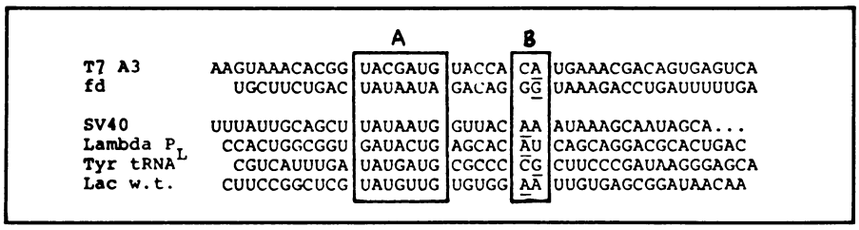
# The promoters of gene transcription




Pribnow/PNAS

*Gene promoters: (A) homologous sequences; (B) where promoter transcription starts.*

The transcription of DNA molecules (genes) into molecules of messenger RNA, and then into molecules of protein goes on in viruses and every living cell, whether it be the one-celled bacterium *Escherichia coli* or in the trillion cells that make up the human body. How this elegant transcription process takes place is being feverishly scrutinized by molecular biologists throughout the world.

Biologists have discovered that in viruses and bacteria, the transcription of a particular gene (DNA molecule) is assisted by two strips of DNA that adjoin the gene. One of these strips is known as an operator. If a so-called protein repressor hops on the operator, translation cannot occur; if the repressor hops off, it can. The other strip is known as a promoter. Once an enzyme known as RNA polymerase binds to the promoter, the enzyme proceeds to transcribe the functional gene into a molecule of mRNA.

Although there is evidence in one microorganism that the promoter lies next to the operator, then the operator lies next to the functional gene, biologists believe that there is no reason that the operator couldn't come first, then the promoter, and then the gene.

While some biologists—notably Walter Gilbert, Allan Maxam, Mark Ptashne and Tom Maniatis of Harvard University (SN: 1/19/74, p. 40)—are probing the chemical structure and action of operators, others are studying the structure and action of promoters—notably David Pribnow, a graduate student in Gilbert's lab.

Pribnow's research, reported in the March PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES, sheds considerable light on the chemical structure of the half dozen or so promoters that have been worked out, and how this structure probably leads to the transcription of a functional gene into a molecule of mRNA.

First Pribnow isolated a promoter from the DNA of a particular virus (bacteriophage T7). He then determined the exact chemical structure of the promoter. It was 44 bases long. Bases are the building blocks of DNA. There are four different kinds—A, T, G and C. A molecule of RNA contains the same bases, except that U substitutes for T.

Pribnow then compared the base sequence of this viral promoter to that of the half dozen or so other viral or bacterial promoters that have been worked out. He found that all of them were about 44 bases in length.

Even more intriguing, Pribnow's comparison shows that a sequence of seven bases is almost identical in each of the promoters. So Pribnow concludes that this stretch is probably the critical stretch in each promoter that allows an RNA polymerase to bind to the promoter. Or as he puts it, "There must be some specific sequence within all promoters that is involved in the stable binding of polymerase molecules."

Finally, Pribnow's research and that of other investigators reveals that after an RNA polymerase binds to the promoter, it begins transcribing the bases in the promoter from the 22nd base on. In other words, the enzyme binds the left half of the promoter, then it transcribes the right half of the promoter, and then it continues to transcribe the functional gene. The genetic information from both the right half of the promoter and the gene are then packaged into one mRNA molecule. □

# Nuclear debate to be televised

The great debate between proponents of nuclear power and opposing environmentalists of various persuasions is heating up again. Pending before Congress is legislation to declare a five-year moratorium on all atomic power development, or to prohibit use of plutonium as a reactor fuel, or alternatively, to give electrical utilities government subsidization in their push to "go nuclear." A lively televised debate on these and other issues of atomic power is now being syndicated to stations across the country by the American Enterprise Institute for Public Policy Research. The program was taped last week in Washington.

AEI's national energy project chairman, Melvin R. Laird, moderated the two hour-long segments, which pitted nuclear advocates Ralph E. Lapp, a private consultant and writer, and former congressman Craig Hosmer against consumer advocate Ralph Nader and Daniel Ford, executive director of the Union of Concerned Scientists. Laurence I. Moss, a nuclear engineer and former president of the Sierra Club, represented a more or less intermediate view of cautious nuclear growth.

Viewers will be able to tell immediately that this is not the first time these combatants have debated. Lapp has even written a book about Nader's views on nuclear energy, calling him a "modern Luddite" who "seeks to head an antitechnology movement." For the most part the panelists either talk past each other or fall to bickering over claims of distortion and misrepresentation, but a wide spectrum of vital issues is eventually covered, and what the debate lacks in reasoned judgment it gains in drama.

Nader takes the traditional environmentalist position that nuclear energy is unsafe and unnecessary—that conservation of the 40 percent of all energy now wasted in this country would tide us over until solar and geothermal energy could be utilized. Ford emphasizes the newer argument favored by nuclear opponents, that atomic energy isn't all it was cracked up to be economically: Many nuclear power projects have been postponed, the capital cost of building a plant has in-

John H. Douglas

*Nuclear debate panel, from left: Hosmer, Nader, Laird, Moss, Lapp and Ford.*