motor manufacturers efforts to clean up their products, but it would also cause many state governments grave problems in meeting other standards specified by the clean air act. He thus refused to entertain the idea of yet another delay.

As for the question of sulphuric acid emissions, that has already caused a split within the Environmental Protection Agency and raised some genuine fears that the catalyst may cause almost as many problems as it solves. The problem is the catalytic converters oxidise not only carbon monoxide and hydrocarbons to carbon dioxide and water, but they also oxidise some of the sulphur in gasoline to sulphur trioxide, and that could result in dangerous levels of sulphuric acid and sulphates in city air.

The problem first came to light earlier this year, and it prompted the EPA's director of research and development to suggest in an internal memorandum that the introduction of catalysts should be delayed until the problem has been given further study. According to the EPA's latest estimates, cars equipped with catalysts will spew between 3 and 5 times more sulphate into the atmosphere than cars not equipped with converters. Mr Train also stated at the hearings that EPA scientists have concluded that unless a mechanism is developed to control sulphate emissions, "more than one model year of cars equipped with catalysts could result in ambient levels of sulphates reaching levels at which recent studies suggest there will be adverse health effects". The EPA will soon be releasing a technical report on the matter, but in any case Train emphasises that if a problem does arise, there will be ample time to find a solution before there is a public health risk. Moreover, Mr Cole testified that "our (GM's) tests and atmospheric modelling show that while there may be some possibility, there is little probability that roadside atmospheric levels of sulphates from catalyst equipped vehicles by themselves will reach any threshold health levels".

But it is on the question of petrol consumption that General Motors testimony was most seriously out of line with that of the other two motor manufacturers. Until recently, all three car makers have been arguing that the exhaust catalyst will greatly increase fuel consumption, a fact that will not do much to help solve the energy crisis. But, much to the dismay of Ford and Chrysler, Mr Cole told the Senate committee that General Motors' cars equipped with catalysts to meet the 1975 emission standards will consume on average 13% less fuel than models being sold this year. To be sure, part of the reason for the dramatic drop is explained by the fact that GM, along with other manufacturers, will be producing smaller cars, but the statement has clearly cut the ground from under Ford and Chrysler's attempts to ride the energy crisis bandwagon to put public opinion on their side in the battle against the catalyst.

Thus it seems inevitable that catalysts will be fitted to some 60% of all cars sold in the United States next year. But the debate will carry on for years to come.

ROYAL SOCIETY

Future Energy Sources

ENERGY in the 1980s, last week's symposium at the Royal Society, painted several different pictures of future trends. Mr D. Clark of the Central Electricity Generating Board, pointing out that his board is the largest consumer of fuel in Europe, stated that coal will be the board's staple fuel until the 1980s, when oil will become increasingly more important. The future after that will lie largely with nuclear power.

Up to the 1980s, Mr Clark said, the board can use all the coal that the National Coal Board can provide providing the price is right. But nuclear power will quickly become economical for lower load factors than at present. With forecasts based on a 5% growth rate, the year 2000 would see 24% of Britain's energy needs supplied by nuclear power. Towards the end of the 1980s, surplus nuclear generating capacity should be available on enough nights of the year to make energy storage a practicality.

But while coal still has a large part to play, Mr Clark was clearly not entirely happy at the prospect. "It is a fact", he said, "that over the last fifteen years electricity production has been hit a lot harder by stoppages in coal supplies than in oil supplies."

He also suggested that the volume of ordering of new coal-fired plant will be too small for technical innovations of any dramatic kind in coal plant.

Mr Leslie Grainger of the National Coal Board disagreed. By his calculations, the price of coal has virtually to double before nuclear power becomes competitive for low load generation. Advances in coal utilisation such as fluidised combustion, liquefaction and gasification were all put forward.

"The time has come", Mr Grainger said, "when we should increase the scale of this operation". A demonstration fluidised combustion plant should be built and a fluidised liquefaction plant producing 10 tons a day should be constructed (a half ton a day plant is already running). Coal is going to be very important on a world scale for many decades, Mr Grainger added, and will increasingly be used for conversion to other forms of energy.

Mr E. B. Walker of Gulf Oil Corporation was also optimistic about energy conversion. His interests lay in converting tar sands, oil shales and coal. By 1985, he predicted, 3.75 million barrels of synthetic oil a day will be being produced in the USA. "This will reduce the United States demands on world supplies," he added, "and will therefore greatly strengthen the free world", although it is highly unlikely that any of the synthetics will be exported. Oil extracted with hot water from tar sands is already being produced at the rate of 50,000 barrels a day and Gulf plan to invest $900 million in a plant that will produce more than twice that amount. Two tons of tar sand produce about one barrel of crude. About the same amount of shale also produce a barrel of oil. But production difficulties in the arid Rocky Mountains mean that there will be long lean times before this source produces large quantities of oil. The cost of these synthetic crudes lies between $4 and $7 a barrel at 1970 prices.

Sir Peter Kent, Chairman of the Natural Environment Research Council and a former exploration manager with British Petroleum, warned of the difficulties that have already occurred in bringing North Sea Oil ashore. Pipelines are being layed at twice the usual depth for offshore oil in a stormy stretch of sea and "delays may very well arise".

Happy Hundredth

SIR RICKARD CHRISTOPHERS is 100 next Tuesday, November 27.

He started his scientific career in 1898 as a member of the Malaria Commission, jointly appointed by the Royal Society and the Colonial Office. Ronald Ross had just published his classical work on the mosquito as vector and Christophers, with his deep understanding of insects, was able to exert an enormous influence on the study of diseases borne by mosquitoes. He worked largely in India until 1930 and then returned to London to continue at the London School of Hygiene and Tropical Medicine. On retirement in 1938, he moved to Cambridge and spent part of the war working on insect repellents. From his reports to the Malaria Committee (1900–02) to his 700-page volume '*Aëdes aegypti*—the Yellow Fever Mosquito' (1960) his publications have been of the greatest distinction.

Sir Rickard finally moved to Dorset in 1963 where he spends much of his time gardening. A full tribute appears in *Trans. R. Soc. trop. Med. Hyg.*, **67**, 729 (1973).