ers, six British and three Romanian, (Shute *et al. Trans. R. Soc. trop. Med. Hyg.* **70**, 474; 1976) have demonstrated the coexistence of sporozoites capable of inducing long or short prepatent periods. They infected humans with 10 , 1×10^2 , 1×10^3 or 1×10^5 sporozoites and found that in those given 10 or 1×10^2 the prepatent periods ranged from 262–628 d, in those given 1×10^3 the prepatent period in one was 16 d and in four others between 257–386 d and in seven infected with 1×10^5 the prepatent periods were 13, 15 or 16 d. In parallel experiments using a tropical strain of *P. vivax* all the prepatent periods were short, 12–17 d (Ungureanu *et al. Trans. R. Soc. trop. Med. Hyg.* **70**, 482; 1976). These experiments suggest that temperate strains of *P. vivax* consist of at least two genetic types, one with a long and one with a short prepatent period and that in any population of sporozoites there are more long prepatent period forms than short whereas in tropical strains the reverse is probably true. The selection of the two forms has presumably been due to differences in the seasonal availability of suitable mosquitoes for transmission.

It may well be that there are more than two forms of *P. vivax* within any one strain and Tiburskaya and Dukhanina (*Med. Parazit.* **45**, 218; 1976) believe that there may be as many as five in one Russian strain and

that the expression of a particular form varies from month to month.

The life cycle of the malaria parasites must now be redescribed. Sporozoites are injected into the host and enter the liver where they may develop rapidly or slowly into multinucleate exoerythrocytic schizonts the products of which invade blood cells. There is no need to postulate a continuous series of exoerythrocytic cycles to account for relapses because these could result from initial infections with sporozoites having prepatent periods of up to several years. Differences in the time taken for different sporozoites to mature into exoerythrocytic stages could account for the irregular relapses characteristic of malaria.

Continuous exoerythrocytic cycles are now no longer thought to occur in any species of human malaria. In *P. vivax* and *P. ovale*, sporozoites with long but variable development are responsible for relapses whereas in *P. falciparum* and *P. malariae* small numbers of parasites persist in the blood after the initial infection and subsequent attacks of malaria result from recrudescences of these and are not true relapses. It is now, more than ever before, important to know exactly what species is causing malaria because parasites that occur only in the blood respond to a number of antimalarial drugs whereas those that develop slowly somewhere else in the body do not. □

Telecommunications in the '80s

from John R. Forrest

A meeting entitled Telecommunications in the 1980s and After was held at the Royal Society on 10–11 March, 1977. A small exhibition also provided a demonstration of telecommunications hardware currently used or under development.

EXOTIC technology, system planning and social implications were all discussed in a balanced programme. Sir Edward Fennessy (British Post Office) saw an optimistic future for telecommunications on the global scale, with some 1,500 million telephones by the year 2000, this figure being dominated by the now-developing countries. He saw electronic letter and document overnight transmission as a very rich field for development in balancing the loading of telecommunications traffic. This optimism in regard to the almost limitless capabilities of technology was shared by K. Corfield (TEMA Ltd), but he showed concern that Britain should itself have a most modern and internationally-compatible telecommunications system as an incentive for a powerful export industry. By contrast,

Dimeric water molecules

from Graham Richards

IN the heady days when 'polywater' was thought to exist and even to represent a danger to life, theoretical chemists were quick to calculate the stability of water dimers and to risk their reputations by lending weight to credence in the new form of water. The bursting of the polywater bubble has not, however, ended interest in the dimeric species (H_2O)₂. It was first postulated to exist in order to explain pressure, volume and temperature observations in water vapour and later observed directly in solid rare gas matrices and by mass spectrometric techniques. The dimer, trimer and other small polymers are of significance in the understanding of liquid water itself and in the study of the all-important hydrogen bond which must be involved in the stability of water polymers and indeed in most natural polymers.

The quality and reliability of the most recent theoretical predictions using *ab initio* molecular orbital methods is demonstrated by a new detailed experimental study of the water dimer by molecular beam electrical resonance spectroscopy (Dyke *et al. J. chem. Phys.* **66**, 498; 1977). Molecular beams of the

hydrogen-bonded dimers were generated by expanding water vapour through a pinhole nozzle. The cooling so produced reduces the temperature of the beam so that the thermal energy is insufficient to break the relatively weak hydrogen bond. Radiofrequency and microwave transitions were observed arising from changes in the rotational energy of the rotating dimer. This gives structural information as does the dipole moment which can be interpreted to give the relative orientations of the two H_2O monomer subunits.

The resultant structure is the so-called "trans-linear" complex. This consists of one water molecule joined to the other by means of a linear hydrogen bond. The covalently-bonded hydrogen of one partner points along a lone pair electron lobe of its mate with a plane of symmetry along the hydrogen bond bisecting the HOH angle of the proton acceptor. The non-hydrogen bonded protons are disposed *trans*

to the long bond.

The distance between the two oxygens is longer in the dimer than it is in liquid water, a similar result also being known for (HF)₂. Apparently then, when a hydrogen bond is formed, charge transfer occurs in such a way as to enhance the formation of further hydrogen bonds which are strengthened, as is the case in liquid water.

Another striking point is that the geometry of the proton acceptor is nearly tetrahedral in conformity with simple ideas about the disposition of electron lone pairs, despite the fact that calculated electron density maps do not show prominent lone pairs on monomeric water. The results do, on the other hand, support the accepted view that hydrogen bonds have an important covalent component and are not merely electrostatic.

The detailed results of this work answer most of the questions about the water dimer, but many remain about the trimer. Is it an open structure with two hydrogen bonds, or is it a cyclic entity with three? No doubt theoreticians will now feel confident to answer this question long before the difficult experiments can be completed.