of all lakes, rivers and reservoirs on the continent. Natural ice is a vast resource as yet barely tapped.

The economic use of ice meltwater is not new either in theory or practice. The earliest known large scale example was the commercial shipping of Alaskan lake ice to San Francisco during the 1850s with its replacement by glacier ice when lake ice was in short supply. Since then even larger scale use of glaciers for water has been suggested many times but has never (except perhaps in the Soviet Union) received a critical analysis.

The first problem is to find a supply of icebergs of the correct shape. In practice this means icebergs of roughly square or circular cross-section to avoid the hazards of rolling during towing. The sources of such "tabular" icebergs in the Arctic are not common, but Antarctica is more plentifully endowed especially in the large ice shelves which fringe the continent. The most obvious sites are the Ross Ice Shelf, which would be particularly suitable for supplying the west coast of South America, and the Amery Ice Shelf, conveniently located to satisfy Australian demands. A further possibility is the Filchner Ice Shelf which could supply icebergs to the Namib Desert area on the west coast of Africa. The selection of icebergs from these regions will be aided during the next few years by photography from polar-orbiting satellites capable of identifying individual objects with dimensions of about one hundred metres.

But would any ice arrive at its destination, or would it have melted away? For icebergs from the Antarctic, surface water temperatures at the northern ends of their journeys will be above 20° C; and for more than half of the transit distances temperatures will be above 5° C. Campbell and Weeks have examined three journeys ranging from 3,240 to 4,680 miles which, assuming an average towing speed of one knot, would last between 120 and 160 days, and conclude that large amounts of ice would remain. For example, an iceberg with lateral dimensions of 1,000 metres and 250 metres thick making a journey from Amery to Australia would end up with lateral dimensions of 760 metres and a thickness of 130 metres, or 30 per cent of the original. Longer journeys are less favourable; but 14 per cent of a Ross iceberg would reach the Atacama Desert.

And what of the economics of the operation? The only cost involved in the transit is that of the power required for towing. The resistance of an iceberg being pulled through water varies as the square of the velocity so that lower speeds are the most economic in terms of power. But longer towing times mean more melting so that a compromise must be made between melting losses and towing costs. Expenses could perhaps be reduced by slow towing along suitable ocean current paths.

Preliminary calculations show that an Amery iceberg of dimensions $2,700 \times 2,700 \times 250$ metres towed at half a knot would reach Australia as one of $2,460 \times 2,460 \times 130$ metres. The 207 billion gallons of water involved would be worth about $5·5 million, or about 10 per cent of the cost of the same quantity of desalinated water, compared with towing costs of about $1 million. A similar iceberg from the Ross Ice Shelf would arrive at the Atacama Desert as 101 billion gallons worth $2·7 million with transport costs of $1·3 million. None of these figures includes the costs involved in iceberg selection, "docking", melting or the transport of the resulting water; but the economics seem favourable enough to warrant more detailed study even with water at its present price.

MATHEMATICS

Jamboree for Number Crunchers

THE academic session 1970–71 is to be Numerical Analysis Year. This name has been announced by Professor D. S. Jones of the University of Dundee, where the Department of Mathematics has just been awarded a grant of £23,000 by the Science Research Council. The money will be spent on a year-long round of conferences, symposia and summer schools, and Professor Jones hopes that at the end, numerical analysis in Britain will be stronger than before. British numerical analysts, Professor Jones believes, are lagging behind their opposite numbers in Europe, the United States and the Soviet Union. The trouble is that news of time-saving developments in numerical analysis is not getting through to the practising mathematicians working in computer departments. During Numerical Analysis Year, mathematicians from abroad will visit Dundee to spread the word and, Professor Jones hopes, generate interest and awareness among the steady flow of people from British universities, colleges, and industry who will visit the department. So far, thirty missionaries from overseas have agreed to come for all or part of the year, and at some point they should all be in Dundee together. Professor A. R. Mitchell, also of Dundee, is in charge of the organization, and a by-product of the concentration of talent could be the encouragement of more universities to do work in this important field.

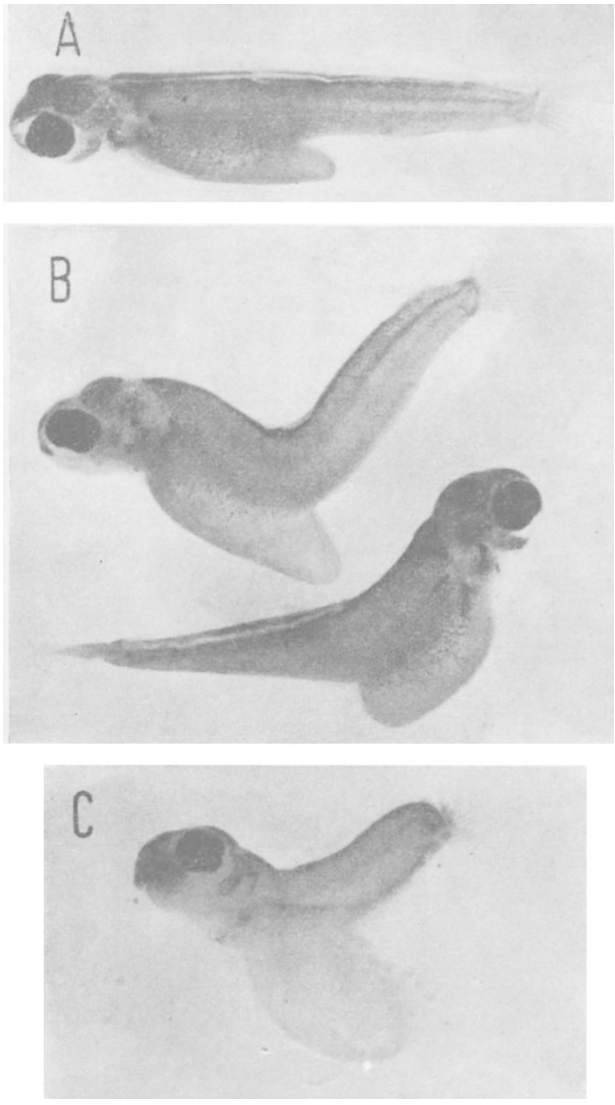
FISHERIES

Scientific Farming

THE basic biology which must underpin any attempt to rationalize the fishing industry is providing the Ministry of Agriculture's marine scientists with a wide range of problems to solve. In his annual report for 1968, which has just appeared (obtainable free of charge on application to the Fisheries Laboratory, Lowestoft), the Director of Fishery Research, Dr H. A. Cole, depicts a scene of healthy progress, both in the physiology, genetics and ecology of sea fish—studies which form the foundation of fish farming projects such as those of the White Fish Authority—and in more peripheral investigations of marine pollution and the disposal of radioactive wastes into the sea. The research is supported by records and predictions of the fishing conditions in the areas exploited by British fishing fleets, including a computer model that analyses productivity in the North Atlantic since 1946.

Commercial considerations have obviously determined many of the research topics. Pigment abnormalities, for example, can make a fish on the shop counter look unattractive to customers, and if plaice are reared in a tank they are often deficient in colour. This deficiency has been correlated with the size of the plaice larvae. Pigment peculiarities in sole are rarer, but have been similarly associated with size. Attempts to cross-breed different kinds of fish aim to generate new characteristics of commercial value,

although work is still at an early stage. Plaice × dab hybridization has been unsuccessful so far, although in some cases the hybrids survived beyond the larval stage. On the other hand, crosses between plaice and flounder thrived admirably, sometimes growing twice as fast as pure-bred plaice. Trying to get round the generation time of up to three years has led also to experiments in gynogenesis with the aim of breeding pure lines of fish faster. Eggs are fertilized with spermatozoa that have been genetically deactivated by ^{60}Co γ-radiation, so that only the female genetic material is used. The resulting embryos are, however, often abnormal (see comparisons in the photographs).



Comparison of normal and abnormal trout embryos: A, normal diploid trout alevin; B, gynogenetic diploid trout alevin (near normal); C, gynogenetic haploid trout alevin (abnormal).

Possible foods for farmed fish include a worm called *Lumbricillus* which frequents rotting seaweed and is apparently so good for the fish that scientists of the Port Erin marine hatchery are trying to cultivate it. The worm grows just as well in horticultural peat as in seaweed humus, and its diet can be supplemented with artificial pre-digested meal. Environmental studies of young fish reared at the Lowestoft laboratories are gradually building up a more comprehensive picture of the most suitable conditions for larvae to mature in. Their capacity for surviving temperature changes of the order that might be expected from a sharp frost is unexpectedly high, but a reduction of the dissolved oxygen content of water below 65 per cent of the saturation value is likely to cause deaths. Oxygen saturation is usually maintained during fish cultivation by pumping fresh seawater through the tanks, but it may be that the expenses of pumping could now be reduced by lowering the concentration—75 per cent seems to be safe at the moment.

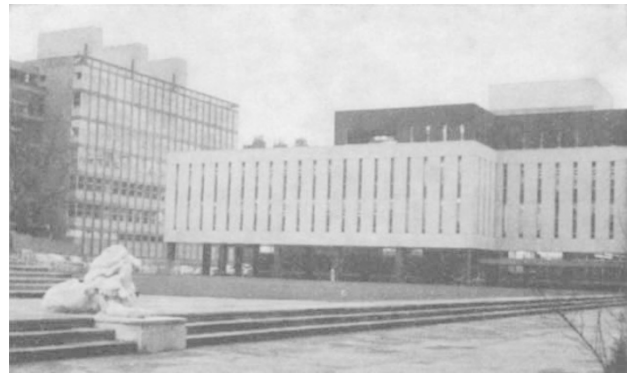
The ministry's work on marine pollution has grown since the report was prepared: after this year's seabird disaster, routine monitoring of marine life has included tests for polychlorinated biphenyls as well as organochlorines and heavy metals. New staff will be looking at sea fish, shellfish and plankton for evidence of how biphenyls get into the food chain. In 1968 there were also investigations of human illness associated with sea food, such as the paralytic shellfish poisoning caused by dinoflagellates in Northumberland (see, for example, *Nature*, **220**, 21; 1968). Oysters from the River Lynher in Cornwall have from time to time caused gastroenteritis, and have proved a more persistent problem.

1968 saw an expansion of research facilities. A dance hall at Lowestoft was converted into laboratories, workshops and offices, and a new ship (Nucella) was launched in February to operate from Burnham-on-Crouch in Essex in connexion with shellfish and inshore research. Academically, a relationship has developed with the University of East Anglia—two of the staff were awarded PhDs—and increasing international cooperation is clear from a long list of staff who worked or attended conferences abroad.

BUILDINGS

New Block for Imperial College

THE new College Block at Imperial College of Science and Technology was officially opened last week. It houses a large hall with seating for 800 people, two lecture theatres, a library, the new department of the



Imperial College.

History of Science and Technology, administrative offices and social and refectory services for both staff and students. The building is situated in the centre of the main site in Kensington. It was designed by Norman and Dawbarn and its total cost was about £3 million.