from the atmosphere more rapidly than deuterium. The snag is that, if the atmosphere of Venus is anything like as turbulent as the atmosphere of the Earth, some of the deuterium will be dragged down to lower levels where it will recombine, and Donahue points out that this will reduce the relative concentration of deuterium at the top of the atmosphere.

What the argument boils down to is that, if the high deuterium–hydrogen ratio at 6,500 km is to be reconciled with a low ratio overall, turbulence on Venus must be much less than on the Earth. There seems to be no obvious reason why this should not be so. Too little is known about the turbulence in the Earth's atmosphere to make possible extrapolations to Venus, but the two planets are sufficiently different for the absence of turbulence on Venus to be feasible. A corollary is that the outer atmosphere of the Earth is unlikely to contain such a high relative density of deuterium as does Venus.

CHEMISTRY

Metal–Metal Bonds

from a Correspondent

A LIVELY discussion on metal–metal bonds in chemical compounds was held by the Chemical Crystallography Group of the Chemical Society on March 4. Professor J. Lewis of University College, London, surveyed the experimental evidence from which the existence of such bonds was deduced. He said that compounds fall into two types: those in which only metal–metal bonds are polymer-forming, and those containing bridging atoms or groups. Professor D. A. Brown of University College, Dublin, considered the compounds $M_2(CO)_{10}$ of the first type, under the provocative title "Theory of Metal–Metal Bonding; Does it Exist?" His molecular orbital calculations indicated that interactions between one metal atom and the carbonyl groups on the other were of the same order of magnitude as metal–metal interactions.

Professor R. Mason of the University of Sheffield described a compound with one gold atom surrounded by ten others, $Au_{11}(Ph_3P)_7(SCN)_3$, all having the configurations of inert gases. He used the bond lengths in three related triangular osmium cluster compounds to illustrate that metal–metal distances might be influenced by anti-bonding orbitals and vary with the other ligands.

Theoretical work by Dr R. W. Jotham and Dr S. F. A. Kettle of the University of Sheffield indicates that the interaction between the copper atoms in carboxylates is a consequence rather than a cause of the dimeric structure, although it is strong enough to produce measurable magnetic effects. They said that their calculations applied only to the occupation of the molecular orbital of highest energy so that the net effect of the other molecular orbitals might be bonding or anti-bonding.

Cooperation between crystallographers and magneto chemists at Imperial College London, has resulted in experiments showing that, for two comparable compounds of the type $(NMe_4^+)_2[Cu_2(RCOO)_4(NCS)_2]$, the one with the greater magnetic effect has the longer Cu . . . Cu distance. Professor Lewis remarked that the four magnetically different forms of cupric benzoate might repay crystal structure analysis.

Sir Ronald Nyholm (University College, London), opening the discussion, emphasized the difficulties facing theoreticians in the excess of parameters over observations, and then went on to describe the compound $Os_3(CO)_{10}ClAuPPh_3$ in order to challenge theoretical interpretation. Although the opinion was generally that metal–metal interaction is not structure-determining, Dr P. G. Owston of the Petrochemical and Polymer Laboratory, ICI, Runcorn, presented crystallographic evidence to the contrary in dimeric nickel complexes with bridging phosphorus atoms.

PARTICLE ACCELERATORS

New Ways with Protons

from a Correspondent

THE anxieties of American accelerator builders were voiced by two principal speakers at the National Particle Accelerator Conference on March 3–5. D. M. Robinson of High Voltage Engineering defended accelerator-based science on the grounds that it has shown a greater economic return than any other investment in science, but he admitted that accelerator programmes have been damaged by recent budget cuts, that applications of basic science are unpredictable and that the time scales are long—sometimes as long as fifty years. To ensure that their discipline has equal priority with applications, nuclear scientists need a united viewpoint which can be put to the press, the public and Congress. This point was reinforced by Representative Craig Hosmer of the Joint Congressional Committee on Atomic Energy, who praised the joint seminars of businessmen and scientists held at the California Institute of Technology. More ominously, Congressman Hosmer reminded the 800 people in his audience that the taxpayer, so ready to pay for defence, is very sensitive to disloyalty, so that scientists must guard their image as loyal citizens. He also spoke of a proposed reorganization of Federal funds for accelerators which would group them with those of other branches of basic science instead of channelling them through the Atomic Energy Commission. On the new 200 GeV accelerator, he was confident that the Nixon administration will continue to back the machine.

Construction of the new machine has just begun at the National Accelerator Laboratory near Chicago and a dozen contributions to the conference reflected the rapid progress which has been made. Most papers dealt with the application of existing knowledge and techniques, but a fresh note was struck by T. L. Collins, who described the planning of the site. A professional city planner has been commissioned to advise on features such as the road network, the preservation of woodland, the provision of a lake reservoir and the transformation of excavated soil into an amenity likely to become the best ski-slope in Illinois.

V. P. Sarantsev of the Soviet Union reported on developments of the electron ring accelerator principle at Dubna. A 1·5 MeV electron ring has been compressed and accelerated by pulsed magnetic fields. Sarantsev admitted disarmingly that there may not have been any protons at all in the work which has been done so far. D. Keefe of the Lawrence Radiation Laboratory pointed out that the collective acceleration