within them, pushing the lesser ring particles away in both directions. A careful search revealed no such moons of the expected sizes—about 30 km in Encke's case — and Encke, in fact, kept up the ring system's reputation for new strangeness at every turn by turning out to possess a particularly unusual ringlet of its own. Besides being oddly distorted or "kinky" (and with no sign of the moonlets that might have been expected to produce such an appearance), it runs right down the middle of the gap in one image while another view shows it hugging the inner edge. This could mean that the ringlet is "merely" eccentric, a phenomenon discovered in other examples by Voyager 1 and multiplied by Voyager 2, which showed even the huge B-ring's outer edge to differ in radius by more than 50 km on different sides of Saturn. But the project's scientists, conditioned by now to expect almost anything where the rings are concerned, leave open the possibility that there could be more than one Encke ringlet, each varying so much in density that it is virtually invisible over parts of its circumference.

Indeed, there may be quite a crowd in what was once thought to be an empty clearing. One of Voyager 2's major triumphs was the use of its photopolarimeter to track the light of a star through the ring system's entire radius, recording the flickering starlight as an indicator of the widths, densities and separations of the thousands of ringlets down to a resolution of 100 meters. Each significant dip in the lightcurve may represent a separate ringlet, and even a preliminary look at the instrument's prodigious output — a kilometer-long stripchart with 10 data points to the centimeter—yields as many as 10 such dips in the Encke gap, 10 more around the F-ring, and so much fine detail over the rest of the rings that elated team leader Arthur L. Lane of Jet Propulsion Laboratory was wondering last week about how he would ever find room to publish his results. The actual ringlets, in fact, notes colleague Larry Esposito of the University of Colorado, may be skinnier still, extending "maybe down to the individual particle size."

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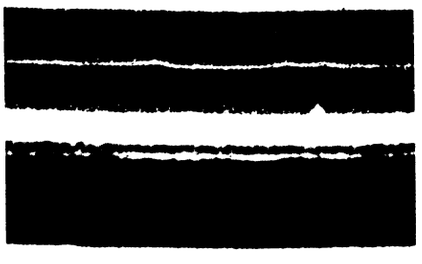
Two views of the A-ring's Encke gap reveal either a single newly discovered ringlet that is eccentric, or two ringlets whose visibility varies with longitude. Other data suggest there may be several more.



Longest-yet synthetic gene: interferon

In what is both a technical tour de force and a practical step toward understanding and improving upon the activities of interferon, British scientists have assembled a stretch of genetic material 514 paired nucleotides in length. The longest gene to be pieced together in a laboratory thus far, it is by design not quite identical to the natural gene for human leukocyte interferon, the sequence of which was determined by other researchers last year. The newly synthesized gene is a modification encoding the same protein, but designed to be more amenable to chemical synthesis and to expression by bacteria.

Michael D. Edge and colleagues at ICI, a British chemical and pharmaceutical company, devised the modifed sequence and then synthesized 67 different DNA chains, each containing approximately 15 nucleotides. They used a novel synthetic method in which the growing chain is bound to a solid support. The ICI scientists say this technique increases the rate of DNA synthesis ten-fold, and is more reliable than previous methods. The shorter DNA chains were joined into the 514 paired-nucleotide length, which includes the signals for starting and stopping protein synthesis and sites for inserting the fragment into a plasmid, the ring of DNA used to transfer genes between cells. The lab-made interferon gene, in its plasmid, was reproduced in bacterial cells, and the biological properties of its product, presumably the protein interferon, will be described in a forthcoming paper, the scientists say.

The advantage of synthesizing the gene, rather than simply snipping it from a chromosome, is the greater potential for altering its product. Natural materials usually can be modified to make more efficient drugs. In the case of interferon, a whole family of genes occurs naturally, and its members exhibit somewhat different activities (SN: 3/7/81, p. 148). Now it is possible to systematically vary the synthetic gene to acquire a variety of interferon proteins. "The availability of a large pool of synthetic fragments clearly extends the range of interferon analogues which can be prepared," Edge and colleagues say in the Aug. 20 NATURE. "The wider implication is that classical medicinal chemistry structure-activity analysis should be possible in relatively large peptides."

While praising the ICI accomplishment, a commentary in NATURE cautions that the reported modifications of DNA-synthesizing techniques fall far short of allowing scientists to assemble a complete copy of an organism's genetic material, its genome. It still takes more than an hour to add each pair of nucleotides to the synthetic ICI chain. NATURE calculates that at this rate it should be possible to assemble 5,000 nucleotides in a year, "...or a whole genome in..., well, a few centuries." □

A dash of morphine in the milk

Both human and cow milk are naturally spiced with a small amount of morphine, and how it gets there is anyone's guess. Scientists at the Wellcome Research Laboratories in Research Triangle Park, N.C., report finding 200 to 500 nanograms of morphine in the milk they examined. While there is a small possibility that the substance is not chemically identical to morphine, Eli Hazum, Pedro Cuatrecasas and colleagues are quite confident of their identification, which is based on a series of chemical, biological, pharmacological and immunological tests.

Plants in the diet are a likely source of the morphine in milk. Hay and lettuce, for example, have measurable amounts of morphine, the scientists find. "We postulate that morphine may be a ubiquitous constituent of plant-derived foods.... Perhaps, in addition, an active concentrating mechanism exists in the mammary gland," they say in the Aug. 28 SCIENCE. Other scientists have reported that after experimental administration of morphine, the drug can be detected in milk.

The amount of morphine reported in a liter of milk is only a few percent of the normal oral dose of morphine as it is used as a painkiller. But the scientists say it could have important, but as yet unknown, pharmacological significance. An unidentified substance that may turn out to be morphine has been found in mammalian brains and intestinal tracts.

With the discovery of morphine in milk, the mystery of the brain's morphine receptors has come full circle. When the receptors were first discovered, scientists believed it was unlikely that the mammalian brain would have evolved sites just to bind morphine, a component of poppy plants, however striking its pharmacological effects. The resultant search for the "body's own morphine" led to the discovery of endogenous substances, the enkephalins, whose role in pain perception and other physiological functions is currently the focus of extensive research. But one of two classes of brain receptors still binds morphine more effectively than it binds enkephalin. With morphine in milk, scientists may conclude the most important natural function of these receptors is to bind morphine, after all. The Wellcome scientists point out that for a variety of substances, such as vitamins, the body makes specific receptors or enzymes although the substances are ingested rather than made internally. □