

and electronic devices, which has already helped to search for lost hydrogen bombs and the nuclear submarine Alvin. According to Dr Clyde F. E. Roper of the Division of Mollusks of the Smithsonian Institution, the creatures belong to the little known sub-order Cirrata. Further identification to family and even genus may be possible on the basis of the pictures.

## INVERTEBRATES

### Self Assembly of Cuticle

from our Insect Physiology Correspondent

MUCH has been learnt recently about the basic architecture of the fibrous cuticle of insects, notably by A. C. Neville and his colleagues (*Tissue and Cell*, **1**, 183, 355, 689; 1969), from the diversity in form of the pore canals. From this can be deduced the arrangement of the structural fibres of the cuticle which could not themselves be resolved.

In the layers of locust cuticle deposited during the day the microfibrils are all orientated in a preferred direction and so the pore canals run a straight vertical course through the cuticle in the form of untwisted ribbons. On the other hand, cuticle laid down during the night is lamellate: the microfibrils follow a helicoidal course changing direction 180° across the thickness of each lamella. This change in direction is imposed on the pore canals, which are then shaped like regularly twisted ribbons. They are not themselves helicoidal, as has been commonly believed. It has been known for more than a century that in Coleoptera and Hemiptera the direction of the fibre bundles in the cuticle changes 60° or 90° from one thick layer to the next. This transition has now been shown to be effected by means of a very narrow helicoidal zone of "lamellate cuticle".

Neville and Caveney (*Biol. Rev.*, **44**, 531; 1969) have applied this knowledge in a study of certain Scarabaeid beetles in which the metallic colours of the elytra are associated with the property of reflecting circularly polarized light in a manner precisely analogous to cholesteric liquid crystals. (This analogy has been pointed out particularly by Conmar Robinson, who demonstrated the same effect with systems formed from synthetic polypeptides.) Neville and Caveney have found evidence that these special interference colours in Scarabaeid beetles are determined by the helicoidal pitch of the microfibrils of the outer layers of the cuticle. The colours follow a bilaterally symmetrical pattern; but the sense of helicoidal rotation is the same all over the beetle, and is therefore bilaterally asymmetrical.

Thus the helicoid pitch seems to be under local control by the epidermal cells which secrete the cuticle; whereas the sense of rotation is presumably determined by the extracellular self-assembly or crystallization of an asymmetrical unit, comparable with the self-assembly of DNA, RNA, synthetic polypeptides and cholesterol derivatives to form helicoidal systems. Curiously enough, this system, by which asymmetrical units condense to form helicoidal microfibrils, seems to be the primitive system; it alone is found in the cuticle of the primitive Apterygota. The system with a preferred orientation, giving non-lamellate cuticle, is the more sophisticated since it requires specialized

direction control by the cells. The microfibrils of the cuticle consist of protein and chitin; it is presumed to be the protein component that regulates the self-assembly into cholesteric liquid crystals, but the chemistry of the process is not known.

## CANCER

### Spread through the Body

from our Medical Biochemistry Correspondent

THE way that tumour cells can spread and produce tumours in other parts of the body—a process known as metastasis—is one of the most peculiar and dangerous aspects of cancer. Some recent work with heparin has shown that the progress of metastasis can be affected by changes in the surface charge of the cells. The effect of heparin on the production of metastasis was thought to be related only to its anticoagulant properties. But B. Hagmar and K. Noorby (*Intern. J. Cancer*, **5**, 72; 1970) have shown that in the concentrations normally used it interacts *in vitro* with cancer cells, and that its *in vivo* effects may sometimes result from interaction with the cell surface.

There was a small but significant reduction in the diameter of cells of the tumour MCG1-SS in suspension when they were incubated with heparin. The formation of aggregates and the viability of the cells were unaffected. There were fewer metastases in the lungs than in other parts of the body when animals received heparin before intravenous injection of tumour cells, probably due to anticoagulation effects. When cells were mixed with heparin and then injected, however, there was a significant increase in the number of metastases in the lungs, but a significant decrease in the volume of each new growth, so that the total volume of tumour in the lungs was reduced. There was also a considerable reduction in the volume of metastases in the liver.

The difference in behaviour when heparin is allowed to interact with cells before injection is probably due to effects on the electrical character of the cell surface, for chondroitin sulphate, another polyanion like heparin, had similar though smaller effects, while the polycation protamine had the opposite effect. Thus one of the factors influencing the spread of tumours and size of secondary tumours, at least for cells of this type, is the surface charge on the cell. Methods of modifying the charge might therefore reduce the spread of cancer.

In some conditions many tumours arise very quickly, and it is not always possible to tell whether the process involves several primary tumours or metastasis. Analysis of enzyme variants has shown that some multifocal tumours are derived from a single clone, while others have arisen from more than one cell and are presumably due to malignant change in several cells.

Recently Fialkow *et al.* have looked at the glucose 6-phosphate dehydrogenase isoenzymes in seven patients with Burkitt's lymphoma, who were heterozygous for this enzyme (*Lancet*, **i**, 384; 1970). Electrophoresis revealed two bands of activity in all normal tissues. Samples from twelve different tumours, however, all contained but one variant of glucose 6-phosphate dehydrogenase. Fialkow *et al.* point out that their results do not necessarily mean that all