plants. Powdery mildew and scab of top fruit can both be controlled with benomyl, which can also afford protection from the red spider mite by preventing the eggs from hatching.

Certain pyrimidine compounds have systemic and fungicidal properties, and one of the most important is ethirimol(5-*n*-butyl-2-ethylamino-4-hydroxy-6-methylpyrimidine). This compound is effective against powdery mildew of cereals, which is responsible for at least 15 per cent of losses of barley in Britain. Dr M. J. Geoghegen (Plant Protection Ltd, Bracknell) reported the results of trials carried out in 1968 and 1969, showing that ethirimol is equally effective on all varieties of barley and all races of powdery mildew encountered in Europe. Trials of this most promising fungicide are continuing.

Tridemorph (N-tridecyl-2,6-dimethylmorpholine) is a systemic fungicide, developed in the Federal Republic of Germany, which also shows promise against powdery mildew of cereals. Dr J. Kradel and his colleagues (BASF Agricultural Research Station, Limburgerhof) reported successful preliminary trials with several varieties of barley. When results are promising with a disease that has previously been very difficult to control, it is not surprising that Mr E. Lester (National Agricultural Advisory Service, Cambridge) is hopeful that in about five years' time systemic fungicides will be a familiar part of the agricultural scene.

BACTERIA

Antagonism in the Fly

from our Microbiology Correspondent

THE microecology of the blowfly's gut has not been well explored. A study by Bernard Greenberg of the University of Illinois now suggests how certain microorganisms inhabiting the gut help to keep the insect clean of *Salmonella*.

By studying bacterial interactions *in vitro* and in gnotobiotic flies (grown from germ free eggs and fed a known mixture of bacteria), Greenberg has tried to define the endemic microflora which, individually or collectively, antagonize enteric bacterial pathogens. He already knew that salmonellae ingested by maggots are usually eliminated from the insect before morphogenesis is complete.

Greenberg has recently investigated the factors that cause the elimination of *Salmonella typhimurium*, looking at the population dynamics of the bacteria at various stages during the development of the fly and in various parts of the digestive tract and pupal case (*J. Bact.*, **99**, 629; 1969). Changes in the population were monitored in several dibiotic and tribiotic situations involving *Streptococcus faecalis*, *Pseudomonas aeruginosa* and *Proteus mirabilis*.

In the absence of competition *Salmonella* survived throughout the life cycle, but in dibiotic combinations it was at parity with *Escherichia coli* (an earlier observation), dominant over *Streptococcus faecalis* and dominated by *Proteus*. Although a dibiotic combination with *Proteus* did not eliminate the pathogen, the ratio of *Proteus* to *Salmonella* had decreased to 12,000 to 1 by the onset of the prepupal stage. Antagonism of *Salmonella* by *Proteus* was noticeably less effective *in vitro*. In mixed broth culture, population densities in descending order were *Proteus*, *Streptococcus* and *Salmonella*, the latter being eliminated after just over a week of incubation. A similar tribiotic system largely eliminated *Salmonella* and *Streptococcus* from the hindguts of maggot and prepupa stages and the elimination intensified throughout morphogenesis. Essentially similar results followed *in vitro* and *in vivo* experiments with mixed populations of *Proteus*, *Pseudomonas* and *Salmonella*.

Greenberg has considered several factors that might be implicated in the differential survival of the bacteria. First, the midgut is highly acid, and *Proteus*, by virtue of its ability to develop high population densities in the crop and multiply in the hindgut, is best adapted to this ecosystem. Nevertheless, *in vitro* experiments have shown that acid conditions *per se* do not account for the differential survival. Similarly, although fatty acids produced by the normal gut flora may be bactericidal towards *Salmonella*, convincing supporting evidence is lacking.

The different rates of growth that have been found for the different bacteria in optimal conditions have little relevance to mixed cultures; Greenberg found that *Pseudomonas aeruginosa* outgrew *Salmonella*, *in vitro* and *in vivo*, in spite of its slower doubling time in monoculture. Finally, Greenberg has pointed to the possible influence of the blowfly itself. The digestive tract of the maggot is far from favourable for microbial development because materials pass through so quickly; the midgut is acidic; there is prepupal starvation and, eventually, ecdysis of the lining of the gut. All these factors drastically reduce the micropopulation. Thus antagonism of *Salmonella* in the breeding medium prevents the development of a population sufficiently large to prevail against these factors, and so emergent adults are largely free of the pathogens.

CONSERVATION

Importance of Old Grassland

from a Correspondent

THE need for greater cooperation between archaeologists and ecologists was demonstrated at a symposium held at the Nature Conservancy's Monks Wood Experimental Station on November 18 and 19. Interesting grassland sites are being lost at an alarming rate, according to Mr A. D. Saunders (Inspectorate of Ancient Monuments) and Mr A. E. Smith (Society for the Promotion of Nature Reserves). They feel that archaeologists and ecologists should cooperate whenever possible to protect nationally important sites.

Reviewing current archaeological research, Mr H. C. Bowen (Royal Commission on Historical Monuments) and Mr P. J. Fowler (University of Bristol) pointed out that archaeologists could sometimes suggest when a grassland site was last ploughed or disturbed—a fact of great importance to ecologists because it might enable them to explain the present species composition of many grasslands in terms of their history and ecology. Mr C. C. Taylor (Royal Commission on Historical Monuments), however, sounded a note of caution on the use and interpretation of historical data by ecologists. Oddly enough, documentation on the early twentieth century is less plentiful than on many earlier periods.

Dr P. J. Grubb (University of Cambridge), Dr M. G. Morris and Dr Lena Ward (Nature Conservancy), who surveyed current research in ecology, stressed the floristic and faunistic richness of old grasslands, and