cant advance has been made, according to preliminary reports, by R. W. F. Hardy's group at Dupont de Nemours, Wilmington, Delaware (*Biochim. Biophys. Res. Commun.*, **39**, 90; 1970).

They have obtained crystals of the Mo–Fe protein from *Azotobacter vinelandii* as needles which appear when the ionic strength of the solution is lowered. This is an unusual procedure for crystallizing proteins: high ionic strengths, or at least lowered water activities, tend to be favoured among practitioners of the art (which tends to have culinary as much as scientific overtones). The Dupont group's product has one or two peculiar properties: although the solution is intensely brown, the crystals are white. The molecular weight exceeds all earlier claims, being nearly 300,000, and the crystals contain approximately two Mo atoms, forty Fe atoms, forty cysteine residues and thirty labile sulphur atoms. Though crystallinity is not, among proteins, an absolute criterion of molecular homogeneity, the prospect of authentic crystals of one of the components of nitrogenase opens exciting vistas for structural studies.

On the more biological front, the use of the acetylene reduction technique continues to revolutionize ideas about the distribution of nitrogen-fixing organisms. Several groups of microorganisms which were believed to be able to fix nitrogen have now been struck off the list; hitherto unsuspected ones are being discovered in strange environments. Perhaps the strangest case was described by F. J. Bergersen and E. H. Hipsley of the CSIRO Division of Plant Industry, Canberra (*J. Gen. Microbiol.*, **60**, 61; 1970), who found nitrogen-fixing bacteria of the *Klebsiella* group in the intestines of pigs, guinea-pigs and humans. Among the humans were not only Europeans from Canberra, but also natives from the Morobe district in the Territory of Papua–New Guinea; natives who live on a very low nitrogen diet, based principally on sweet potatoes. These observations raise once more the idea, never completely dismissed, that nitrogen-fixing bacteria can contribute to the nutritional status of animals, including man, when the dietary nitrogen is low. Bergersen and Hipsley showed that a guinea-pig which had been fed a diet low in nitrogen for several days reduced acetylene, slowly but definitely, when exposed to this gas in an enclosed chamber. This experiment shows that the nitrogen-fixing bacteria in its intestines were actually active, though their relevance to its nutrition is still an open question. All the well established nitrogen-fixing associations have been between bacteria and plants, and the leguminous association, which is perhaps the best known, has been peculiar because neither the plant nor the microorganism can be persuaded to fix nitrogen separately. At the April meeting of the American Society for Microbiology, Hardy's group reported use of the acetylene reduction technique to demonstrate fixation *in vitro* by microorganisms growing with isolated plant cells. Rapidly dividing cultures of root cells from soya bean were inoculated with *Rhizobium japonicum*; an association was formed which could be observed by electron microscopy and which reduced acetylene at about 1 per cent of the rate found with intact soya bean root nodules. As Hardy and his colleagues recognize, these experiments open, for the first time, the prospect of studying the effects of plant hormones on this curiously obligatory symbiosis.

PERCEPTION

Detectors in Human Visual System

from our Neurophysiology Correspondent

EVIDENCE has recently been published for the existence of orientation and size detectors in the human visual system (Campbell and Maffei, *J. Physiol.*, **207**, 635; 1970). This gives firm support to the possibility of linking neurophysiological and psychophysical data.

Campbell and Maffei showed their subjects gratings on an oscilloscope face. These were fields with brightness sinusoidally modulated spatially, giving the appearance of fuzzy, alternating light and dark bars. Previous experiments had established psychophysical thresholds for seeing a grating at various contrast levels and spatial frequencies (discussed in *Nature*, **224**, 311; 1969). The psychophysical threshold was defined as that contrast level at which the subject could correctly report the orientation of the grating, which implied that he could clearly distinguish it from a uniformly bright field of the same mean luminance. To obtain a neurophysiological measure Campbell and Maffei presented the gratings as before, but reversed their contrast eight times a second. They recorded the evoked potential to this stimulus between two scalp electrodes above the visual cortex. The evoked potential was filtered so that its power at eight cycles, the stimulus frequency, could be measured. Each experimental datum was therefore an evoked potential amplitude for a grating of particular spatial frequency at a given contrast level. To obtain a measurable evoked potential amplitude it was necessary to average the response to several hundred presentations, improving the signal-to-noise ratio. This limited the experiment to stimuli well above threshold contrast as the nearer the threshold the longer the averaging time needed for a measurable amplitude.

Their results show that amplitude is linearly related to log contrast, as would be expected if Weber's law applied. (Weber's law states that the least discriminable stimulus increment is a linear function of background stimulus intensity.) Further, linear extrapolation to zero amplitude gives a value of contrast agreeing well with the psychophysically measured contrast thresholds at all spatial frequencies used.

This technique was also used to investigate the effect of adapting the retina to one grating on the visibility of a second. There was no decrement in visibility if a grating of the same spatial frequency as the adapting grating was presented in an orientation such that its axis was at least 15° from the axis of the adapting grating. With orientation differences between 0° and 15° there was an approximately linear increase in the amplitude of the evoked potential of the second (test) grating. Similarly, gratings of the same orientation but at least one octave apart in spatial frequency showed no decrement in visibility. Reducing the frequency produced an increasing interaction leading to a decrease in the visibility of the test grating.

Campbell and Maffei have thus given clear evidence of many channels sensitive to frequency and orientation, which are largely independent. Subsidiary results show that the foveal and extra-foveal distributions of these are different. Where relevant psychophysical data are available they agree with data from these experiments.