cells. Apart from the strain of *Xenopus* that lacks nucleoli, amphibian genetics is undistinguished. What is needed is a haploid cell line from a mammalian species, such as the mouse, the genetics of which has already been worked out in some detail. The problem, of course, is to obtain a large enough population of haploid mammalian cells to give some hope of finding one cell with a genetic constitution compatible with growth in culture. One approach, being tried at Oxford, is to grow a haploid mouse embryo, but it may be technically much simpler to isolate a population of spermatids by velocity sedimentation (see page 1188) or some other cell separation technique and, with luck, establish a haploid cell line from them.

CHROMOSOMES

Chromosomes Manipulated

from our Cytogenetics Correspondent

TECHNIQUES for manipulating and changing chromosomes within living cells could provide somatic cell geneticists with more useful tools, if recent achievements with microneedles and laser beams live up to their promise.

In 1967, R. B. Nicklas and his colleagues manipulated chromosomes in living spermatocytes of the grasshopper *Melanoplus* with the aim of elucidating how they become exactly divided at meiosis. Nicklas (*Chromosoma*, **21**, 1, 17; 1967) introduced a fine glass needle into the cell and pushed and pulled the chromosomes into new positions. He found that the bivalents were firmly attached to the spindle apparatus by their kinetochores; but they could be detached and then reattached to the spindle in a new orientation. The bivalent then segregated normally and the cell divided, but the resulting nuclei contained different chromosomes than would have been the case without manipulation.

Nicklas could also make bivalents behave in unusual ways. Both halves of a bivalent could be attracted to the same pole of the spindle if the kinetochores were suitably orientated by manipulation. Such a bivalent would always revert to a normal orientation, however. It seemed that bivalents with both kinetochores orientated towards the same pole (unipolar orientation) underwent reorientation because the forces of tension between bivalent and spindle necessary for a stable metaphase configuration in some way were not satisfied. To test this, Nicklas and Koch (*J. Cell Biol.*, **43**, 40; 1969) induced unipolar orientation in a metaphase bivalent, and then applied a force from a microneedle in the opposite direction to the poleward pull of the spindle fibres running to both kinetochores. Such bivalents under tension never reorientated; they only did so when the source of tension was removed. Thus it seems that a state of tension between the bivalent and spindle is required for a stable bivalent orientation that leads to orderly segregation.

Henderson and Koch have extended this observation recently (*Chromosoma*, **29**, 207; 1970). They induced two unipolar bivalents and caused them to interlock through micromanipulation, so that each exerted a force on the other. As expected, such a configuration was stable; it also resulted in the non-disjunction of both pairs of half bivalents. Such a manipulation allows the cell to bring about its own feat of genetic

engineering without further intervention from the experimenter.

Other attempts at tinkering with chromosomes have been described by Berns and Rounds (*Sci. Amer.*, **222**, 98; 1970). Using laser beams they have been able to change, or destroy at will, segments of chromosomes in living dividing cells of salamander. One of their experiments was to destroy the secondary constriction in metaphase chromosomes—as might be expected, the daughter cells in the following interphase lacked a nucleolus. The laser beam can also remove pieces of chromosome.

This form of chromosome surgery, together with the other techniques for manipulation, would seem to offer considerable scope for influencing the structure and behaviour of genomes in somatic cells.

MARINE BIOLOGY

Strange Creatures of the Deep

THE objects in the photograph are not the open and closed version of an umbrella but deep sea octopods found at a depth of 13,000 feet off St Croix in the Virgin Islands. Scientists from the Naval Research Laboratory, Washington, photographed the creatures with a "fish", a versatile box of underwater cameras