Further support for this view comes from Hiroshi Hamada and his colleagues at the National Cancer Institute who found that the *Drosophila* genome contains some 2000 copies of a repetitive sequence in which purine bases alternate with pyrimidine bases. Such sequences more readily undergo the B- to Z-DNA transition than DNA segments without the alternating pattern. At one time purine-pyrimidine alternation was considered a prerequisite for Z-DNA formation, but Rich and his colleagues have more recently found that it is not (*4*, *5*). "We overestimated the extent to which we need alternating purines and pyrimidines," Rich explains, "but that means our ability to recognize Z-DNA-forming regions has gone down."

This problem and the difficulties encountered in the antibody-binding studies have increased the need for better methods of detecting Z-DNA. Rich's group and that of Winship Herr at Cold Spring Harbor Laboratory have been developing chemical reagents that are sensitive to the unusual conformation assumed by Z-DNA and may therefore permit more accurate identification of Z-DNA regions at the nucleotide level.

Attempting to define the physiological function of Z-DNA has proved even more problematical than trying to demonstrate its presence in living cells. Even Rich concedes that it is "by no means clear at the moment" what Z-DNA might be doing in the cell. The main difficulty, he suggests, is the dynamic nature of the system. Z-DNA is less stable than B-DNA and may form only transiently, depending on such factors as protein binding, degree of methylation, and the negative supercoiling status of the DNA.

By all accounts, the best evidence so far in support of a physiological role for Z-DNA comes from William Holloman of the Cornell University Medical College in New York City and Eric Kmiec of the University of Rochester. In work that was largely done while they were at the University of Florida College of Medicine in Gainesville, the investigators have implicated the structure as an important intermediate in genetic recombination in a simple eukaryote, the yeast-like fungus called Ustilago.

Chromosomes that are undergoing recombination first pair and then exchange segments. These reactions are promoted in Ustilago by an enzyme called rec1 that was identified a few years ago by Kmiec and Holloman. The investigators have now found in a test-tube model of recombination that Z-DNA is generated in double-stranded DNA at the site of pairing,

Dental Humans, Infant Apes

In examining the fossilized jaws of early human ancestors, paleoanthropologists have tended to apply modern human standards of sequence and timing of tooth eruption and wear in estimating the age of death of particular individuals. The assumption of a modern human pattern in early hominids might, however, be a mistake, suggest Timothy Bromage and Christopher Dean of University College, London. They conclude from a study of certain detailed growth patterns in tooth enamel of nine juvenile hominids that lived between 1 and 3.7 million years ago that the growth characteristics were more apelike than human-like (*1*). If correct, this conclusion has important behavioral implications.

Microscopic examination of tooth enamel reveals two types of incremental growth lines, which are presumed to be the result of rhythmic changes in the activity of the enamel-secreting ameloblasts. Although it has not yet been demonstrated beyond doubt, there is a good deal of agreement that the smaller of the two incremental lines represent 24-hour intervals. Bromage and Dean's interest, however, lies primarily with the larger increments, which are coarser lines that pass obliquely from the enamel-dentine junction to the surface of the enamel where they are sometimes visible as ridges known as perikymata. Although there is some variation in the number of smaller lines separating the coarser increments, the British researchers consider them to be the result of weekly fluctuations in enamel formation: there are, on average, seven to eight small striations between the larger ones. Count the number of ridges in a tooth crown and you know how many weeks it took to grow, which then allows an estimate of infancy.

This suggestion is met with some skepticism, not least because of an inability to explain the origin of biological fluctuations with a weekly period. Nevertheless, Bromage and Dean are able to cite several 7-day rhythms in physiological activity of soft and hard tissues, which, they say, adds credence to the idea of a 7- to 8-day periodicity in enamel formation. Lawrence Martin of the State University of New York at Stony Brook whose recent work on the evolution of human and ape enamel formation has had such an impact on the field (*2*), notes that critics can find many uncertainties to question in Bromage and Dean's scheme but guesses that it is unlikely to be far wrong.

For a number of technical reasons, incisor crowns offer the most appropriate target for counting perikymata and estimating age at death, which Bromage and Dean did for nine hominid specimens, including a 1.7+ million year *Homo*, from South and East Africa. In all cases the age at death was younger by at least one third compared to that inferred using modern human standards for tooth growth characteristics. If correct, this implies that infancy in these creatures was more like that in apes and had not yet become prolonged, as it is in modern humans. Dean reached similar conclusions based on a study of root growth patterns (*3*).

Prolonged infancy in humans is obviously important for protecting and nurturing the young, whose brain expands fourfold after birth as compared with a doubling in apes. Robert Martin also of University College, London, has calculated that special parental protection would be required for the hominid infant only when the adult brain size exceeded some 750 cubic centimeters (*4*). Had it lived, the *Homo* specimen in Bromage and Dean's survey would probably have developed an adult brain close to this size. Martin's conclusion about brain growth and infancy is therefore consistent with Bromage and Dean's estimate of infancy based on the teeth. Although the *Homo* species living at this time demonstrably made and used stone tools and, therefore, enjoyed a behavioral repertoire that in some ways at least was different from that of apes, these new data on tooth growth and infancy once again warn of the probable danger of thinking of early hominids simply as diminutive humans.—**Roger Lewin**

References

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