rates, and that the completion of β-chains is controlled by the release of α-chains. Just for good measure, Luppis *et al.* throw in the observation that no aggregates of αβ chains could be detected on polysomes, in contrast to what would be predicted by the second form of translational control model. It is perhaps surprising that at a time when a bacterial system has just been shown to suffer translational control (see *Nature New Biology*, **229**, 2; 1971), this possibility is ruled out for a system at first sight in much greater need of it. Luppis *et al.*'s final conclusion leaves only one loophole; they say that the only translational control mechanism not disproven by their results would be at the initiation of protein synthesis.

METALLOPROTEINS

Metal for Metal

from our Biological Chemistry Correspondent

THE number of metalloenzymes in which one metal has been exchanged for another is now increased by the arrival of two coboglobins to swell the hybrid ranks. The reconstitution of complexes from dimethyl cobalt(II) - protoporphyrin-IX and the globin protein switches cobalt for iron in either haemoglobin or myoglobin and provides Hoffman and Petering with functional, oxygen carrying metalloproteins which contain a paramagnetic probe and which can be investigated by electron paramagnetic resonance spectroscopy.

Hoffman and Petering report (*Proc. US Nat. Acad. Sci.*, **67**, 637; 1970) that both analogues bind oxygen and provide useful EPR spectra in deoxy and oxy forms. Although some coboglobin preparations show signs of cobalt–porphyrin aggregates adsorbed to the protein, the predominant interaction of these structural units seems to be a specific one, characteristic of five-coordinate cobalt in the low-spin state. A single, axially sited nitrogen ligand can be recognized and is presumably that proximal histidine which is seen bound to the iron in haemoglobin structures. When this deoxy-coboglobin binds oxygen, the resulting EPR changes are so similar to those seen on oxygenation of the simple cobalt–porphyrin complex that no specific interaction between oxygen and the globin protein seems likely. These oxy-coboglobins are best described for electronic book-keepers as $Co(III)\text{-}O_2^-$ and are likely to have a bent cobalt–dioxygen structure like that advanced by Pauling for oxyhaemoglobin.

Significantly, whereas the myoglobin analogue exhibits a simple hyperbolic uptake of oxygen, the reversible binding of oxygen to the haemoglobin analogue, Cb, shows the cooperativity characteristic of haemoglobin itself. Although this effect, gauged by Hill plots, is diminished by a factor of three it seems a small price to pay for the change in size from iron to cobalt. A comparison between the movement of the cobalt relative to the porphyrin ring and the degree of cooperativity may well provide a searching test of Perutz's explanation of cooperativity for haemoglobin (*Nature*, **228**, 726; 1970).

TUMOUR VIROLOGY

Crossing Barriers

from our Cell Biology Correspondent

"ONE naturally wonders if man may also be susceptible to infection by feline sarcoma virus"; that is the pregnant sentence with which Chang, Golden and Harrold end their description of the propagation of feline sarcoma virus in seven of the nineteen lines of human fibroblasts they tested (*J. Virol.*, **6**, 599; 1970). And there is no denying that the cat sarcoma and leukaemia viruses are potentially very dangerous agents. Unlike their relatives the murine and avian sarcoma and leukaemia viruses, these feline viruses are notorious for their capacity to cross species barriers both *in vivo* and *in vitro*. They can transform and replicate in cultivated cells of several species other than the cat and inoculations of feline sarcoma virus induce tumours in at least one primate, the marmoset monkey.

The experiments of Chang *et al.* extend similar work reported by Sarma and his colleagues earlier last year. At least some lines of cultivated human cells are transformed, albeit at low frequency and slowly, and productively infected by feline sarcoma virus. The transformed cells have altered morphology; they enlarge, become hyper-refractile, motile and intensely staining with haematoxylin some 10 days to 3 months after exposure to the virus. Whether they divide or not seems to depend on the strain of sarcoma virus and the line of cell. Sarma found that the human fibroblasts he studied divided to form multilayered foci whereas Chang *et al.* report that the cells of the seven lines which were transformed did not divide.

The variable responses of different human fibroblast lines to feline sarcoma virus noticed by Chang and his colleagues merit further investigation. Cells of two of their nineteen lines were morphologically transformed but failed to release progeny virus, whereas cells of ten lines were neither transformed nor produced progeny. Sarcoma virus could, however, be recovered from at least some cells of some of these non-producer lines by co-cultivation with cat cells. What is the biochemical basis of this apparent resistance to transformation of some lines of human fibroblasts ?

It is becoming increasingly clear that the very wide host range, and therefore potential danger, of these feline viruses is determined by their envelopes. Recently, for example, O'Connor and Fischinger (*J. Nat. Cancer Inst.*, **44**, 429; 1970) reported that a virus believed to comprise a murine sarcoma genome enclosed in an envelope specified by a feline leukaemia virus transforms and eplicates in human fibroblasts of three lnes simultaneously infected with feline eukaemia virus. By contrast murine sarcoma and leukaemia viruses do not infect these cells. Chapman, Fischinger and O'Connor (*J. Nat. Cancer Inst.*, **45**, 1047; 1970) have now studied the response of dog cells to this murine sarcoma, feline leukaemia virus pseudotype, MSV(FeLV). Primary cultures of canine embryonic cells are susceptible to transformation by and support the replication of MSV(FeLV) in the presence of feline leukaemia virus, and, after passage in dog cells, MSV-(FeLV) develops the capacity to induce foci of transformants instead of single transformed cells. The passage in canine cells of both MSV(FeLV) and feline leukaemia virus does not, however, change the underlying predilection of these viruses for cat rather than dog cells.

In the hierarchy of susceptibility dog cells are less susceptible to transformation by MSV(FeLV) than cat cells, but more susceptible than human cells. Three days after infection, canine transformants can be scored whereas transformed human cells are not discernible until some 10 to 15 days after infection. In both dog and human cells, however, MSV(FeLV) behaves as a defective virus; it cannot replicate unless the cell is simultaneously infected with feline leukaemia virus, particles of which are always present in stocks of MSV(FeLV). Because of this, superinfection with feline leukaemia virus of cultures of dog cells, infected with stocks of MSV(FeLV), enhances the formation of foci of transformed cells, which at least in part arise from the multiplication of a single transformed cell. By contrast foci of murine cells transformed by MSV(FeLV) apparently develop as a result of infection of cells neighbouring a single transformed cell producing progeny virus.

As Chapman *et al.* note, the dependence of the MSV(FeLV) pseudotype on a leukaemia virus, which is presumably required to provide an envelope for the particles, may prove to be extremely useful. For it should be possible to use MSV(FeLV) as an indicator virus for the presence of leukaemia viruses in cells. Because leukaemia viruses do not alter the morphology of many types of cells their presence may remain unnoticed; if, however, such infected cells were to be superinfected with MSV(FeLV) they might be morphologically transformed and/or yield progeny MSV(LV) pseudotypes which could be assayed by focus formation. No doubt Chapman and his colleagues will not be slow in exploiting this tool to search for leukaemia viruses of various mammals including man.