

account of the stellar intensity interferometer at Narrabis, Australia, with which the angular diameter, and hence the radiation temperature of hot bright stars can be measured. Dr P. J. Treanor from the Vatican Observatory at Castel Gondolfo showed how he had measured the angle of polarization of stars. His method enables the statistical distribution of angles of polarization to be measured from one exposure.

## Four Classes of Microtubules

from our Correspondent in Cell Biology

ONE of the problems that continually faces electron microscopists is deciding whether organelles with the same fine structure have identical chemical composition and cellular function. Usually, the more complex the structure of the organelles, the easier it becomes to make this decision. Few would question, for example, that mitochondria and chloroplasts seen in different cells perform the same cellular functions. But does this apply to structurally simple organelles such as microtubules? Are they identical? According to Behnke and Forer (*J. Cell Sci.*, **2**, 169; 1967) there are at least four classes of microtubules.

Microtubules, simple cylindrical structures a few hundred angstroms in diameter and up to several microns long, are thought to be a virtually ubiquitous cell organelle. They occur in specifically arranged aggregates in cilia, flagella, sperm tails and the mitotic spindle, but also occur free in the cytoplasm without any obvious pattern of arrangement. The latter are known simply as cytoplasmic microtubules. Their function remains a mystery although various pieces of circumstantial evidence have led to a host of more or less likely suggestions: involvement in cell motility, cytoplasmic streaming, skeletal support, cellular plumbing, and the like. Surprisingly, however, despite all these proposed functions, it has generally been held that all microtubules are the same.

Now Behnke and Forer report that treatment of crane fly spermatids, rat sperm and rat tracheal cells with pepsin, colchicine, or storage at 0°C or 50°C clearly differentiates four classes of microtubules. In crane fly spermatids the cytoplasmic microtubules and those in the 9+2 arrangement, the central pair and each tubule of the nine outer doublets of their sperm tails respond differently to these treatments. Behnke and Forer conclude that these four classes have intrinsic differences in their chemical and/or physical composition. Furthermore the same four types occur in rat sperm and rat tracheal cells.

When examined after negative staining these four types of tubules have identical substructure. It appears that despite other differences, microtubules are in general constructed to a basically similar pattern, and Behnke and Zelander (*J. Ultrastruc. Res.*, **19**, 147; 1967) present more evidence of this. They have examined the substructure of the microtubules in mammalian blood platelets, which, like those in many other cell types, are labile to osmium tetroxide fixation but are preserved by glutaraldehyde fixation. They find the structure of these G-tubules is very similar to that of O-tubules, microtubules fixed by both osmium and glutaraldehyde. The wall of both types is constructed of about twelve fine filaments each about 35–40 Å in diameter and arranged in a cylinder with a 60 Å centre to centre distance.

## Parliament in Britain

### University Computers

THE Secretary of State for Education and Science, Mr A. Crosland, stated that purchase of computers for universities to the total value of £6.5 million had been approved so far against the programme outlined by the Flowers Committee, which was being kept under review by the Computer Board. Further major provision was under consideration by the board. It was still expected that expenditure in the first three years would average about £3 million a year when account was taken of building and operating costs. Expenditure by the research councils on "off line" computers totalled nearly £2 million in 1966–67 and was expected to be £1.5 million in 1967–68. (Written answer, July 12.)

### Teachers

REPLYING for the Government in a short debate in the House of Commons on July 10 on regulations for the training of teachers, the Minister of State, Department of Education and Science, Mr G. Roberts, said that full-time staff in the colleges now numbered 7,900. He agreed on the need to attract more graduate teachers in mathematics and science. The target was now 110,000 teacher training places, outside the universities, in England and Wales in 1973–74 and 100,000 by the end of this decade, the latter figure corresponding with an annual intake of 35,000 at a cost of £68 million in 1966–67. Since 1962–63 the number of new entrants had increased from about 5,000 to 9,500 but was still only about 28 per cent of all entrants, instead of the desired 35 per cent. The number of entrants aged 25 and more trebled between 1962–63 and 1966–67, when it reached 6,100. The proportion of those trained who left teaching was probably well below 3 per cent. On consultative machinery a wide range of views had been expressed and it would not be easy to reach a conclusion which would be universally acceptable. The Weaver report had been generally welcomed, and colleges of education had been invited to prepare schemes of government and provided with models from which they could work. Schemes were coming forward, but it was not intended to seek to impress any rigid uniformity in the articles of government. A modern scheme of government for voluntary colleges had also been agreed with the voluntary bodies and circulated to all colleges, and they were now submitting their proposals for new schemes of government. Mr Roberts hoped both types of college would emerge with the fullest possible academic and student autonomy appropriate to their nature. (House of Commons, July 10.)

### Steelworks

MR ARTHUR BOTTOMLEY, Minister of Overseas Development, gave details of the aid provided by the British Government for the development of the Durgapur Steelworks in India. Loans totalling £68 million had been offered since 1957, he said, and £60 million of this had so far been taken up. The expansion of the steelworks from 1.6 to 3.4 million tons had been postponed because the project was too expensive for the Indian Government, and the growth of the steel market in India had been slower than anticipated. Before expanding, the Indian Government wanted to attain full production at the existing capacity, he added. (Written answer, July 12.)