SYMBIOSIS

Temperate Cleaners

from our Marine Vertebrate Correspondent

SYMBIOTIC cleaning relationships between fishes were first explored and described in the 1950s when marine biologists using SCUBA diving gear were finally able to get on to something like equal terms with their subjects. A considerable literature has since developed around the subject, and it has become clear that many tropical marine fishes practise this form of symbiosis. Essentially it consists of a small species of fish, usually conspicuously marked or coloured, acting as a cleaner of parasites or fungal infections to larger, even predatory fishes, which allow it immunity. Most examples described so far have concerned fishes in tropical communities; observations on temperate cleaner fish are few, and mostly concern the Californian senorita (*Oxyjulis californica*). Recently, however, observations on cleaner symbiosis have been made in temperate New Zealand waters, and A. M. Ayling and R. V. Grace have published (*NZ J. Mar. Freshw. Res.*, **5**, 205; 1971) an interesting account of their findings.

Ayling and Grace have found that in the waters of north-east New Zealand there are no fewer than five species of fish which act as cleaners to other fishes. All are wrasses—a family much given to cleaning behaviour. All are distinguished by the possession of very obvious markings, such as would be easily recognized by other fishes. Four of them have one or more contrasting stripes on the body, and the juveniles of the fifth species, *Pseudolabrus miles,* have a black bar across the base of the tail fin (in this species only the juvenile fish act as cleaners). Such distinctive marks, known as "guild marks", are conspicuous features of tropical cleaner fishes.

In New Zealand waters the cleaner fish do not adopt fixed individual territories, as do most tropical cleaners, some of which can be immediately recognized by their attention-arresting behaviour on some conspicuous site, as well as by their guild mark. Instead, the New Zealand fishes, such as the young *Coris sandageri,* seem to have loosely defined cleaning stations which are inhabited by groups of fish, whereas others are solitary but non-territorial in their behaviour. None appeared to display conspicuously to attract customers, their cleaning reaction being released by the approach and behaviour of the other fish. Larger fishes were, however, approached by the cleaners. All fish, no matter what their size, seem to react in the same way to the cleaner's approach by stopping swimming and by spreading their fins. Depending on their centre of gravity they assume a head-up or tail-up posture. The red mullets (*Upeneichthys porosus*) observed by the authors also often open their mouths wide when posturing to allow the cleaner fish to search for parasites, although actual entry of the mouth was only observed on one occasion. Then a young *Coris sandageri* removed a 2 cm long parasitic isopod from the mouth of a red mullet, and before eating it, disabled it by beating it on a nearby rock.

Study of the stomach contents of the five species of wrasse has shown that they are not completely dependent on ectoparasites as food. One, an undescribed species of *Halichoeres,* is nearly an obligate cleaner, only occasionally feeding on benthic crustaceans, but the others are facultative cleaners, much of their food being free-living crustaceans. In spite of this even the facultative cleaners are very active, and Ayling and Grace record one *Coris sandageri* which in 15 minutes cleaned twenty-one fishes belonging to four species.

Ayling and Grace's observations greatly add to knowledge of this kind of symbiosis in temperate waters, and confirm some of the general conclusions that had been postulated by others. The lack of display, gregarious behaviour, and in the main facultative cleaning are all typical of temperate cleaners. Cleaning symbioses in temperate waters are clearly less important for the health of the fish than in tropical waters, presumably because ectoparasites, bacterial, and fungal infections are less prevalent in cooler waters than in the tropics. The work which Ayling and Grace have carried out has shown, however, that this behaviour can be more widespread in temperate regions than had been previously appreciated.

ATMOSPHERIC POLLUTION

Limestone Dust on Trees

from our Plant Ecology Correspondent

RECENT work on the effects of the accumulation of limestone dust on forest composition in southern Virginia highlights some of the pitfalls associated with studies of the effects of atmospheric pollution (Brandt, C. J., and Rhoades, R. W., *Environmental Pollution,* **3**, 217; 1972).

Most of the evidence for effects of atmospheric pollution on natural ecosystems is of a circumstantial nature, and as yet there have been few experimental studies or long term documentation of vegetational changes in areas subject to such pollution. Undoubtedly much of the circumstantial evidence is valid and can be interpreted in terms of changes brought about as a direct consequence of pollution; a good example is the work on lichen distributions in relation to areas of high concentration of

SV40 DNA Synthesized Discontinuously

IN next Wednesday's *Nature New Biology* (August 30) Fareed and Salzman report a further step in their exemplary analysis of the replication, in monkey cells, of the covalently circular, double stranded and supercoiled DNA of Simian Virus 40. Last year Salzman's group described the isolation of the replicative intermediates of SV40 DNA which contain two forks, three branches, one of which is the supercoiled unreplicated part of the parental molecule, and no free ends. These structures, precisely those predicted by the Cairns model of replicating circular DNAs, resemble the replicative intermediates of the DNAs of *Escherichia coli,* phage lambda and colicin E1 and the latest finding of Fareed and Salzman, that SV40 DNA is replicated discontinuously, provides a further parallel with the replication of these prokaryotic DNAs.

When dividing *E. coli* cells are fed for a few seconds pulses of ^{3}H-thymidine, the label is incorporated into short DNA strands, the so-called Okazaki pieces, which are then ligated to the nascent daughter DNA strands. In other words the daughter DNA strands of *E. coli* are made as a series of discontinuous pieces. Pulse labelling monkey cells infected by SV40 for periods as short as 15 s is technically difficult but, as Fareed and Salzman have shown, by no means impossible, and during such short pulses label is incorporated into short DNA strands which sediment at 4S and have a molecular weight of about 50,000 daltons. As pulse chase experiments reveal, these 4S pieces of DNA are incorporated into the nascent daughter SV40 DNA strands; in other words apparently both strands of SV40 DNA are replicated from start to finish in the same discontinuous way in which *E. coli* DNA is replicated.

The significance of these findings is manifold. This is, for example, the first evidence of discontinuous synthesis of a very small circular DNA molecule and these observations prove that at least some DNAs in a eukaryotic cell environment are replicated by a mechanism essentially similar to that which seems, by all accounts, to prevail in prokaryotes.

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