64

Joshua Lederberg

Unpredictable Variety Still Rules Human Reproduction

BIOLOGY AND politics are bridged at many places, but few connections are more salient than that between reproduction and sex. This gives an unpredictable variety to each generation.

Every new individual gets a gambler's sample of half the genes of each of his parents. The pretensions of hereditary aristocracy are then perennially refuted by the dice throws of genetic recombination by which every egg and sperm are formed.

We do recognize some exceptional examples of vegetative reproduction among higher animals, and even man. For example, identical twins occur when the original fertilized egg undergoes one cycle of vegetative division before settling down to the business of embryonic development. A twin pair is then a familiar example of a "clone," a term borrowed from botany for a family of vegetatively related individuals, literally a set of cuttings from a given source.

Except for twin births, we must look to lower animals for most common examples of clones. An earthworm can be cut into several segments, each one capable of regenerating into an intact worm. These new animals are genetically identical and thus together constitute a clone.

Examples of parthenogenesis might be clones or not, depending on how the egg is formed and activated. Dr. M. W. Olsen's parthenogenetic turkeys are not clonal but result from a nuclear fusion within the egg after some some genetic assortment has occurred. Thus they hatch out into male birds.

NEW POSSIBILITIES of clonal reproduction have arisen as a by-product of experiments on nuclear changes during development of frogs and toads. Drs. Robert Briggs and Thomas J. King of Philadelphia's Institute for Cancer Research started renucleating frog eggs about 15 years ago.

After the egg was fertilized in the usual way, the fusion nucleus was removed. Lacking any genetic information, such a denucleated egg would not develop at all. However, a new nucleus could be provided by some deft micro-surgery from another cell.

Briggs and King asked whether nuclei of specialized tissue cells undergo any permanent changes in the course of embryonic development. Their first experiments laid a sound experimental groundwork.

Eggs renucleated from other eggs or from early division stages of normal embryos developed normally. However, eggs renucleated from differentiated tissues of later embryonic stages would develop only to a certain characteristic point, then stop without being able to form the full variety of normal tissues.

This suggested that tissue differentiation is associated with a selective switching off of some genes in the nucleus. However, many nuclei might have been damaged by the transplant operation, the younger cells being more rugged, and therefore more successful, donors.

DR. J. B. GURDON, a zoologist at Oxford, has pursued such experiments with a toad species called Xenopus. Here, renucleation often succeeds even from specialized tissue samples, like gut cells from late tadpole stages.

These renucleations can be set up in batches, each egg issuing from a different cell of the same donor tadpole. Reared to full maturity, they give a clutch of toads having the same sex and every other genetic characteristic of the donor animal, in fact a clone.

Such experiments might eventually be made to work in man, perhaps within a few years, though they are not yet reported even for the laboratory mouse. If a single nucleus from a specific tissue is not competent, we might combine eggs renucleated from several different tissues to restore the full range of developmental capability.

It is an interesting exercise in social science fiction to contemplate the changes in human affairs that might come about from the generation of a few identical twins of existing personalities. Our reactions to such a fantasy will, of course, depend on just who is immortalized in this way—but if sexual reproduction were less familiar, we might make the same comment about that.