two or three inputs compared with thousands in a real neuron, the scientists at Kent, under Dr I. Aleksander, decided to break away from the neuron model altogether and use logic circuits instead. The main advantage of this approach is its simplicity and the use of the microcircuits which means that the whole processing volume of the machine is smaller than a match head.

Sophia is taught to recognize a pattern, say the figure two, by showing it a two and at the same time the desired recognition pattern. After three or four of these lessons, each with a slightly different two, it will respond to a two at its input by reproducing the recognition pattern. Sophia is capable of generalization in that it can recognize patterns which are not exactly the same as those it has seen during training.

The basis of the machine's ability to learn is the collection of learning cells known as SLAMs (stored logic adaptive microcircuit). Each of these has three inputs, one output and a "teach" terminal. After feeding in a three bit pattern to the input and a particular response function at the teach terminal two or three times, the cell then responds to that pattern at the input by reproducing the learned function at the output. The way the cells are built into a network gives the machine the property of generalization.

Sophia is the forerunner of a much more powerful machine consisting of 1,000 SLAMs which is being built with a Science Research Council grant of £20,000. The way such a machine might be used in practice is to teach it to perform a particular task, like controlling complex machinery or industrial processes, or recognizing handwritten postcodes on letters, and then using the information stored inside it to build another, much cheaper non-learning machine which will perform only that particular function. The learning machine could then be taught to perform a completely different operation.

ROAD RESEARCH

Faster Traffic Flow

THE Road Research Laboratory seems to have been remarkably successful in selecting problems within the vast field of traffic control, road safety and road construction where its research efforts could be most effective. Some of these are described in the laboratory's annual report (HMSO, 27*s* 6*d*). There are items as diverse as the design of road patterns on motorways to help drivers estimate their speed, comprehensive surveys of the flow of traffic and people in the central areas in eight towns and the study of movements of bridges in response to changes of temperature.

In the field of safety, the laboratory is particularly concerned with the close-following of cars travelling on motorways carrying high-density traffic. A survey on the M4, running west from London, showed that 30 per cent of all accidents involve head-to-tail collisions between successive vehicles. Measurements of driver behaviour are being carried out on the M4 at Slough in which the headway, speed and wheelbase of individual cars are measured under varying weather conditions and at different times of the day and night. The laboratory is also looking at the perceptual problems associated with close-following and with the estimation of speed. Attempts are being made to help create the illusion of relative speed on featureless motorways by painting geometrical patterns on the road and it has been shown that a pattern of transverse white lines extending about a quarter of a mile up to the terminal roundabout of a motorway causes motorists to reduce their speed by about 15 per cent.

Follow-up studies on people injured in road accidents have led to a number of concrete proposals for designing cars so as to reduce injuries. One study showed that someone ejected in an accident is twice as likely to be seriously injured and four times as likely to be killed or seriously injured as if he were wearing a safety belt and remained in the car. About 13 per cent of people injured in car accidents are hurt by windscreen glass, and the use of safety belts could probably reduce this type of injury. Toughened glass was found to be three to five times more likely to cause injuries than laminated glass, but reports from the United States seem to indicate that the risk with a new type of laminated glass is much less. Hip injuries were involved in 9 per cent of cases, and suggested improvements that would help reduce this type of injury are better energy absorption characteristics in fascia panels, heater units and steering wheels and the provision of floor mounted gear levers which deflect or break easily.

Most of the delays on roads occur at junctions, and the Road Research Laboratory has developed a new roundabout design which when tested at Peterborough reduced the delay by more than a half and increased the capacity by about 20 per cent. The central island is only 12 feet in diameter and drivers give way to traffic from the right throughout the junction and not just at the entrances. New ways of setting traffic signals have already substantially reduced journey times in Glasgow's city centre. One, called the combination method, gave reductions of 20 per cent during the evening peak and 12 per cent averaged over the whole working day; another called TRANSYT gave 25 per cent during the evening peak and 16 per cent over the working day. These represent savings in congestion costs of about £550,000 to £650,000 annually.

CORAL REEFS

March of the Starfish

CORAL in the warmer waters of the world has raised an imposing offshore buffer to the oncoming battering of prevailing seas and weather, as well as a prolific habitat for marine creatures including a number important for fisheries. But coral structures must be alive to be geologically and environmentally stable. A science-fiction-like scourge from the coral polyp's predator, *Acanthaster planci*, the "crown of thorns" starfish, is causing grave concern in several parts of the Pacific. There is even talk of the loss of parts of Australia's much exposed coast due to predations to the Great Barrier Reef, where the crown of thorns invasion was first recorded three to four years ago.

Invasion is not too strong a word. An explosion of the Pacific crown of thorns starfish population seems involved. The creature was considered a rare species as recently as 1963. The attacking wave reaching the American mid-Pacific island of Guam in 1967 has been charted in detail by Richard H. Chesher of the University of Guam (*Science*, **165**, 280; 1969). Ninety per cent