its favour. One day it may be possible to devise a way of keeping birds away from aeroplanes, although for the moment the best approach seems to be to keep aeroplanes away from birds. One possible warning device, under development at the National Research Council in Ottawa,