tion. So, if proteolytic digestion assists in removing controls involved in density dependent inhibition of growth, which is not ruled out by these results, it does not manage it by itself. This conclusion is perhaps not surprising but worth stating in any case, especially for those cell biologists who are studying the role of serum factors and hormones in growth control.

THEORETICAL CHEMISTRY

Quantum Chemical Game

from our Molecular Physics Correspondent

ALL too often the complexities of the many-electron problem in chemistry lead to a frontal, and sometimes premature, assault by computer, relieved only occasionally by the elegance of a result from group theory or elsewhere. So familiar has this pattern become that it is a pleasant surprise to be presented with a simplification that is both unusual and elegant and, in its way, outright amusing.

Such a description may justly be applied to the paper entitled "A Game Theoretic Model for the Determination of Charge and Configuration in Metal Complex Compounds" by Haberditzl and Bartel (*Chem. Phys. Lett.*, **19**, 432; 1973). The authors show how at least one stage of the, in principle enormously complicated, problem of calculating the distribution of electrons between the central ion of a metal complex and its neighbours can be reduced to a simple exercise in the theory of games, the ion and its neighbours 'competing', as it were, for the electrons available. The type of idealised game involved proves to be quite a simple version of the 'two-person zero-sum' game in which two players seek an optimal course of action to maximise their chance of gain from a fixed premium. The various 'pure strategies' in the game correspond to suitable wave functions for the ion and the ligand system, and the 'payoff matrix' gives the hypothetical gain of electrons by the central ion for differing combinations, with due allowance for symmetry.

Of course the elements in the latter must be calculated by whatever means are to hand—inevitably some form of perturbation theory—and it is here that the full difficulty and scope for ingenuity in the problem very much remain. Yet, once the 'payoff' conditions have been specified, the optimal strategy for the central ion can be computed in a very simple manner and, moreover, in a single step (with considerable advantage over the laborious and somewhat fickle iterative methods used up to now).

Specialists will no doubt be quick to delimit the scope and practicality of the method, but it seems entirely possible that it will find applications to 'competitive' situations other than that between a metal ion and a ligand system. At the same time no one should go out of their way (as the authors conspicuously refrain from doing) to see anthropomorphic subtleties in the interatomic battle for electrons. The game-theory insight reveals a curious and perhaps far reaching new minimum principle, separates a messy calculation into two usefully distinct stages, and provides an illuminating mapping of one computational problem into a better known one. Quantum chemistry, perhaps of all theoretical sciences one of the most liable to be seen as a confusion of woods and trees, can certainly do with more adventurous touches of this kind.

JUPITER

Plea for Observations

by our Cosmology Correspondent

PIONEER 10 is now rapidly approaching Jupiter, and in a recent issue of *Icarus* (**20**, 52; 1973) Coffeen, of the University of Arizona, puts in a plea for ground based observations to coincide with those of the probe. The period of particular interest is from November 28 to December 10, and there is a need for ground based photography, spectroscopy, photometry and polarimetry; during that period, Jupiter will be at a declination of 18°.8, with phase angle 9°, 4.1 h east of the Sun, so that southern latitude observations at around the time of evening twilight will be most effective.

PETROLOGY

Kimberlite Conference

from a Correspondent

ALTHOUGH kimberlites provide a more thorough sampling of the upper mantle than any other type of magmatic rock, they have never before formed the focal point of a major international conference. This was largely redressed when the first international conference on kimberlites was held, appropriately in South Africa, at the University of Cape Town from September 23–29.

In the session on kimberlite geology, descriptions were given of less well-known kimberlite provinces in North America, Greenland and South Africa, and M. Bardet (Bureau de Recherches Géologiques et Minières, Orléans) described kimberlites from West Africa that lack the normal kimberlite 'indicator' minerals (pyrope, picroilmenite) and suggested that many of these atypical kimberlites are yet to be discovered, having been missed by current prospecting techniques. Although there was general agreement on an explosive origin of kimberlite diatremes, there was considerable debate as to whether the explosion mechanism results from high pressure gases within the kimberlite magma or is due to super-heating of groundwater by the ascending magma. In this context, the D/H and $^{18}O/^{16}O$ studies by S. M. F. Sheppard (Scottish Universities Research Reactor Centre, East Kilbride) indicated the involvement of warm groundwater in the formation of some diatreme kimberlites. Micro-probe analyses of the hitherto neglected groundmass minerals in the kimberlite matrix have now provided valuable information on the physical conditions prevailing during the crystallisation of the kimberlite matrix. This was exemplified by S. E. Haggerty (University of Massachusetts) whose work on the opaque phases has revealed considerable variation in the redox conditions, cooling rate and solid-solid, solid-gas and solid-liquid reactions during crystallisation. Haggerty also reported the occurrence in kimberlite of a new barium-vanadium titanate, and the first terrestrial occurrence of armalcolite.

In the sessions on xenoliths, two aspects made the most impact. Until now virtually no work has been carried out on the petrofabrics of kimberlite xenoliths, but A. Nicolas (University of Nantes) and B. Harte (University of Edinburgh) both reported a wide variety of deformation and recrystallisation features that have been imposed on these rocks within the upper mantle. The second aspect linked up strongly with the deformation studies of Nicolas. F. R. Boyd (Geophysical Laboratory, Washington) and P. H. Nixon (Department of Mines, Lesotho) showed that highly-sheared lherzolites have equilibrated at relatively high temperatures (1,300–1,400° C) compared with the more normal granular lherzolites (950–1,100° C), and together with the granular lherzolites could be used to infer a Cretaceous geothermal gradient; also Boyd and Nixon interpreted the shearing as due to the movement of the African Plate during the breakup of Gondwanaland.

The geochemistry of sheared lherzolites provided another focus of attention. They contain more CaO and Al_2O_3 than the granular lherzolites (and hence more potential basalt) but A. J. Erlank (University of Cape Town) showed them to be strongly depleted in both Nb and Zr. In addition N. Shimizu (Geophysical Laboratory, Washington) reported that the clinopyroxenes in the sheared lherzolites have very high K/Rb ratios (2,000–2,200), extremely high K/Cs ratios (1,000,000–3,000,000), and low $^{87}Sr/^{86}Sr$ ratios (0.7027–0.7038). This apparent clash between the major and trace element evidence, together with the wide-