March 25. Examinations in computing science leading to membership qualifications are to be introduced in 1969 but, to begin with, the qualifying requirement will be based on age and computing experience. A spokesman for the society said this week that the qualifying examinations would be on the level of a BSc honours degree in computing science.

Overall co-ordination of recognized computer courses is to be undertaken by a new committee, the Co-ordinating Committee for Examinations in Computing Studies. This committee, said Mrs Williams, "is allocating courses among its constituent members, and is trying to establish nationally recognized examinations . . . but we cannot give any absolute guarantee that this will happen". The committee cannot force private schools to follow syllabuses leading to these examinations, but it is hoped that those that do will "drive out the bad".

A second committee will also help to inform prospective students about recognized training courses. Known as the Computer Training Policy Subcommittee, it has been established by the Engineering Industry Training Board with representatives from the DES, the main computing manufacturers, the National Computing Centre and from the new co-ordinating committee.

Optics Applied

THE applied optics section at Imperial College, a post-graduate section of the Department of Physics, was set up towards the end of the First World War to improve the poor quality of the optical instruments used by the British forces, and is this year celebrating its jubilee. At an open day to mark the event, the wide variety of research now being undertaken in the section's laboratories was exhibited. This work includes an investigation of the lighting of picture galleries, various aspects of the physics of vision, colour measurement, holography and optical design. It is the optical design group, set up as an experiment 7 years ago by the forerunner of the Science Research Council, which recently has been particularly successful. The group is concerned with improving the performance of existing lens designs, and developing new lens systems, and has pioneered the use of computers to carry out the tedious calculations involved.

The group is making its name in telescope optics by designing lens systems to correct an aberration known as coma, a defect common in large astronomical telescopes. Coma is one of the penalties paid for keeping astronomical telescopes as short as possible to cut down the cost of the dome which houses them. The group has designed corrector lenses for a number of telescopes, including the 200 in. on Mount Palomar and the Isaac Newton telescope.

Sophisticated lens systems are also needed in high energy nuclear physics, for bubble chamber photography. The optical design group has assisted with the optics of a number of bubble chambers including one at Brookhaven National Laboratory. An automatic scanner is now being developed to speed up the analysis of stereoscopic photographs of bubble chamber tracks. The applied optics section at Imperial College is also working on the illumination of large bubble chambers, in the region of 4 metres in diameter. To make full use of these large chambers, an optical system with a good depth of focus is needed. Holographic techniques are being developed using an optical system arranged so that the central plane of the chamber is in focus. A photograph will then include focused images of tracks in the central plane together with holograms of the out-of-focus tracks, which enable the locations of the out-of-focus tracks to be measured.

Seeing Round Corners

THE basis of fibre optics is that light is transmitted along narrow fibres of glass, coated with a material of lower refractive index, by multiple internal reflexions. Light thus follows the path of the fibre, so long as the curvature of the fibre is not so great that the angle of incidence of the light inside the fibre exceeds the critical angle. Typically, the thickness of the fibres is between 0·01 mm and 0·1 mm. For all practical purposes they are bunched together, in various ways depending on the application, so that each fibre transmits light from one end of the bundle to the other.

The development of this simple idea has been slow, chiefly because of manufacturing problems to do with the coating of the individual fibres and production of the bundles. These commercial obstacles are beginning to be overcome, however, and devices incorporating fibre optics are appearing on the market. Basically there are two ways of arranging the fibres to make up a fibre optic device. In a so-called coherent device the relative positions of the fibres are the same at each end of the bundle, so that an image at one end of the device is faithfully reproduced at the other end. The resolution depends on the thickness of the fibres. On the other hand, the fibres in a non-coherent bundle are bunched together at random and so cannot transmit an image. Because the relative positions of the fibres in coherent devices have to be maintained at both ends of the bundle, their cost is greater than for non-coherent bundles of the same size and wherever possible non-coherent devices are used.

It is not difficult to think of applications for fibre optics. For instance, devices incorporating coherent bundles are already available for viewing inaccessible places, the illumination provided via a non-coherent bundle. In conjunction with photo-electric cells fibre optics can be used to construct instruments as diverse as burglar alarms, punched card readers, illuminated display panels and fire detectors. Bundles of fibres can be fused together to form rigid rods, transmitting light in the same way as the flexible bundles. By drawing out one end of a rigid coherent rod, a cone of fibres which will produce a magnified or reduced image is formed. A 180° twist in a coherent rod is a simple way of accomplishing image reversal.

Many applications of fibre optics which have been put forward are only fractionally simpler ways of carrying out tasks which are now being done by electrical and optical systems. The question is whether the advantages of fibre optics are sufficient to make their introduction worth while. Medical and dental applications of fibre optics are a different matter, however. The chief advantage here seems to be in the provision of cold light sources, as the fibres do not transfer the heat from the initial light source to the object being viewed. For example, deep tissue can be illuminated by a non-coherent fibre optic the size of a large hypodermic needle, the tissue being viewed by a second coherent fibre optic connected to a microscope.

Non-coherent light pipes are already being used in dentistry, built into dental mirrors and drills.

In common with the laser, fibre optics may yet find its most important application in telecommunications. Fibre optics engineers are already talking of constructing light guides with lengths measured in miles, carrying information in the form of pulses of light. The problem is that present glasses can only be used to make guides up to about 100 ft in length, because of absorption in the glass. So far, the lengths of the longest guides have been tens of feet rather than miles. Research is therefore likely to concentrate on finding new materials with transmission properties which will make long fibres feasible.

Economical Desalination

DESALINATION as a source of fresh water is well established technically. Now, like nuclear power, it faces a period in which its economic advantages are likely to be argued out *ad nauseam*. A new report, produced by M. J. Burley and P. A. Mawer of the Water Research Association (WRA, £5), sets the ball rolling. It examines the various ways of removing salt from water and of bringing brackish water up to a drinkable standard, and describes the situations in which each method would be economically justified.

The first, and most important, conclusion is that flash distillation, so far the market leader in desalination equipment, is unlikely to be economic for base load production of fresh water in Britain for "a considerable number of years". Conventional water supply schemes can almost always supply fresh water at costs of less than 3*s*. a thousand gallons—of twenty-four schemes considered in the report, only two were more expensive than this. In contrast, flash distillation costs are well in excess of 3*s*. per thousand gallons, and without favourable financing and low cost steam would be unlikely to fall below 4*s*. 8*d*. per thousand gallons. Where a supply of brackish water is available, electrodialysis offers a better alternative, although it can only be used with mildly brackish water. The costs of this process, the report says, would at least in some cases fall below the 3*s*. per thousand gallons reference line. The additional costs of boreholes, effluent discharge and the like would add only another 3*d*. to 4*d*. a thousand gallons. Reverse osmosis, the report says, is unlikely to be competitive with electrodialysis for the treatment of low salinity, but it may well become cheaper for the slightly more brackish sources.

But the most interesting conclusion in the report concerns the joint use of conventional supplies and desalination plant. The idea here is to take more water from a reservoir than would otherwise be justified, and use the desalination plant as a hedge against prolonged dry spells. In this case, the load factor of the desalination plant would be low, perhaps no more than 10 to 15 per cent, but its advantage would be to maintain the overall reliability of the system. The main use of the desalination plant would be during the summer months, when demand for electricity is lowest; it might therefore be possible to negotiate cheap rates for the supply of steam during these periods. If this were done, the overall cost of the water would work out at about 2*s*. 11*d*. per thousand gallons. This type of system, it is suggested, might be particularly useful as a means of deferring major capital investments in new reservoirs until the demand really justifies them. The report also suggests that it might be worthwhile considering the possibility of using desalination to augment all the linked surface water resources in the south-east of England. While this might not show an immediate advantage, it might be a useful scheme later in this century.

Defence Research

DESPITE the successes of the past few months, the Society of British Aerospace Companies is disturbed about British Government policy towards aviation. The society, represented by Dr D. H. Gardner, Mr L. Boddington, Mr L. S. Greenland, Mr S. Bragg, Mr R. H. Francis and Mr Green, made plaintive noises about it when it gave evidence to the Select Committee on Science and Technology. The chief difficulty, according to the society, is "the absence of a coherent and firm national aerospace programme". The Government should make "a firm declaration of projects which Britain intends to support". Without this, it will be impossible to arrange partnership with foreign countries on an advantageous basis. "The UK has no bargaining lever in securing design leadership if it is known that it will not embark on a project except in partnership with a foreign country".

Dr Edmund Davies was unimpressed by these arguments. What the society was really complaining about, he suggested, was not the lack of government policy but its direction. The policy was quite clearly defined in the White Papers, and the society was alarmed because it involved no major aircraft projects. Why did the society itself not produce a plan ? Dr Gardner revealed that "steps were being taken to see if this can be done". Dr Davies suggested that the society's case was equivalent to saying that it wanted a guaranteed home market for its products, while at the same time arguing that the export market was vast.

The society gave a jaundiced view of the virtues of international collaboration. Mr Green said that the loss of technical information across the Channel had become far more serious than the loss of manpower to the United States. But within Britain, at least, things seem to be getting better. A new committee had been set up, with members from the Ministry of Technology, the industry, the nationalized airlines and the Air Registration Board, to discuss research policy. This was a splendid innovation, and gave the industry a chance of influencing research policy at an early stage. But the society claimed that not enough research was being done. There was a particular need for a wind tunnel suitable for work on low-speed aerodynamics, very important for problems of take-off and landing. The industry had been asking for this tunnel for seven years, but it was not yet built.

The witnesses could give no clear explanation of the industry's failure to estimate costs more accurately, except to say that the initial estimates, usually the least accurate, were produced by government departments. Unless the specifications were firm, it was impossible to produce reasonable estimates. If specifications changed, as they often did, then so quite naturally did costs. But in part it seemed that escalation in costs was caused by always trying to do more than had ever been done before. Producing less ambitious