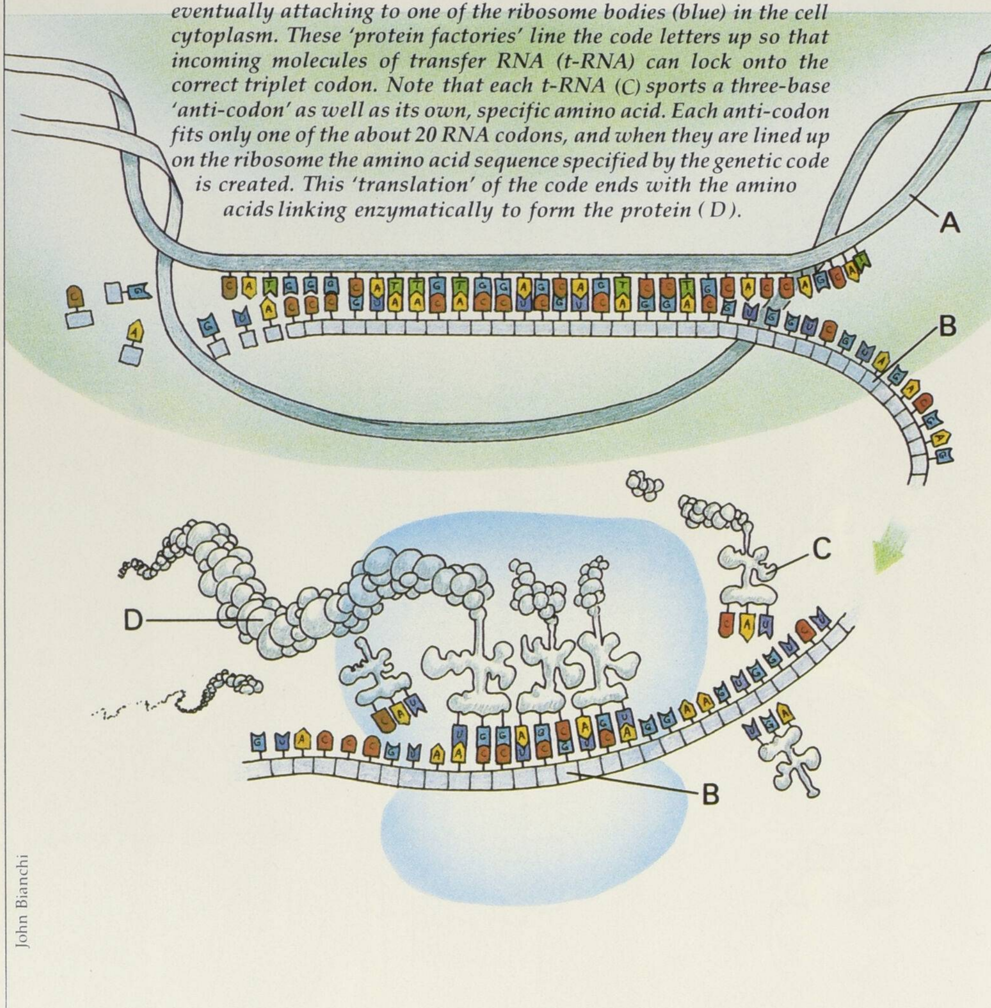

The processing of the genetic code. DNA (A) within the cell nucleus (green) is first unravelled from the double helix structure, and the base code copied or 'transcribed' into another kind of nucleic acid, messenger RNA (B). This messenger molecule then leaves the nucleus, eventually attaching to one of the ribosome bodies (blue) in the cell cytoplasm. These 'protein factories' line the code letters up so that incoming molecules of transfer RNA (t-RNA) can lock onto the correct triplet codon. Note that each t-RNA (C) sports a three-base 'anti-codon' as well as its own, specific amino acid. Each anti-codon fits only one of the about 20 RNA codons, and when they are lined up on the ribosome the amino acid sequence specified by the genetic code is created. This 'translation' of the code ends with the amino acids linking enzymatically to form the protein (D).

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ning them that only A, T, C, and G appear on the running line — the chemist's shorthand for adenosine, thymidine, cytosine, and guanosine. These so-called "nucleotide" molecules, known to Narang since his undergraduate days in India, are the subunits of the gene molecule deoxyribonucleic acid, or DNA. They are, as one noted molecular biologist puts it, the primal letters in the alphabet of life.

Though Narang has written them in a straight line on the board, in life the string is wound in a graceful helix, a double helix in fact, where one spiral holds the gene code and the other is a "template" for the code, used when the cell divides. This now-famous structure was worked out almost thirty years ago by James Watson and Francis Crick at Cambridge. From their model of winding metal plates and wire deduced from the evidence of X-rays shot through crystals of DNA, it became clear immediately how the molecule duplicates itself so unerringly when organisms reproduce. The entwined spirals, which look like a twisted rope ladder, form a smooth fit *only* if the facing base letters that make up the rungs always have adenosine across from thymidine, and cytosine from guanosine. Alter this and you distort the smooth flow of the helix. When the strands are pulled apart at cell division (the letters are held by relatively weak "hydrogen" bonds) each is used as a template to build an exact replica of the parent molecule. Thus, DNA possesses an ability unique in the cosmos — the capacity to duplicate itself. As molecules go, it is immortal.

But the letters themselves are not nearly as important as their order along the spiral. It is this order, on the almost endless tracts of DNA found in living cells, that holds the code for all things alive in the biosphere, from bacteria to biological chemists. Narang indicates a particularly long string of letters — 66 in all — chalked in yellow. "That's part of the insulin gene we built called the A chain", he explains. "It's about one quarter of the whole gene. If you want to build genes for valuable proteins, you not only have to know the sequence of letters in their DNA codes, but you also need the laboratory skill to string them together."

These feats, the uncovering of the genetic code itself, and the chemical know-how that makes such synthetic strings possible, are two key elements in the new technology. They are also linked together in the timeline of Narang's career as an organic chemist. When he arrived at the Wisconsin laboratory of Dr. Har Gobind Khorana from India back in 1963, Saran Narang dropped into the middle of one of the most exciting quests in molecular biology — the cracking of the genetic code. Khorana and others at the time knew a great deal about the flow of information from DNA and how it is converted into the elements of the living cell, but a crucial element was missing — the precise nature of the DNA-to-protein information trans-